

**Tööstuslikud termotöötlusseadmed. Osa 1: Tööstuslike  
termotöötlusseadmete üldised ohutusnõuded  
KONSOLIDEERITUD TEKST**

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

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 746-1:1999+A1:2009 sisaldab Euroopa standardi EN 746-1:1997+A1:2009 ingliskeelset teksti.</p> <p>Standard on kinnitatud Eesti Standardikeskuse 30.09.2009 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 12.08.2009.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 746-1:1999+A1:2009 consists of the English text of the European standard EN 746-1:1997+A1:2009.</p> <p>This standard is ratified with the order of Estonian Centre for Standardisation dated 30.09.2009 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.</p> <p>Date of Availability of the European standard text 12.08.2009.</p> <p>The standard is available from Estonian standardisation organisation.</p>
--	---

ICS 25.180.01

### Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:  
Aru 10 Tallinn 10317 Eesti; [www.evs.ee](http://www.evs.ee); Telefon: 605 5050; E-post: [info@evs.ee](mailto:info@evs.ee)

### Right to reproduce and distribute Estonian Standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:  
Aru str 10 Tallinn 10317 Estonia; [www.evs.ee](http://www.evs.ee); Phone: +372 605 5050; E-mail: [info@evs.ee](mailto:info@evs.ee)

English Version

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

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

Industrielle Thermoprocessinganlagen - Teil 1: Allgemeine  
Sicherheitsanforderungen an industrielle  
Thermoprocessinganlagen

This European Standard was approved by CEN on 15 February 1997 and includes Amendment 1 approved by CEN on 16 July 2009.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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.








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

Management Centre: Avenue Marnix 17, B-1000 Brussels

# Contents

Page

Foreword.....	3
Introduction .....	5
1 Scope .....	5
2 Normative references .....	7
2.1 Basic Standards.....	7
2.2 Group Safety Standards.....	7
2.3 Product Safety Standards .....	9
3 Definitions .....	10
4 List of Hazards .....	11
5 Safety requirements, measures and verification means .....	21
5.1 General.....	21
5.2 Mechanical.....	23
5.3 Electrical .....	26
5.4 Thermal .....	28
5.5 Noise .....	30
5.6 Vibration .....	31
5.7 Radiation.....	31
5.8 Materials and substances .....	32
5.9 Ergonomics .....	33
5.10 Hazard combination.....	33
5.11 Malfunction.....	34
5.12 Missing and incorrectly fitted safety devices .....	35
6 Information for use .....	35
6.1 General.....	35
6.2 Marking .....	35
6.3 Technical Data, Installation and Commissioning.....	36
6.4 Instruction Handbook (Operation) .....	37
6.5 Instruction Handbook (Maintenance) .....	39
6.6 Instruction handbook (De-commissioning) .....	41
Annex A (informative) List of Industrial Thermoprocessing Equipment covered by  EN 746-1  .....	42
Annex B (informative) Typical test report (as described in 6.3.10) .....	44
Annex C (informative) PERMIT to work certificate (as described in 6.5.8).....	45
Annex D (informative) Used Definitions .....	47
D.1 English, German, French .....	47
D.2 German, English, French .....	48
D.3 French, German, English .....	49
Annex ZA (informative)  Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC  .....	50
Annex ZB (informative)  Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC  .....	51

## Foreword

This document (EN 746-1:1997+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 February 2010, and conflicting national standards shall be withdrawn at the latest by February 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document includes Amendment 1, approved by CEN on 2009-07-16.

This document supersedes EN 746-1:1997.

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, Sweden, United Kingdom.

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

The full list of parts of EN 746 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 European Standard 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  EN ISO 12100  for hazards which are not covered by this standard.

This European Standard is a type-C standard as defined in  EN ISO 12100 .

**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

**1.1** This part of EN 746 specifies common safety requirements for industrial thermoprocessing equipment (for example industrial furnaces and industrial heating equipment), which meets the definition for machinery given in  EN ISO 12100-1:2003 .

It details the anticipated significant hazards associated with industrial thermoprocessing equipment and specifies the appropriate preventative measures for reduction or elimination of these hazards.

This standard gives general principles and common requirements for the reduction of risks for equipments covered by the scope.

The common requirements apply to all of the subsequent parts of this EN 746 dealing with specific equipment unless an exception is stated in the relevant Part. The general principles (subclauses are pointed out) will be used to establish the specific technical measures in the subsequent Part(s) dealing with safety requirements for particular equipment.

**NOTE** For similar equipment not covered by the particular Parts of this standard, EN 746-1 can be used to assist in the reduction of risk for the Hazards identified in clause 4 (List of Hazards).

**1.2** This part of EN 746 is applicable to industrial thermoprocessing equipments for use in fields such as:

- Metallurgical and metal working plant;
- Glass making plant;
- Ceramic manufacturing plant;
- Cement, lime and gypsum manufacturing plant;
- Chemical plant;
- Waste incineration equipment;

And heated by:

- Gaseous fuels;
- Liquid fuels;
- Solid fuels;
- Mixed fuels;
- Electricity.

The thermoprocessing equipment covered by this Part of EN 746 is further specified in clause 3.

A more detailed list of thermoprocessing equipment within these categories is given in Annex A.

In the remainder of this standard the expression "equipment" will be used.

This Part of EN 746 is not applicable to blast furnaces, converters (in steel plants), boilers, welding machines or food processing equipment.

**1.3** This Part of EN 746 specifies the requirements 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 which can occur in the equipment.

It specifies the safety requirements at stages in the life of the equipment, and its design, ordering, construction, use and disposal.

It specifies safety requirements for:

Protection against:

- Mechanical hazards, movement of machinery and material, ejection of parts or material or liquids and gases, implosion, structural failure;
- Electrical hazards;
- Thermal hazards: explosion, fire, scalds, contact with hot parts, gases and flames;
- Noise and vibration;
- Thermal, optical and ionising and non-ionising radiation;
- Harmful by-products and hazardous substances, poisoning, biological and microbiological contamination, pollution and environmental discomfort;
- Other hazards such as listed in clause 4;

maintenance, provision for indicators, and inspection.

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



## 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**

### 2.1 Basic Standards

**A1** *deleted text* **A1**

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

**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 60364-4-43, *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**

### 2.2 Group Safety Standards

**A1** *deleted text* **A1**

EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

**A1** *deleted text* **A1**

EN 547-1, *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, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings*

**A1** *deleted text* **A1**

EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 626-1, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

**A1** *deleted text* **A1**

EN 842, *Safety of machinery — Visual danger signals — General requirements, design and testing*

EN 953, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards* <sup>A1</sup>

<sup>A1</sup> *deleted text* <sup>A1</sup>

EN 981, *Safety of machinery — System of auditory and visual danger and information signals*

EN 982, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

EN 1037, *Safety of machinery — Prevention of unexpected start-up*

EN 1088, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

<sup>A1</sup> EN 1127-1, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology* <sup>A1</sup>

<sup>A1</sup> EN 1299, *Mechanical vibration and shock — Vibration isolation of machines — Information for the application of source isolation* <sup>A1</sup>

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

EN 60825-1, *Safety of laser products — <sup>A1</sup> Part 1: Equipment classification and requirements (IEC 60825-1:2007)* <sup>A1</sup>

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals* <sup>A1</sup> (IEC 61310-1:2007) <sup>A1</sup>

EN 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking* <sup>A1</sup> (IEC 61310-2:2007) <sup>A1</sup>

<sup>A1</sup> EN ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)* <sup>A1</sup>

<sup>A1</sup> EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)* <sup>A1</sup>

<sup>A1</sup> EN ISO 13850, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)* <sup>A1</sup>

<sup>A1</sup> EN ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)* <sup>A1</sup>

<sup>A1</sup> EN ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)* <sup>A1</sup>

<sup>A1</sup> IEC 60405, *Nuclear instrumentation — Constructional requirements and classification of radiometric gauges* <sup>A1</sup>

<sup>A1</sup> IEC 60417-DB, *Graphical symbols for use on equipment* <sup>A1</sup>

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*



ISO 7243, *Hot environments — Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature)*



ISO 7933, *Hot environments — Analytical determination and interpretation of thermal stress using calculation of required sweat rate*

## 2.3 Product Safety Standards

EN 746-2:1997, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems*



EN 746-3, *Industrial thermoprocessing equipment — Part 3: Safety requirements for the generation and use of atmosphere gases*



 EN 746-4, *Industrial thermoprocessing equipment — Part 4: Particular safety requirements for hot dip galvanising thermoprocessing equipment* 

 EN 746-5, *Industrial thermoprocessing equipment — Part 5: Particular safety requirements for salt bath thermoprocessing equipment* 



prEN 746-6, *Industrial thermoprocessing equipment — Part 6: Particular Safety Requirements for Liquid Phase Treatment Equipment*



prEN 746-7, *Industrial thermoprocessing equipment — Part 7: Particular Safety Requirements for Vacuum Thermoprocessing Equipment*



 EN 746-8, *Industrial thermoprocessing equipment — Part 8: Particular safety requirements for quenching equipment* 



 EN 1547, *Industrial thermoprocessing equipment — Noise test code for industrial thermoprocessing equipment including its ancillary handling equipment* 



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



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



 EN 60519-3, *Safety in electroheat installations — Part 3: Particular requirements for induction and conduction heating and induction melting installations* (IEC 60519-3:2005) 



 EN 60519-4, *Safety in electroheat installations — Part 4: Particular requirements for arc furnace installations* (IEC 60519-4:2006) 

 IEC/TS 60519-5 , *Safety in electroheat installations — Part 5: Specifications for safety in plasma installations*

 EN 60519-6, *Safety in electroheat installations — Part 6: Specifications for safety in industrial microwave heating equipment* (IEC 60519-6:2002) 

 IEC 60519-7 , *Safety in electroheat installations — Part 7: Particular requirements for installations with electron guns*

 EN 60519-8, *Safety in electroheat installations — Part 8: Particular requirements for electroslog remelting furnaces* (IEC 60519-8:2005) 

 EN 60519-9, *Safety in electroheat installations — Part 9: Particular requirements for high-frequency dielectric heating installations* (IEC 60519-9:2005) 

### 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 D.

#### 3.1

##### **metallurgical and metal working plant**

plant and/or equipment which is used for thermal production, melting or remelting of ferrous and non-ferrous metals as well as to enable the molten material to be held, heated, alloyed and restructured before recasting into predetermined shapes.

