



**SLOVENSKI STANDARD**  
**SIST EN 746-5:2001**  
**01-junij-2001**

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**Industrial thermoprocessing equipment - Part 5: Particular safety requirements for salt bath thermoprocessing equipment**

Industrial thermoprocessing equipment - Part 5: Particular safety requirements for salt bath thermoprocessing equipment

Industrielle Thermoprozeßanlagen - Teil 5: Besondere Sicherheitsanforderungen an Salzbad-Wärmebehandlungseinrichtungen und -anlagen

Equipements thermiques industriels - Partie 5: Prescriptions particulieres de sécurité pour les équipements thermiques a bain de sel

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English version

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Prescriptions particulières de sécurité pour les  
équipements thermiques à bain de sel

Industrielle Thermoprozeßanlagen - Teil 5: Besondere  
Sicherheitsanforderungen an Salzbad-  
Wärmebehandlungseinrichtungen und -anlagen

This European Standard was approved by CEN on 22 November 1999.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

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## FOREWORD

This European Standard 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of an identical text or by endorsement, at the latest by March 2001, and conflicting national standards shall be withdrawn at the latest by March 2001.

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).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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

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

This standard forms one part of a series safety standards covering 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

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

The annexes A and ZA are informative.

## 0 INTRODUCTION

The EN 746-1 General Safety Requirements contains the common safety provisions and devices for all types of industrial thermoprocessing equipment. This part of the standard details in addition those extra safety requirements which need special attention against the equipment listed in the scope.

This European Standard is a type C standard as defined in EN 292:1991.

The extent to which hazards are covered is indicated in the scope of this standard.

## 1 SCOPE

This part of EN 746 gives the specific hazards and safety requirements for the melting and use of molten salt that shall be provided by the manufacturer for Salt Bath Industrial Thermoprocessing Equipment, whether it is used as an independent unit or an integrated part of a plant. The limits of the equipment will include any transportation equipment which is located wholly or partially in the bath.

This part of EN 746 does not cover the handling, storage, transport, disposal, transfer or regeneration of the salts and processed material outside the limits of the equipment.

This part of EN 746 applies not only to the normal operation of the equipment but also to the safety of personnel and property when foreseeable faults occur.

Examples of salt bath furnace set-ups are shown in Fig. 1, Fig. 2, Fig. 3 and Fig. 4.

NOTE: There are many variations in the design of salt bath equipment. Only three examples of the various types are given in this text.

## 2 NORMATIVE REFERENCES

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

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EN 166	Personal eye-protection - Specifications
EN 292-1:1991	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
EN 292-2:1991	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications

- EN 345 Specification for safety footwear for professional use
- EN 346 Specification for protective footwear for professional use
- EN 469 Protective clothing for firefighters - Requirements and test methods for protective clothing for firefighting
- EN 531 Protective clothing for industrial workers exposed to heat (excluding fire fighters' and welders' clothing)
- EN 563 Safety of machinery - Temperatures of touchable surfaces - Ergonomics data to establish temperature limit values for hot surfaces
- EN 614-1 Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
- EN 746-1:1997 Industrial Thermoprocessing Equipment - Part 1: Common Safety Requirements for Industrial Thermoprocessing Equipment
- EN 746-2:1997 Industrial Thermoprocessing Equipment - Part 2: Safety Requirements for Combustion and Fuel Handling Systems
- EN 746-8:2000 Industrial Thermoprocessing Equipment – Part 8: Particular Safety Requirements for Quenching Equipment
- EN 953 Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards
- EN 954-1 Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
- prEN 1005-2:1998 Safety of machinery - Human physical performance Part 2: Manual handling of machinery and component parts of machinery
- prEN 1005-3:1998 Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation
- EN 1070 Safety of machinery - Terminology
- EN 1093-4 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 4: Capture efficiency of an exhaust system - Tracer method
- EN 10095 Heat resisting steels and alloys



EN 61310-1 Safety of machinery - Indication, marking and actuation -  
Part 1: Requirements for visual, auditory and tactile signals  
(IEC 61310-1:1995)

### 3 DEFINITIONS

For the purposes of this standard the definitions given in EN 1070 apply.

Additional definitions specifically needed for this part of this standard are added below:

#### 3.1 Salt Bath Thermoprocessing Equipment

Equipment which melts and/or contains various molten salt or salt mixtures into which workpieces are partially or fully immersed for a predetermined time interval in order to modify the structure and/or the physical properties of the workpiece, or in which salt is circulated as a heat transfer system.

The equipment includes the unit for melting salt plus that handling equipment used immediately in the vicinity to treat either single or multiple components:

This equipment may include for example:

- mechanical handling systems;
- heating systems;
- cooling systems;
- environmental control systems;
- electrical