Equipment used to remelt and re-alloy selected scrap material to produce primary ingots for remelting.

Equipment used to change the structure of the solid material by heating and cooling through various temperature gradient changes before its return to ambient temperature.

Equipment used to pre-heat metal prior to mechanical working or joining.

#### 3.2

##### **glass making plant**

plant and/or equipment which is used to heat and melt the constituents which make up glass and to allow for their proper mixing before the molten material is used directly to manufacture glass products.

Plant and/or equipment which is used for heat treatment or forming of glass products.

#### 3.3

##### **ceramic manufacturing plant**

plant and/or equipment which is used for firing, hearing and/or melting ceramic raw material and/or products (e.g. tiles, sanitary ware, table ware, bricks) to process the product to its intermediate or final state.

Plant and/or equipment for the reheating and drying of such products to apply glaze and other decoration to the item.

#### 3.4

##### **cement, lime and gypsum manufacturing plant**

plant and/or equipment used to calcine and/or fire selected raw materials to produce cement, lime and gypsum.

#### 3.5

##### **chemical plant**

plant and/or equipment which provides the heat input into chemical plants used in processes such as thermo-chemical reactions, oxygenation, catalysing, reduction, chain reactions and distillation.

#### 3.6

##### **waste incineration equipment**

equipment used to dispose of by burning, household and industrial waste, sewage sludge, tyres, special and toxic waste, medical and hospital waste but excluding atomic waste.

#### 3.7

##### **drying equipment**

equipment used to cure or expel moisture or volatiles from a product or material by heating.

#### 3.8

##### **cooling equipment**

equipment with heating and/or cooling systems used to reduce the temperature of products.

## 4 List of Hazards

Anticipated significant hazards are listed in broad outline in the scope and are detailed in Table 1.

For ease of reference table 1 also indicates the corresponding preventative measures and should be used in conjunction with clauses 5 and 6.

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

NOTE When personal protective equipment is referred to, the manufacturer should recommend it in the information for use manual

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
1	GENERAL		General design concept (Structure, access for operation, maintenance and cleaning, lighting, etc.)	5.1.1 to 5.1.3
2	MECHANICAL			
2.1	General		Design, structural details	5.2.1
			Emergency stops; Guards	EN ISO 13850 A1, EN 953 A1
2.2	Crushing	Moving parts Traps created by auto and manual feeding/take-off mechanisms	Fit guard,	5.2.2, EN 953 A1.
			fit interlocks,	prEN 1088
			Means of warning (audible, visual),	EN ISO 7731 A1, prEN 842, EN 981, EN 61310-1
			Provision of safety distances,	EN ISO 13857 A1; EN 349; A1 deleted text A1; EN 547-1
			Provision of warning signs,	ISO 7000; EN 61310-1
			Emergency stops,	EN ISO 13850 A1
			Push button with visual inspection, Maintenance/cleaning, good practice (particularly on guards).	
2.3	Shearing	Moving parts, moving of charging doors, feeding/take-off mechanism	Fit guard,	5.2.3; EN 953 A1
			Fit interlocks,	prEN 1088,

(continued)

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
2.4	Entanglement	Rotating shafts (e.g. fan shafts, conveyors, transmission machinery)	Means of warning (audible, visual),  Provision of warning signs,  Safety distances, Perimeter fencing, marking, Push button with visual inspection.	EN ISO 7731 <sup>A1</sup> , prEN 842, EN 61310-1, EN 981  ISO 7000, EN 61310-1  EN 349, EN 547-1
2.5	Drawing-in	Nips created by rolls (e.g. conveyors)	Guards	EN 953 <sup>A1</sup> 5.2.4
2.6	Impact	Struck by moving parts (e.g. doors, chargers)	Guards, Perimeter fencing systems or signs	EN 953 <sup>A1</sup> 5.2.6
2.7	High pressure fluids	Hydraulic leaks/failure Steam and service fluids	Prevent as far as possible by adopting good maintenance procedures. Design features; Guards,	5.2.7 prEN 982, prEN 983  EN 953 <sup>A1</sup>
2.8	Ejection of parts	Molten metal, Process components/materials, Machinery parts	Containing and draining.  Effective protection of defined areas or sections;  Provision of personal protective equipment	5.2.8   6.4.15
2.9	Implosion	Ejection of parts	Guarding, Design features, Method of operation	EN 953 <sup>A1</sup>
2.10	Stability	Collapsing of parts or equipment or materials; Movement of components or of machinery	Design (e.g. civil engineering) and maintenance; Design, training, understanding of the system, signs	5.2.9 prEN 746-7  5.2.10  ISO 7000, EN 61310-1

(continued)

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
2.11	Slip/trip	Floor surfaces, Walkway surfaces,	Ladders, walkways designed in accordance with defined specifications: no trip conditions; easy to maintain and clean; good maintenance and cleaning.	5.2.11
2.12	Falls	Spilled fluids,  Inadequate lighting.  1 – From equipment;  2 – Into equipment (e.g. openings, charging);  3 – Inadequate lighting	Provide containment and draining;  Provide adequate lighting  Ensure openings are covered or guarded  Provide adequate hand holds; Flat safe surrounding floors; Ensure openings closed during normal operation;  Provide adequate lighting	5.2.12
3	ELECTRICAL			
3.1	General		<p>– For electroheat installations, design and operation to be in accordance with EN 60519-1, EN 60519-2, and other parts of IEC 519</p> <p>– For all other thermoproc. equipment: design and operation in accordance with  <sup>A1</sup> IEC 60364-4-41 <sup>A1</sup>,  <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup> and EN 60204-1.</p>	<p>5.3.1 EN 60519-1; EN 60519-2, <sup>A1</sup> EN 60519/IEC 60519 Parts 3 to 9 <sup>A1</sup></p> <p><sup>A1</sup> IEC 60364-4-41 <sup>A1</sup>,  <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup>,  <sup>A1</sup> <del>deleted text</del> <sup>A1</sup> and EN 60204-1</p>
3.2 3.2.1	Contact Direct	Exposed or accessible live connectors, bus bars, etc.	<p>Appropriate protection (fixed/interlocking guards), locked control cabinets, safety audit, enclosed electrical control and supply rooms</p> <p>– For electroheat installations: see EN 60519-1, EN 60519-2, <sup>A1</sup> EN 60519-3 <sup>A1</sup> and following parts;</p>	<p>5.3.2 <sup>A1</sup> EN 953 <sup>A1</sup> prEN 1088</p> <p>EN 60519-1 EN 60519-2 <sup>A1</sup> EN 60519/IEC 60519 Parts 3 to 9 <sup>A1</sup></p>

(continued)

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
3.2.2	Slip/trip  Indirect	Insulation breakdown Earthing faults Physical contact	<p>– For thermoproc. equipm. see:  <sup>A1</sup> IEC 60364-4-41 <sup>A1</sup>, <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup>,  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>, <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup>, <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>, <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>,  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>;</p> <p>– Guards</p> <p>– For electroheat installations: see EN 60519-1,  EN 60519-2, <sup>A1</sup> EN 60519-3 <sup>A1</sup> and following parts</p> <p>– For thermoprocess equipment see:  <sup>A1</sup> IEC 60364-4-41 <sup>A1</sup>, <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup>,  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>, <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup>, <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>,  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>, <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>, <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>,  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup></p>	<p><sup>A1</sup> IEC 60364-4-41 <sup>A1</sup>  <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup>  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>  <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup>  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup></p> <p>5.3.2.2  <sup>A1</sup> EN 953 <sup>A1</sup>;  prEN 1088</p> <p>5.3.2  EN 60519-1  EN 60519-2  <sup>A1</sup> EN 60519/IEC  60519 Parts 3 to 9 <sup>A1</sup></p> <p><sup>A1</sup> IEC 60364-4-41 <sup>A1</sup>  <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup>  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>  <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup>  <sup>A1</sup> <i>deleted text</i> <sup>A1</sup></p>
3.3	Electrostatics	Discharge into the measuring, controlling and regulating devices e.g. stored programme system or computer	Design and protection in accordance with supplier's requirements	5.3.3
3.4	Electrical overload and short circuit	Breakdown/reduction of electrical insulation; Fire; Radiation; Ejection of molten particles; Chemical reactions.	Adequate protection should avoid this factor during normal operation: – design; – correct placement and protection of tables.	5.3.4 EN 60519-1 EN 60519-2 <sup>A1</sup> EN 60519/IEC 60519 Parts 3 to 9 <sup>A1</sup> <sup>A1</sup> IEC 60364-4-41 <sup>A1</sup> <sup>A1</sup> IEC 60364-4-43 <sup>A1</sup> <sup>A1</sup> <i>deleted text</i> <sup>A1</sup> <sup>A1</sup> IEC 60364-4-44 <sup>A1</sup> <sup>A1</sup> <i>deleted text</i> <sup>A1</sup>
3.5	Thermal radiation or other hazard	Fire;  Molten metal, Molten metal fusion in an electrical panel; Heat	<p>Protect as far as possible from fire/explosion effects;</p> <p>Protect from any likely splash of molten metal;</p> <p>Equipment and cabling designed and positioned to avoid damage (e.g. heat shields, cooling).</p>	5.3.5

(continued)



Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
3.6	External influences	Electromagnetic Fields (See also 7.2.4).  Induced Voltage peaks (in control circuits) by switching high currents or voltage; Disturbing signals in control circuits, RF interference, Lightning.	For electroheat installations with high electromagnetic fields:  – forbidden area for people with pacemakers  Proper design for control circuits	5.3.6 6.4.17  5.3.6
4	THERMAL			
4.1	General		Design features	5.4.1 ISO 7933
4.2	Heat sources	Contact with hot/cold surfaces Heat radiation  Contact with hot gases and flames  Ejection of hot parts (molten material or liquids);  Extremes of temperature	Reduce access where possible; provide protection (insulation behind barriers and screens, ventilation etc.)  Provide warnings; Danger zone marking; personal protective equipment provision and usage;  Provision of information in Instruction handbook: – commissioning, – use, – maintenance.  Design work position to minimise exposures. Personal protective equipment	5.4.2 EN ISO 13732-1 A1 EN 953 A1  6.4.15  6.4  ISO 7933 6.4.15
4.3	Fire/explosion			
4.3.1	Fire	Failure of controls and/or equipment leading to fire;  Escape of flames  Escape of materials  Heat transfer fluids fire  Fires in quench oil  Fires in service oil/fuel oil	Design, operation Handbook  Guards, maintenance  Guards, proper procedures and maintenance  Proper procedures and devices for the use of heat transfer fluids,  Maintain cleanliness, agitate, control temperature, avoid contamination, auto extinguish system  Protection, design, maintenance.	5.4.3.1 6.4  6.4 EN 953 A1  6.4 EN 953 A1  5.4.3.1  5.4.3.1 EN 746-8 A1

(continued)

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
4.3.2	Explosion	<p>Failure of control and/or equipment leading to explosion; ejection of hot parts or liquids</p> <p>Flame failure: generation of explosive atmospheres</p> <p>Failure of purge (evacuating gases)</p>	<p>Provision of explosion relief sufficient to prevent disintegration of equipment, provision of explosion relief designed to deflect effects away from work areas</p> <p>Instruction handbook: – commissioning – use – maintenance</p> <p>Design to prevent escape of unburnt gases, flash back in the pipework</p> <p>Design work position to minimise exposures</p> <p>Protection against ejection of service or process fluids</p> <p>Flame safeguard, provision of adequate explosion relief, remove explosion hazards</p> <p>Purging procedures clearly defined (e.g. Number of volume changes) in accordance with circumstances</p>	<p>5.4.3.2 EN 1127-1 A1,</p> <p>6.4, 6.5</p> <p>5.1.3</p> <p>5.4.4</p> <p>5.4.3.2 EN 746-2</p> <p>5.4.3.2 EN 746-2 EN 746-3</p>
4.4	Ejection of hot particles/work-pieces	Molten metal, process components/materials, machinery parts	<p>Effective protection of defined areas or sections; guarding, design features</p> <p>Method of operation</p> <p>Personal protective equipment provision</p>	<p>5.4.4 EN 953 A1</p> <p>6.4</p> <p>6.4.15</p>
4.5	Thermal stress/other physiological effects	Contact with hot surfaces or liquids, extremes of temperature (including draughts, cold).	<p>Reduce access, where possible, protection by: insulation barriers, screens, ventilation, etc.</p> <p>Provide warnings, danger zone marking</p> <p>Personal protective equipment</p> <p>Provision and usage, provision of information in instruction handbook</p>	<p>5.4.5</p> <p>EN 61310-1, ISO 7000</p> <p>6.4.15;</p> <p>6.4</p> <p>(continued)</p>

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
5	NOISE		Design work position to minimize exposures	ISO 7933
5.1	Noise effects	Sound emission	Noise-reducing design, enclosures, silencers, reduce vibration	5.5.1 EN ISO 11690-2, 6.4.7
5.2	Hearing loss and physiological effects	Sound emission	Noise reduction measures, soundproof booth, hearing protectors	5.5.1 6.4.7
5.3	Interference with communications	Messages incorrectly heard, warnings not understood due to sound emission	Ensure the functioning of the communication system, noise reducing measures  Provide audible/visual alarms	5.5.2 6.4.7  [A1] EN ISO 7731 [A1] prEN 842
6	VIBRATION			
6.1	Vibration effects	Vibration effects (also physiological)	Design, maintenance anti-vibration mountings	5.6 [A1] EN 1299 [A1]
7	RADIATION			
7.1	General			5.7.1
7.2	Non-ionizing radiation			5.7.2
7.2.1	Infrared, visible, UV radiation	Burning from flames, arcs, furnace walls, materials  Excessive heat, UV eye and skin damage, damage to sight, eye and tissue damage	Prevent direct sight of radiation sources  Provision and use of safety tinted glasses or tinted view holes, provide warning signs	5.7.2.1  ISO 7243 ISO 7933 6.4.16 EN 61310-1
7.2.2	Electric Arc	Eye and tissue damage	Prevent direct sight of radiation sources  Provision and use of safety tinted glasses or tinted view holes, provide warning signs	5.7.2.1 5.7.2.2  6.4.16 EN 61310-1
7.2.3	Laser beam	Contact with eye	Any laser application should meet EN 60825	5.7.2.3 EN 60825
7.2.4	Electromagnetic field:	Exposure of pacemaker, physiological effects	Specific exclusion of users of pacemaker	5.7.2.4 6.4.17
	Low frequency, Medium frequency, High frequency	Induced burns from the wearing of/or implanted metals on persons	Instructions concerning removal of metal objects in contact with the body	5.7.2.4 6.4.17

(continued)

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
7.2.5	Microwaves	Body tissue and organ damage (Physiological)	Measures to prevent persons with implanted metal from being in the area  Provision in accordance with <b>EN 60519-6</b> .	5.7.2.4 6.4.17  5.7.2.5 <b>EN 60519-6</b>
7.3	Ionizing radiation	Accidental exposure to ionising radiation	Use only sealed sources in accordance with <b>IEC 60405</b> .  Provide marking and warning signs.	5.7.3 <b>IEC 60405</b>  ISO 7000 EN 61310-1 EN 61310-2
8	MATERIALS AND SUBSTANCES			
8.1	General			5.8.1
8.2	Harmful by-products	Escape of dust/fume from combustion, from process, from workpiece, from quenching  Gas-by-products from special atmospheres (these can be toxic, flammable, asphyxiant or cause distress) including inhalation, ingestion, absorption, asphyxiation, toxicity	Provision of local exhaust ventilation, provision of proper evacuation  Provision of detecting devices, provision of specific danger warning sign, provision of warning devices, periodic environmental sampling of working atmosphere, defined maintenance procedures	5.8.2 EN 626-1  EN 746-3  6.5
8.3	Fire/explosion	see 4.3.1 and 4.3.2	Flameguards  Fuel cut-off devices and interlocks Fire detectors – flammable gas detectors	5.8.3 <b>EN 1127-1</b>  EN 746-2 EN 746-3
8.4	Biological and microbiological contamination	Exposure to biological and microbiological organisms e.g. contaminated cooling systems or processed material	Specify treatment for systems, adequate filtration, prevent contact and exposure	5.8.4 6.4.5
9	ERGONOMIC			
9.1	General		Principles for design Referenced group standards to be observed	5.9 EN 614-1
	Insufficient lighting	Vicinity of the machine or process	Provide sufficient lighting	5.1.3  (continued)

Table 1: (continued)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
10	HAZARD COMBINATION			
10.1	General	Refer to clause 5.10.1	General (design) provision to prevent enhanced cumulative effects of hazardous combination	5.10.1
11	MALFUNCTION			
11.1	General			5.11.1
11.2	Failure of energy supply	Loss of control (process and power)	Effective safe shut-down, provision of preferential supply systems	5.11.2 6.3.9
	Failure of service fluids	Partial or total loss of services	Stand-by safety and reserve supply system	5.11.2 6.3.9
		Failure of equipment to operate correctly	Instruction, training, good maintenance	6.4 6.5
11.3	Ejection of parts (or fluids)	See 2.7, 2.8, 4.4		5.2.7 5.2.8 5.4.4
11.4	Errors of fitting/assembly	See also stability 4.2.10	Design, training, understanding of the system, marking, identification, etc.	5.11.4 6.4.1 6.5.1
11.5	Effect of malfunction of control system devices	Unexpected operating condition	Well-trained and instructed personnel, good maintenance	5.3.6 5.11.5 6.4 6.5 A1) EN ISO 13849-1 A1)
11.6	Lack of information/warning devices	No reaction to situations requiring remedial action (Auto or Manual) e.g. flame failure, high temp etc. Overuse of devices and hence loss of effectiveness	Provide means to identify dangerous deviations from normal operation. Maintenance, design, training	5.11.6 EN 981 EN 61310-1 EN 61310-2
11.7	Warning signs	No warning of particular dangers (in addition to the device)	Comply with EN 61310-1 Signs are to be pictorially clear, correctly positioned, difficult to remove or permanently marked.	5.11.7 6.2.3 6.2.4
11.8	Failure of equipment	Inadequate instructions to operating personnel	Instruction handbook, training	5.11.8 6.4
		Inadequate maintenance	Instruction handbook, maintenance at prescribed intervals	6.4 6.5
				(continued)

Table 1: (concluded)

1 Clause	2 Hazard	3 Hazardous Situation	4 Preventative Measures	5 References
12	MISSING/INCORRECTLY FITTED SAFETY DEVICES			
12.1	General			5.12.1
12.2	Guards	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	6.4 6.5
12.3	Safety devices	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	5.1.3 6.4 6.5
12.4	Start/stop	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	6.4 6.5 prEN 1037
12.5	Information/warning signs	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	6.4 6.5 EN 61310-1
12.6	Energy supply disconnection devices	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Properly energy isolating devices	5.12.2 [A1] EN ISO 12100-2:2003 [A1] prEN 1037
12.7	Emergency stops	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	[A1] EN ISO 13850 [A1] 6.4 6.5
12.8	Feeding/take-off devices	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	6.4 6.5
12.9	Adjustment/maintenance	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	6.4 6.5
12.10	Gases evacuation		Refer to clause 5.8.2 and 6.5.13 of this standard and EN 746-2 and EN 746-3.	5.8.2 6.5.13 EN 746-2 EN 746-3
12.11	Failure of equipment a) by operator	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	5.11.8 6.4 6.5
	b) by manufacturer or supplier	Absence or incorrect fitting can cause injury or death to the operator or bystanders	Maintenance, design, training.	

## 5 Safety requirements, measures and verification means

### 5.1 General

#### 5.1.1 Requirements

The manufacturer shall meet the requirements detailed in this standard.

Where particular requirements of the other parts of EN 746 and/or other standards exist, they shall supplements or modify the common requirements.

Verification of the preventative measures detailed in this clause, can, in most cases, be carried out by simple inspection.

If other methods of verification apply these are given under the relevant sub-clause in this clause.

#### 5.1.2 Signs, warning labels etc

Any signs or warning labels etc. attached to or adjacent to any machinery dealt with in this Part of EN 746 shall meet the requirements of ISO 7000, [A1] IEC 60417 [A1], EN 61310-1 and EN 61310-2 as appropriate (see also 5.3.1, 5.4.2, 5.7.2, 5.7.3, 5.8.2, 5.11.6, 5.11.7, 6.2.3, 6.2.4).

#### 5.1.3 General design and construction requirements

The manufacturer shall maintain evidence that all aspect of the design referred to in this Part of this standard have been addressed.

The structural assembly, e.g. civil foundations, steel unions, auxiliaries and services which form part of the equipment shall be stable, suitable for function and the intended use.

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

- Static stability of the equipment including structures intended for containing the processed materials and the materials entering and leaving the equipment;
- Accessibility;
- Maintenance and cleaning clearances;
- Movement of material and machinery;
- Safety in operation;
- Health and safety in the workplace;
- Protection against fire;
- Pollution.

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 equipment require frequent inspection, they shall either be provided with lighting appropriate to the structure and the nature of the process, or the user shall be advised to install suitable lighting at the time of placing the order.

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

- Escape of unburnt gases to the equipment, to pipes not intended for such gases or to the outside;
- Flashback in the pipework.

The safety devices shall:

- Be efficient and durable throughout the range of adjustment to the regulation of the equipment;
- 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 and under the same working conditions.

Where auxiliary fluids such as lubricants, dielectric, diathermic and dynamic fluids are used, their chemical composition, as far as is possible, shall be such that in the event of fire the products of combustion are not harmful.

Floor drains which form part of the equipment 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 equipment and which are likely to become dangerous if subjected to corrosion or extreme temperature or wide variations in temperature, pressure, voltage, etc. shall be marked.

#### **5.1.3.1 Access**

All parts of the equipment 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 also 5.2.11).

Inspection and service floors of the equipment shall be safe, well lit, well ventilated, protected against heat radiation and be fire resistant (see 5.4.3.1).

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

#### **5.1.3.2 Roofs and covers**

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

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

Roofs or covers which have to be walked on for operating, maintenance and inspection purposes, and which are more than 1 metre above floor level, shall be accessible through safe ascents and shall be fitted with railings to prevent falls. When the heat source is located in the roof, e.g. in the ceramics or glass industry, one escape route shall be available in front and one behind the firing zone of which at least one shall be a stairway.



### 5.1.3.3 Access channels

In general, the dimensions of access channels shall be in accordance with EN 547-1. However for channels intended for repair purposes below tunnel furnaces or kilns as defined in 3.3 the unobstructed passage way shall be at least 1,80 m high x 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.

## 5.2 Mechanical

### 5.2.1 General

(formulated as general principles)

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

Where the construction of the equipment includes:

- Corners and projections;
- Passages of reduced height;
- Manhole covers, drains, etc.



They shall be protected and marked in such a way so as not to present a hazard.

### 5.2.2 Crushing





(formulated as general principles)

The design shall incorporate means to minimise 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. When guarding is not practicable audible and/or visual signals shall be provided in accordance with EN 61310-1,  EN ISO 7731  and/or prEN 842.

Strategically positioned emergency stop shall be provided to enable potentially hazardous moving machinery to be halted.

Emergency stop devices shall comply with  EN ISO 13850 . Guarding, when provided, shall comply with  EN 953  and prEN 1088.

Any traversing part of the equipment or material carried by it shall not be closer to any fixed structure than the safety distance requirements given in EN 349.

The design of the equipment shall take account of the minimum distance requirement given in EN 349, **EN ISO 13857**, EN 547-1 and/or EN 547-2.

### 5.2.3 Shearing

(formulated as general principles)

When possible shear traps shall be eliminated by:

- a) filling the gaps or reducing the maximum clearance between the moving parts so that parts of the body cannot enter the gap;
- b) increasing the minimum clearance between the shearing parts such that parts of the body can enter the gap safely, see EN 349 and EN 547-1.

Where it is not possible to avoid the creation of a shear trap adequate guarding shall be used (see **EN 953** and prEN 1088).

Means shall be provided to prevent unintentional closure or opening of doors.

### 5.2.4 Entanglement

(formulated as general principles)

Design measures shall be taken, or suitable guards shall be provided, to prevent entanglement by rotating shafts, conveyors and transmission machinery (see **EN 953**).

### 5.2.5 Drawing-in

(formulated as general principles)

Design measures shall be taken, or suitable guards shall be provided, to avoid drawing-in (see **EN 953**).

### 5.2.6 Impact

(formulated as general principles)

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 should be kept to a minimum by the designer, in order to reduce the possibility of injury.

When this is impracticable adequate guarding or safety devices shall be provided including a perimeter fence if necessary.

### 5.2.7 High pressure fluids

An injury can be 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 specification and all parts of the system shall be protected against overpressure. See also prEN 982 and prEN 983.



Verification of leak tightness shall be achieved by pressure testing to at least the intended operating pressure. Any pressure relief device can be verified by testing in accordance with their 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. Special care shall be taken to guard against flexing or twisting during movement, and thermal damage.

### 5.2.8 Ejection of parts

(formulated as general principles)

The body may be crushed or penetrated by material or parts of the equipment ejected unexpectedly or accidentally.

When there is a risk of ejection of parts occurring adequate guarding shall be provided (see  EN 953 .

### 5.2.9 Implosion

All parts of the equipment which work with a vacuum shall be constructed in such a way that implosions are avoided as far as is possible.

Suitable devices shall ensure, after repressurising, a gradual decompression of the equipment before the doors can be opened, e.g. interlocked double release devices which ensure detaching of the door before the complete opening.

For particular measures/provisions for vacuum thermoprocessing equipment see prEN 746-7.

### 5.2.10 Stability

The equipment structures shall be designed and calculated for their static and dynamic strength. The design shall take into account both the normal and foreseeable accidental thermal static and dynamic working stresses, including those resulting from chemical and physical explosion and any operation below atmospheric pressure.

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

### 5.2.11 Slip/trip

Working platforms shall be designed so as to provide a level standing space of adequate size with a firm foothold. Walk ways 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.

### 5.2.12 Falls

(formulated as general principles)

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

## 5.3 Electrical

### 5.3.1 General

Electrical components and installations for any equipment and services located in the same unit(s) up to the defined equipment limits shall be suitable for their function and intended use.

The following requirements shall be considered:

- Safety of Electrical Installation and Use regulations and standards given in clause 2;
- The design and operation of electroheat installations shall be in accordance with EN 60519-1, EN 60519-2 and A1 EN 60519/IEC 60519 Parts 3 to 9 A1 as appropriate;
- The design and operation of electric installations in other equipment shall comply with A1 IEC 60364-4-41 A1, A1 IEC 60364-4-43 A1, A1 *deleted text* A1, A1 *deleted text* A1, A1 IEC 60364-4-44 A1, A1 *deleted text* A1, A1 *deleted text* A1, A1 *deleted text* A1 or EN 60204-1;
- Energy supply of moving parts of the installation shall be shut off in case of emergency in accordance with EN 60204-1 "Stop Category 0".

A detailed analysis of the electrical installation shall be made, including the following elements:

- Piping conveying flammable gases shall not be installed in channels, pipes or trenches carrying cables. Channels, pipes or trenches carrying cables shall be installed in such a location to prevent the unintended conduit of flammable gases;
- Electrical power carrying capacity and insulation characteristics of the conductors in the installed positions;
- Temperature rise of conductors and the ambient temperature environment;
- The suitability of connectors and terminations;
- Minimisation or elimination of undesirable induction heating effects;
- Estimated temperature of operation of devices in their installed position;
- Minimising electrical induction or interference between power and control cables, sensors etc.;
- Protection of cables, groups of cables, devices or motors against overload and short circuit;
- Prevention of damage to conductors from heat, shearing, trapping, cutting, crushing, fluids or other contamination;
- Prevention of, or protection against earth leakage;
- Prevention of, or protection against electric arcs;
- Safe access or prevention of access to live circuits;
- Adequate warning signs;
- Adequate identification of devices, cables, fuses and distribution boards;
- Adequate electrical schematic drawings, cable schedule drawings, software programmes and their adequate provision to equipment engineering, operation and maintenance operatives.

Verification of preventative measures shall be made in accordance with EN 60204-1 or [A1] IEC 60364-4-41 [A1], [A1] IEC 60364-4-43 [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1], [A1] IEC 60364-4-44 [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1] as well as with EN 60519-1 and IEC 519 if applicable.

### 5.3.2 Direct or indirect contact

**5.3.2.1** Measures against direct or indirect contact with live conductors/terminations shall be taken for electroheat installations in accordance with EN 60519-1, EN 60519-2 and [A1] EN 60519/IEC 60519 Parts 3 to 9 [A1] as appropriate and for other thermoprocessing equipment in accordance with [A1] IEC 60364-4-41 [A1], [A1] IEC 60364-4-43 [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1], [A1] IEC 60364-4-44 [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1] and [A1] *deleted text* [A1].

**5.3.2.2** Where it is necessary during commissioning, re-commissioning, maintenance or fault-finding operations to gain access to live installations appropriate interlocks, protection systems or guarding shall be incorporated (see [A1] EN 953 [A1] and prEN 1088).

### 5.3.3 Electrostatics

Suitable earthing or other means shall be provided to minimise hazards caused by electrostatic effects.

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

### 5.3.4 Effects of electrical overload

Measures shall be taken to prevent electrical overload in electroheat installations in accordance with EN 60519-1, EN 60519-2 and [A1] EN 60519/IEC 60519 Parts 3 to 9 [A1] and for other thermoprocessing equipment in accordance with [A1] IEC 60364-4-41 [A1], [A1] IEC 60364-4-43 [A1], [A1] *deleted text* [A1], [A1] IEC 60364-4-44 [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1], [A1] *deleted text* [A1] and [A1] *deleted text* [A1].

### 5.3.5 Thermal radiation or other phenomena

(formulated as general principles)

The layout, installation, mounting, cable grouping, selection and protection of electrical conductors and devices shall be such as to ensure reliable normal operation and to minimise hazards to health and safety during predictable failure modes of the equipment. Particular attention shall be given to the siting of electrical conductors and devices in areas affected by the discharge of hot components, opening, exhausts and vents for hot gases, vapours or fluids.

### 5.3.6 External influences

(formulated as general principles)

The design shall minimise the hazards presented to health and safety by the effect of external influences on the electrical power, controls and systems.

Disconnection and/or restoration of the electricity supply shall not cancel the safety and interlock conditions.

The electrical control system shall be suitably protected or guarded against mechanical damage from operations within the equipment environment.

**NOTE** Such influences can be beyond the boundaries defined within the scope of this standard and should be dealt with in contract between the supplier, agents importers and/or users of the equipment.

## 5.4 Thermal

### 5.4.1 General

The use of this type of equipment involves many thermally hazardous situations, therefore precautions shall be taken to prevent operators or bystanders from coming into unintended contact with work pieces, flames or industrial thermoprocessing equipment which can be at elevated or below ambient temperatures.

Special requirements are given in 5.4.2, 5.4.3, 5.4.4 and 5.4.5.

**NOTE** Such influences can be beyond the boundaries defined within the scope of this standard and should be dealt with in contract between the supplier, agents importers and/or users of the equipment.

### 5.4.2 Contact with hot/cold surfaces

Precautions shall be taken to prevent contact with operating controls at elevated temperature either accidentally or whilst operating them. In general, the temperatures of operating controls shall not exceed the values specified in [A1](#) EN ISO 13732-1 [A1](#).

Where it is not possible, for process reasons or other constraints, to maintain surface temperature below those specified then steps should be taken to prevent hot operating controls being touched. Wherever possible this shall be by means of guards complying with [A1](#) EN 953 [A1](#).

If these measures are not practicable then areas of elevated temperatures shall be indicated by means of suitable marking, warning signs etc. In addition, attention shall be drawn in the technical documentation to the presence of such hazards.

Where it is not possible to avoid contact with controls etc. which are at temperature above those specified in [A1](#) EN ISO 13732-1 [A1](#) then suitable protective clothing shall be used. Requirements for such clothing shall be included in the technical documentation (see 6.4.15).

### 5.4.3 Fire/Explosion

#### 5.4.3.1 Fire

As far as is practicable equipment shall be constructed of fire resistant material, and installed in and on a fire resistant structure (fire resistance shall be not less than 60 min). Where the use of flammable materials cannot be avoided and it is not practicable to meet the fire resistance conditions above the materials shall be insulated from heat and ignition sources.

The design and construction of the equipment shall be such as to prevent the leakage of hot gases, combustion products and flames, other than at purpose designed flues, vents and doors etc.

In particular the following shall be considered:

- Discharge of hot gases or flames from openings;
- Loading and unloading of hot workpieces.

When the equipment is heated by gaseous, liquid or solid fuel then the fuel circuits shall be designed to prevent leakage. In addition the fuel circuits shall be capable of withstanding foreseeable mechanical damage. Further guidance is given in EN 746-2.

Where hydraulic oil actuated components are used, piping and hydraulic equipment shall be protected from flames. Any oil leakage shall be prevented from reaching hot parts by suitable design, location and proper maintenance.

Particular attention shall be given to quench tanks containing flammable oil. Further guidance is given in **EN 746-8 A1**.

Heat-transfer fluids shall be non toxic and shall not be used at temperatures exceeding the maximum recommended by the manufacturer or supplier of the fluid. The humidity and oxygen content in the fluid should be controlled.

When considering the maximum level of the heat-transfer fluid account shall be taken of its expansion during normal working conditions. The system shall be fitted with safety vents that are protected against the ingress of hazardous contaminants (e.g. moisture and air).

Any heating equipment for heat-transfer fluids shall be provided with a device to prevent over-temperature.

Suitable devices to control the burner, heating element and/or circulation pump shall be fitted when any of the following parameters are of consequence for safety:

- Pressure;
- Temperature;
- Level (of fluid);

Further guidance is given EN 746-2.

Where applicable, fire extinguishing facilities shall be installed on the equipment at positions where there is the greatest risk of fire occurring. Particular attention shall be given to the selection of the type of extinguisher to be used.

#### **5.4.3.2 Explosion**

The equipment shall be designed to minimise the risk of a foreseeable explosion.

The design shall incorporate means to prevent the explosive co-existence of a flammable substance and an oxidising agent (usually air) with an ignition source within the flammability limits (see also 5.2.3.1 of EN 746-2:1997).

The removal of a flammable mixture can be achieved by means of a purge with air or an inert gas (see EN 746-2 and EN 746-3).

Particular attention shall be given to work pieces which are not themselves flammable but which may, by design or otherwise, be coated with substances which could give rise to a flammable mixture.

Unless it can be shown that the probability of a flammable mixture being formed is minimal, or that any foreseeable explosion will be safely vented by other means, or safely contained, then explosion relief(s) of sufficient area and mass to relieve foreseeable explosions shall be fitted.

Explosion reliefs shall be positioned such that they are unimpeded, both inside and outside the equipment, and shall discharge in such a manner that personnel are not subject to hazards. The strength of the relief(s) shall be such to as to relieve the pressure of an explosion before serious damage is caused to the equipment.

Where doors are not designed as explosion reliefs they shall be fastened in such a manner they cannot open when subjected to the force of a foreseeable explosion. Doors shall not open other than in their intended direction.

#### 5.4.4 Ejection of hot particles/workpieces

The equipment shall be designed to contain hot particles/workpieces within its structure. Particular attention shall be paid to the loading/unloading areas. If additional guards or barriers are required they shall comply with **EN 953**.

Where liquid metals, oils or salts are being heated, the introduction of moisture into the liquid shall be prevented (reference should be made to **EN 746-4**, **EN 746-5**, prEN 746-6 or **EN 746-8**, as appropriate).

#### 5.4.5 Thermal stress and other physiological effects

The equipment shall be designed so that the effects of thermal stress on human beings are minimised (see ISO 7933). An estimation shall be made of temperatures that could be reached in areas to which operators have access. Preventative measures, such as ventilation and operating booths with cooling, shall be provided if necessary.

### 5.5 Noise

#### 5.5.1 General

All equipment emits noise to a greater or lesser extent, determined in noise-emission values. Therefore it shall be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, particularly at source.

The designer shall be aware of potential noise hazards and devise preventative measures to cope with them. In order of preference, the designer shall consider the following messages:

- Noise reduction at source

Reduce noise by design, e.g.:

- Choose low noise burners;
- Optimise the burner rating;
- Choose low noise components.

- Noise abatement by devices

Reduce noise using e.g.:

- Baffles for ventilators;
- Baffles adjacent to burner(s);
- Encasing of pumps;
- Silencers;
- Noise absorbing walls and covers (see EN ISO 11690-2);
- Enclosures.

- Noise abatement at workstation



Reduce noise using e.g.:

- Cabin for the operators;
- Hearing protectors (see 6.4.7).

The designer shall consider and, where practicable, reduce the noise generated by the movement of process material.

The measurement and verification of noise emission values, shall be made in accordance with **EN 1547 A1**.

### 5.5.2 Interference with communications

The manufacturer should design the equipment and reduce its noise emission so that spoken communications and acoustic signals, warnings etc. are audible.

Consideration shall be given to the spectrum of the airborne noise and audible signals as well as the weighted noise level.

If it is necessary to specify personal hearing protection then the effect of wearing such equipment on communications will need to be considered.

## 5.6 Vibration

(formulated as general principles)

The equipment shall be designed and constructed such that hazards associated with vibration are reduced to the lowest level. Primary measures shall be by the reduction of vibration at source.

When secondary measures are required then the use of anti-vibration mountings or other measures is recommended. Guidance on the minimisation and reduction of vibration is given in **EN 1299 A1**.

## 5.7 Radiation

### 5.7.1 General

Means shall be provided to minimise the harmful effects of radiation emissions as specified in 5.7.2 and 5.7.3 and, for electrically heated equipment, in EN 60519-1, EN 60519-2 and **EN 60519/IEC 60519 Parts 3 to 9 A1**. Such means shall be appropriate to the circumstances obtained within the thermoprocessing equipment.

### 5.7.2 Non-ionising radiations

Any inspection points, where operators are liable to exposure from infra-red and ultra-violet radiations shall be shielded by the use of appropriately tinted sights so as to avoid direct contact.

The design of controls, measuring instruments and monitoring accessories employing non-ionising radiations, microwaves, laser, electromagnetic fields and/or radio frequency fields, that are integral part of the equipment shall comply with Regulations and Directives concerning emission limits.

#### 5.7.2.1 Infra-red/Visible/UV Radiation (optical and thermal)

Suitable protection against infra-red, visible and UV radiation shall be provided (see also 5.4.5).

Direct sight contact with the radiation source shall be prevented. Inspection sight holes shall be shielded, and where necessary control cabinets and rooms integral with the equipment shall have tinted glass windows.

Specific danger warning signs shall be provided.

#### 5.7.2.2 Electric arcs

The requirements given in the second and third paragraph of 5.7.2.1 shall apply.

#### 5.7.2.3 Laser beam

Laser equipment and its use shall comply with EN 60825. Where necessary lasers shall be positioned so that casual operator contact is possible. Suitable interlock(s) shall be fitted to prevent access to the laser beam.

Specific warning signs shall be provided.

#### 5.7.2.4 Electromagnetic fields



Sources of electromagnetic fields sufficient in power to be a hazard shall be separately enclosed and isolated, as far as is possible, from normal operator working and resting positions.

In areas where electromagnetic fields are operative warning signs shall be provided prohibiting the entrance of persons having heart pace makers, metallic implants or who are wearing metallic rings, bracelets etc.

#### 5.7.2.5 Microwaves

Microwave equipment shall comply with  EN 60519-6 .

#### 5.7.3 Ionising radiations

Where measuring instruments and monitoring accessories employing X-rays and/or radionuclides are used on the equipment they shall not constitute a risk to people. Only sealed sources complying with  IEC 60405  shall be used.

Such installations and instruments shall be marked with the specific danger sign. Specific hazard warning signs shall be provided in the area.

If the equipment is likely to be accessible during production and in foreseeable circumstances then:

- Interlocks shall be fitted so that access is only obtained if the shutter is closed (sealed source) or the power is cut off;
- Clear warnings indicating the status of the equipment (e.g. shutter open/shutter closed or on/off lights about to start rays), shall be installed.

### 5.8 Materials and substances

#### 5.8.1 General

The equipment designer shall take note of possible hazards and avoid as many as possible by suitable choice of design features. In addition the instruction handbook shall clearly specify any particular working practices and personnel protection which are necessary to ensure safe use of the equipment (see EN 626-1).

**NOTE** Hazardous situations can arise as a result of the nature of the process being undertaken by the equipment, such as contact with, or inhalation of, dust or harmful liquids, gases, vapours, mists and fumes.

### 5.8.2 Harmful By-Products

The design shall take account of the dangers of toxicity and asphyxia. The design shall incorporate devices for preventing the leakage of dust, fumes and gaseous by-products. Where some leakage is unavoidable then suitable vents connected to an induced draught system shall be provided (see also EN 626-1). Specific hazard warning signs shall be provided.

**NOTE** It is not possible to be specific about the by-products until the material(s) to be processed has/have been specified by the user.

### 5.8.3 Fire/Explosion

(formulated as general principles)

The equipment shall incorporate appropriate measures to prevent or minimise the risk of fire and/or explosion.

Such measures shall include, where appropriate, the fitting of:

- a) Flame guards;
- b) Fuel cut-off devices and interlocks;
- c) Cooling means for equipment or workpieces;
- d) Fire detection means.

(Extinguish facilities already referred to in 5.4.3.1);

- e) Gas detectors.

In addition the fuels as well as the combustion and controlled atmospheres to be used in the process shall comply with 5.4.3 and EN 746-2 and EN 746-3.

### 5.8.4 Biological/Microbiological Contamination

See 6.4.5.

## 5.9 Ergonomics

(formulated as general principles)

The equipment shall be designed to take account of the ergonomic aspects of using, maintaining and servicing the equipment (see EN 614-1).

## 5.10 Hazard combination

### 5.10.1 General

(formulated as general principles)

Provision shall be made to prevent hazards from occurring in combination or cumulatively.

**NOTE** For example, the failure of a stop device to operate could cause a series of hazardous events. Control circuits should be designed to minimise, as far as is practicable, the foreseeable hazard combinations that are likely to occur (see EN 60204-1).

## 5.11 Malfunction

### 5.11.1 General

The manufacturer shall take account of the hazards and hazardous situations detailed in this clause in the design of the equipment concerned.

### 5.11.2 Failure of power supply and auxiliary fluids

Undesirable and unscheduled changes in the pressure of the auxiliary fluid actuating instruments and monitors (e.g. compressed air, oil hydraulic circuit fluid, main fluid in the case of self actuated devices etc.) shall be detectable by some suitable devices if the condition is likely to cause a hazardous situation.

If pressure change is likely to cause a hazardous situation then devices shall be provided to shut the equipment down or place it in a safe condition.

For failure in electricity supply see 5.3.6 and 6.3.9.

Additional stand-by machinery such as air compressors, electrical supply units, compressors for service fluids and power engines shall be located separately from the thermoprocessing equipment. Air intakes shall be located in open places away from gaseous discharges or flammable vapours e.g. vehicle exhausts (gaseous discharge) or stored material e.g. paraffin (flammable vapour).

### 5.11.3 Ejection of parts or fluids

The requirements of clauses 5.2.7, 5.2.8 and 5.4.4 shall apply.

### 5.11.4 Errors of fitting/assembly during installation

There shall be adequate supervision of fitting and assembly operations.

The design shall where possible, ensure that parts cannot be incorrectly fitted or assembled. Where not practicable parts shall be appropriately identified and marked.

### 5.11.5 Effect of malfunction of control system/component devices

The manufacturer shall assess the effect of malfunctions of control systems/component devices in the design analysis. In the event of malfunction of a control component an unsafe situation shall not arise (see **A1** EN ISO 13849-1 **A1**).

### 5.11.6 Information/Warning Devices

Where applicable the equipment shall be provided with information and warning devices relating to the occurrence of a malfunction. Such devices shall meet the requirements of EN 981, EN 61310-1 and ISO 7000.

### 5.11.7 Safety signs

If safety signs are provided they shall meet the requirements of EN 61310-1 and ISO 7000.

### 5.11.8 Failure of equipment

The instruction handbook and maintenance instructions shall include suitable text (see also 6.4 and 6.5).

## 5.12 Missing and incorrectly fitted safety devices



### 5.12.1 General

(formulated as general principles)

In considering the design and construction of the equipment, the designer/manufacture shall take account of the possibility that in use parts, components or safety devices might be incorrectly refitted or removed altogether. Appropriate fittings or identification of parts shall be provided.

The information for use documentation shall provide further assistance and also give suitable warnings about incorrectly fitted or missing parts in those areas where the manufacturer assesses that a hazard could occur if parts are missing or incorrectly fitted.

### 5.12.2 Power supply disconnection devices

The equipment shall be fitted with devices to disconnect it from all power sources and to dissipate all stored energy. Devices to ensure that disconnection and dissipation has been achieved shall be provided e.g. by means of pressure gauges, meters, audible or visual signals. Further guidance is given in prEN 1037 and  EN ISO 12100-2:2003 .

## 6 Information for use

### 6.1 General

#### 6.1.1 The information for use handbook shall make reference to the following:



- The foreseeable use for which the equipment has been designed;
- That the equipment has been designed for use by trained operators or supervisors.

The information for use handbook shall draw the user's attention to hazards that experience has shown can occur.

The handbook shall include any drawing and diagrams that are relevant to safety.

Additional specific requirements shall be given if the equipment is designed to operate in potentially explosive atmospheres.

#### 6.1.2 The format and content of the information for use handbook shall comply with

 Clause 6 of EN ISO 12100-2:2003 .

### 6.2 Marking

**6.2.1** A durable data plate containing at least the following information shall be fixed to the equipment at a location which is visible after installation:

- Name and address of manufacturer;
- Mandatory marks<sup>1)</sup>;

---

1) For EU countries, the CE-mark, for example.

- Designation of series or type;
- Serial number, if any;
- Year of construction;

And if applicable:

- Source of energy used;
- Maximal thermal load in kilowatts;
- Maximum permissible temperature;
- Maximum permissible charge load or output to be treated;
- Atmospheres which can be used (e.g. non inflammable, explosive, toxic).

**6.2.2** Auxiliary electrical installations shall be fitted with a durable data plate containing data in accordance with EN 60204-1, including the casing protection grade.

**6.2.3** Where it is not possible to fit a safety device a durable warning sign shall be fitted to warn against foreseeable hazards.

Warning signs shall be considered to be as important as any safety devices that have been fitted.

**6.2.4** Warning signs shall be fitted in a position where they are clearly visible. The colour of the plate shall be such as to stand out from the surface to which they are fixed. The wording shall be easily readable from a safe distance.

**6.2.5 Services shall be:**

- Painted or identified by the appropriate colour code;
- Marked with the specific danger sign.

## **6.3 Technical Data, Installation and Commissioning**

Technical data, installation and commissioning instructions shall be provided and shall contain at least the following information.

**6.3.1** The stability requirements for the equipment structure shall be as given in 5.2.10.

**6.3.2** The flooring around the equipment shall be non-combustible (Class of reaction 0);

NOTE See Annex F of prEN 1539:1995 for further information

**6.3.3** The accidental leakage of molten materials or dangerous liquids should be prevented or contained by tanks or collecting pits in case of emergency situations.

Means should be provided for the collection and removal of such discharges.

Storage and use of flammable materials in the vicinity of the equipment is prohibited.

**6.3.4** The manufacturer shall include in the technical documentation a list of essential spare parts to cater for immediate safety and maintenance emergencies.

**6.3.5** During installation and demolition operations, technical means and individual protection shall be provided to ensure the safety of persons, property and the environment.

**6.3.6** The user shall ascertain that the room or location intended to hold the equipment and the means required for construction and installation comply with the safety requirements of this part of this standard. Adequate ventilation shall be provided.

If necessary, the building containing the equipment or the equipment itself, if partially or completely located in the open air, shall be protected from atmospheric electrical discharges (i.e. lightning).

**6.3.7** The user should be made aware of the possibility that the noise level can be affected by the surroundings in which the equipment is to be installed.

**6.3.8** Any measuring and monitoring device using laser or radio nuclides shall be accompanied by instructions covering correct and safe installation/use, calibration, maintenance and disposal.

**6.3.9** If shut-down resulting from a failure of electrical supply is dangerous, the user should provide in the equipment either a preferential supply system or a stand-by supply system or install equipment with automatic start-up and operation.

If appropriate, automatic admission of inert gas to the equipment should be adopted by the user in the event of a power failure to pressurise and/or purge the equipment.

**6.3.10** If applicable, the manufacturer and the user should agree on the date and conditions for the start-up and for the acceptance testing of the equipment in accordance with the stated conditions for the use. It is recommended that, prior to start-up, a test report should be drawn up countersigned by both parties.

An example of a suitable test report is given in Annex B.

Supervision of commissioning until hand-over of the equipment shall be the responsibility of the manufacturer in the absence of any other special documented agreement.

When delivery, commissioning and testing have been carried out and the user has accepted the equipment, responsibility passes to the user unless any other specific agreements have been made.

## **6.4 Instruction Handbook (Operation)**

The manufacturer shall supply an operating instructions manual covering the description of the equipment, the heating system and all the auxiliary systems. These instructions accompanied by diagrams, drawing and leaflets when applicable, shall contain at least the following details:

- Data plate information;
- Type of equipment;
- Heating and fuel, burner, electrical installations;
- Air borne noise emission (see **A1** EN 1547 **A1**);
- Safety and regulating devices;
- Starting, operating and shut-down arrangements;

- When possible, action to be taken in the event of faults or irregularities and abnormal operation;

NOTE When it is not possible to include such information in the instruction handbook then such actions should be recorded in a special hazard prevention user instruction manual

- Use limitation;
- Instructions for preventing hazardous conditions by suitable user training and control;
- Details of necessary emergency escape routes;
- Consideration of the effect of equipment failure and instructions to prevent it through appropriate maintenance, training, service life of components;
- Personal protection requirements for special workstations, if applicable.

The manual shall include at least the following:

**6.4.1** Clear means for demonstrating the correct positioning of safety devices and clear identification of the components concerned.

NOTE When practicable, parts should be marked for identification

**6.4.2** Start-up and shut-down procedures for combustion and fuel handling systems in accordance with EN 746-2.

In particular the flow of fuel shall be shut off such that the fuel does not continue to flow through the burners. This technique shall be used to avoid explosive mixtures from developing inside the equipment, in the fume ducts and in the air and fuel pipes.

**6.4.3** Information for equipment with controlled atmospheres in accordance with EN 746-3.

**6.4.4** Information for equipment with emission of volatile compounds

NOTE For instance prEN 1539

**6.4.5** Specifications concerning treatment, installation details or monitoring procedures that are necessary to ensure that cooling systems or the material being processed cannot become contaminated with harmful organisms.

**6.4.6** Noise emission in accordance with A1 *deleted text* A1 and 5.5.1 of this part of this standard.

**6.4.7** Information that when noise reduction measures in accordance with 5.5.1 cannot be incorporated sufficiently, hearing protectors shall be worn. The effect that ear protection can have on communications shall be considered.

Proper warnings shall be provided when practicable.



**6.4.8** Information that the instruction handbook should be updated by the user where modifications are made by the user after the original installation.

**6.4.9** Instruction that the personnel operating the equipment shall be trained and competent in the operation of the equipment and in the hazards associated with the process, and their prevention.

**6.4.10** Instruction that the equipment shall be started and stopped in accordance with the manufacturer's written instructions.

**6.4.11** Instruction that the safety devices shall:

- Be effective or not rendered ineffective;
- Not be by-passed (see exception in 6.5.4).

**6.4.12** Instruction that the efficient operation of safety and control equipment shall be the responsibility of competent personnel, who shall be instructed to inform the supervisor of any hazards or faults which arise during the operation of the equipment.

**6.4.13** Instruction that if equipment is put out of action through the operation of a safety device, it shall only be put back into action after remedial action by authorised personnel.

**NOTE** A safety automatic system of supervision can be considered if special agreement has been made between the manufacturer and the user.

**6.4.14** Instruction that cut-off, regulating and measuring devices shall not be shut off or disconnected during a temporary shutdown of the equipment. The parts of equipment equipped with cooling and sealing water circulation shall be protected against frost.

Particular attention shall be paid to the build-up and the removal of encrustations at the prescribed maintenance/servicing intervals.

**6.4.15** Instructions that where it is not possible to avoid contact with hot elements, suitable protective clothing shall be used. This also applies where hot gases and vapours can exhaust, to hot workpieces during charging/discharging or where hot parts or fluids can be ejected (see also ISO 7243). Advice on medication to counter dehydration, etc. shall be given, if applicable. Troublesome and harmful draughts shall be avoided. The thermal stress and physiological effects of wearing specified protective clothing shall be considered.

**6.4.16** Instruction that for short duration work where shielding is impracticable (e.g. during component loading or unloading) operators shall be provided with appropriate eye protection.

**6.4.17** Instruction that electromagnetic fields, marked as such, shall not be entered by persons having heart pace makers or metallic implants or who are wearing metallic rings, bracelets etc.

**6.4.18** Recommendation that relevant extracts from the instruction handbook, produced in durable form and with an indication of their date of issue, should be displayed near the equipment control panel.

**6.4.19** Recommendation that a log should be kept to note any problems encountered, faults or incidents which occur and maintenance carried out under the responsibility of the user.

## **6.5 Instruction Handbook (Maintenance)**

The manufacturer shall supply a maintenance manual which gives information to the user on the methods to be used to comply with the following subclauses:

**6.5.1** The clear means for demonstrating the correct positioning of safety devices including clear identification of the components concerned.

NOTE When practicable, parts should be marked for identification

**6.5.2** In both routine and special maintenance operations the requirements of this part of this standard shall be adopted in order to ensure the proper and safe functioning of the equipment.

NOTE Maintenance operations can either be routine or special. Routine maintenance operations are normally carried out with the equipment in operation or shut down. Special maintenance operations are normally carried out with the equipment shut down. In the case of special maintenance operations auxiliary equipment can be retained in operation.

**6.5.3** The proper functioning of the safety devices shall be subject to a periodical inspection programme. The frequency of such inspections shall be defined at the design stage in accordance with the device type, its fragility, its reliability and its importance. They can be modified during the operation stage.

**6.5.4** Where the continuous nature of the process prevents the equipment being stopped when a fault condition occurs it can be necessary to bypass or override the safety measures detailed in clause 5 to allow maintenance, inspection and repair to be carried out. In this situation safe systems of work shall be used to give an equivalent level of safety. Special emphasis shall be given to the need for the use of trained personnel and the requirements for training.

**6.5.5** The safety, regulating and measuring devices shall be subject to periodic inspection and if necessary, adjusted, serviced or replaced to ensure their continued efficient operation and suitability for service. In particular the calibration of the devices and their efficiencies shall be checked by means of periodical test operations at frequencies detailed by the manufacturer. Such checks shall also be carried out after modifications or maintenance of the equipment. The results should be recorded.

**6.5.6** A periodic inspection and maintenance programme, carried out at the frequency detailed by the manufacturer, shall be established to verify that the equipment continues to perform efficiently for thermal, electrical and mechanical performance conditions as well as for proper functioning of any components.

**6.5.7** The periodic inspection and maintenance programmes shall be performed by competent and trained persons.

If, during one of these inspections, a faulty or ineffective safety device is discovered, then the equipment shall be made safe or be shut down until the proper functioning of the safety device has been restored or the safety device has been replaced or serviced (see also 6.5.4).

**6.5.8** Essential maintenance operations carried out in hazardous areas such as

- Working in gas-danger areas;
- Working on or in gas pipes;
- Welding in confined spaces;
- Cleaning waste gas systems;
- Working in access channels or confined spaces

shall be carried out by competent and trained persons who fully understand the risks involved. In such case a second person shall be present and they shall maintain close communication during the operation concerned.

Essential maintenance operations carried out in hazardous areas shall be authorised and performed in accordance with a PERMIT-TO-WORK Certificate. A typical PERMIT-TO-WORK certificate is shown in Annex C.

**6.5.9** The sequence logic of the interlocked automated devices and in particular the modes of the ignition and cut-off functions shall be verified before every maintenance operation and at the frequency detailed by the manufacturer in the maintenance manual.

**6.5.10** The maintenance of the equipment and of any insulation or baffles provided for noise reduction shall be carried out in accordance with the maintenance and servicing instructions.

**6.5.11** The instructions concerning periodical sampling of thermal fluids, in particular to control humidity and oxygen content, shall be provided.

**6.5.12** Before purging, the ducts of liquid and gaseous fuels shall be safely blanked off, e.g. by blind flange etc. The atmosphere in ducts and combustion chambers shall be rendered inert. On continuous shut-down branches shall be blanked off from the operating system, e.g. by blind flange, or removed.

The solid fuel supply hoppers shall be closed and the duct shall be empty and clean.

**6.5.13** The maintenance of vent system and their detecting instruments (if applicable) shall be carried out together with periodic sampling of the working environment (if applicable). Adequate room air changes shall be provided.

The manufacturer shall specify any devices or instruments to be provided by the user which are considered necessary to detect and warn of hazardous environmental conditions.

**NOTE** The user is responsible for operations which involve dismantling, the taking down of parts for major repairs or modifications, repairing the furnace walls, demolition and the complete removal of the equipment ensure the safety of bystanders and the environment.

When major works are involved a supervisor should be responsible for coordinating the work of the persons carrying out the contract, to ensure the safety of all personnel in the area. The work should be programmed if applicable.

## **6.6 Instruction handbook (De-commissioning)**

The manufacturer shall provide de-commissioning instructions, which identify the risks. The manufacturer shall indicate procedures and measures to be carried out (e.g. purge, use of personal protective equipment and/or special devices or area delineations).



<u>2. in Glass Making Plant for</u>	
Melting	EN 746-2 <sup>1)</sup> , prEN 746-6
Cooling	EN 746-2 <sup>1)</sup>
Decorating	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup> , prEN 1539
Heat Treatment	EN 746-2 <sup>1)</sup>
<u>3. in Ceramic Manufacturing Plant for</u>	
Dewaxing	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Drying	EN 746-2 <sup>1)</sup>
Heating	EN 746-2 <sup>1)</sup>
Annealing	EN 746-2 <sup>1)</sup>
Sintering	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Firing	EN 746-2 <sup>1)</sup> , 3 <sup>1)</sup>
Decorating	EN 746-2 <sup>1)</sup> , prEN 1539 <sup>1)</sup>
<u>4. in Cement, Lime and Gypsum Manufacturing Plant for</u>	
Calcining	EN 746-2, (WI 151 022) <sup>2)</sup>
Firing	EN 746-2, (WI 151 022) <sup>2)</sup>
Heating	EN 746-2, (WI 151 022) <sup>2)</sup>
Cooling	EN 746-2, (WI 151 022) <sup>2)</sup>
<u>5. in Chemical/Petrochemical Plant for</u>	
Calcining	EN 746-2 <sup>1)</sup>
Distillation	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Drying	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Endoth./Exoth. gas production	EN 746-2 <sup>1)</sup> , 3
Gasifying	EN 746-2 <sup>1)</sup>
Impregnating	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Liquefying	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Polimerization	EN 746-2 <sup>1)</sup>
Pyrolizing	EN 746-2
Reaction	EN 746-2 <sup>1)</sup>
Reforming, cracking	EN 746-2 <sup>1)</sup>
Sintering	EN 746-2 <sup>1)</sup>
Melting	EN 746-2 <sup>1)</sup> , prEN 746-6
Vulcanising, curing	EN 746-2 <sup>1)</sup> , $\boxed{A_1}$ EN 746-5 $\boxed{A_1}$ <sup>1)</sup>
<u>6. in Waste Incineration Equipment for</u>	
Incineration of domestic refuse, sewage, sludge, refuse derived fuel, industrial and special waste (such as toxic)	EN 746-2
Pyrolizing	EN 746-2
Gasifying	EN 746-2
<u>7. in other industries for</u>	
Drying paper, printings	EN 746-2 <sup>1)</sup> , prEN 1539 <sup>1)</sup>
Drying granular	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Drying textiles	EN 746-2 <sup>1)</sup> , prEN 31111
Drying wood	EN 746-2 <sup>1)</sup> , prEN 746-7 <sup>1)</sup>
Reclaiming used foundry sands	EN 746-2

---

2) A standard is being prepared by CEN/TC 151 under the work item WI 151 011.

Annex B  
(informative)

Typical test report (as described in 6.3.10)

This report should:

- Contain adequate description of tests and actions carried out, indication of standards and guides employed and of the results obtained;
- Be countersigned by attending persons and by contractors' parties.

The test mode should be agreed between parties, preferably in the ordering stage and as far as possible in accordance with this standard and to the guarantee terms

TEST REPORT				
Company				
Works of				
Tested equipment				
Mod/Type				
Serial No. ....				
Construction Year				
Name plate data				
Equipment (Listing):				
Accessories and their characteristics				
Start time of test of.....				
(specify test object)				
of.....(date)				
in accordance with Standards (List and specify				
section, chapter, clause)				
Testing methods (specify)				
Employed instrumentation:				
calibration of the .....(date)				
Measurement conditions				
RESULTS				
Tested characteristic or device examined	Expected value	Measured value	Contract tolerance	Deviation STD
.....	.....	.....	.....	.....
Note: Specify possible difficulties or disturbing cause.				
Final observations.....				
List of attending persons and their representatives				
Undersigning, place and date				

## Annex C (informative)

### PERMIT to work certificate (as described in 6.5.8)

Entering/Working into confined spaces (Containers, tanks, pits, ducts)

1 Order

Object : .....

Register no. : ..... Building ..... Department .....

Size (m<sup>3</sup>) : ..... Content .....

Entry into this equipment will be authorised for the purpose of  
INSPECTION/CLEANING/REPAIR/MODIFICATION/DISMANTLING/REVISION within approved time on  
condition that the safety measures in accordance with clause 5 and 6 have been carried out prior to start.

Maintenance-/Repair order has been submitted.

Date:.....

(Signature/authorised person)

2	<u>The following safety measures are to be carried out prior to work:</u>	Yes	No
2.1	Clear confined space	0	0
2.2	Clean empty confined space	0	0
	Rinsing:.....hours using.....hot/cold.....times		
	Purging:.....hours using AIR/STEAM/NITROGEN/CO <sub>2</sub> .....times		
	.....		
2.3	Disconnect other devices and pipework by	0	0
	* Removal of joint elements/pressure equilisation		
	* Blanking off connections		
	* Closing of isolating valves/Display of warning signs		
	* .....		
2.4	De-energise drives and electrical connections and secure against restarting by fitting the appropriate signs at fuses/switches, locking switches in 'CLOSE'-position, removal of	0	0
	.....		
2.5	Call for a fire attendant (for works like welding, oxyacetylene cutting etc.)	0	0
2.5.1	Application form for fire attendant is attached to this Certificate		0
2.6	Continuous oxygen measurement (required ca. 21%)	0	0
2.7	Continuous CO-measurement (required less than 50 ppm)	0	0
2.8	Analysing air constituents. Analysis being attached to this Certificate	0	0
2.9	Other safety measurements: .....	0	0
3	<u>During work the following safety measures must be applied to:</u>		
3.1	Wearing protective clothes:	0	0
	* Protective goggles (Normal-/Heat radiation-/Acid-Type), rubber boots, protective shoes (electrostatically conducting, acid proof), protective gloves, helmet, acid protective harness, welding protective harness		
	* .....		
3.2	Use appropriate breathing apparatus. The Fire Brigade determined which type of breathing apparatus must be used. The use of heavy breathing apparatus is only permitted under supervision of the Fire Brigade and is restricted to trained persons proved to be fit for use by medical examination.	0	0

3.3	Electrical lamps and appliances: Low voltage/Protective transformer/explosion-proof	0	0
3.4	Use of spark avoiding tools (copper-beryllium)	0	0
3.5	Provide adequate ventilation: Fresh air by suction/forced flow/utilizing natural draft	0	0
3.6	Use of ladder for entry/Plastic ladder/Integrated ladder/.....	0	0
3.7	Use life belt and life line	0	0
3.8	Observation by fire attendant with/without prepared breathing apparatus	0	0
3.9	Keep fire fighting equipment ready for use (responsible Fire Brigade). Dry chemical extinguisher/CO <sub>2</sub> -extinguisher/hose-system	0	0
3.10	Keep working area wet	0	0
3.11	Further safety measures	0	0

Distributors:	Checked and authorised for the following time: from:.....to:.....	The safety measures laid down have been carried out.
	          ..... (Signature/Department)      Signature/wkg-group)	The operation and the wearing of personal protective clothes will be supervised.  (to be signed only shortly before work is being started.)



## Annex D (informative)

### Used Definitions

Trilingual index

#### D.1 English, German, French

Ref.	English	German	French
3.4	Cement, lime and gypsum manufacturing plant	Zement-, Kalk-und Gipswerk	Usine de production de ciment, de chaux et de plâtre
3.3	Ceramic manufacturing plant	Keramikwerk	Usine de fabrication de produits céramiques
3.5	Chemical plant	Chemiewerk	Usine chimique
3.8	Cooling equipment	Kühlanlage	Équipement de refroidissement
3.7	Drying equipment	Trocknungsanlage	Équipement de séchage
3.2	Glass making plant	Glashüttenwerk	Verrerie
3.1	Metallurgical and metal working plant	Metallerzeugende und-verarbeitende Werke	Usines métallurgiques et de travail des métaux
3.6	Waste incineration equipment	Abfallverbrennungsanlage	Équipement d'incinération de déchets

**D.2 German, English, French**

Ref.	German	English	French
3.6	Abfallverbrennungsanlage	Waste incineration equipment	Equipement d'incinération de déchets
3.5	Chemiewerk	Chemical plant	Usine chimique
3.2	Glashüttenwerk	Glass making plant	Verrerie
3.3	Keramikwerk	Ceramic manufacturing plant	Usine de fabrication de produits céramiques
3.8	Kühlanlage	Cooling equipment	Equipement de refroidissement
3.1	Metallerzeugende und-verarbeitende Werke	Metallurgical and metal working plant	Usines métallurgiques et de travail des métaux
3.7	Trocknungsanlage	Drying equipment	Equipement de séchage
3.4	Zement-, Kalk-und Gipswerk	Cement, lime and gypsum manufacturing plant	Uusine de production de ciment, de chaux et de plâtre

### D.3 French, German, English


Ref.	French	German	English
3.6	Equipement d'incinération de déchets	Abfallverbrennungsanlage	Waste incineration equipment
3.8	Equipement de refroidissement	Kühlanlage	Cooling equipment
3.7	Equipement de séchage	Trocknungsanlage	Drying equipment
3.1	Usines métallurgiques et de travail des métaux	Metallerzeugende und-verarbeitende Werke	Metallurgical and metal working plant
3.5	Usine chimique	Chemiewerk	Chemical plant
3.3	Usine de fabrication de produits céramiques	Keramikwerk	Ceramic manufacturing plant
3.4	Usine de production de ciment, de chaux et de plâtre	Zement-, Kalk-und Gipswerk	Cement, lime and gypsum manufacturing plant
3.2	Verrerie	Glashüttenwerk	Glass making plant

## **Annex ZA** (informative)

### **Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC**

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by Directive 98/79/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements, except Essential Requirement 2.1, of that Directive and associated EFTA regulations.

**WARNING —** Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard. 

## Annex ZB (informative)

### **A1** Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements, except Essential Requirement 2.1 of that Directive and associated EFTA regulations.

**WARNING** — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard. **A1**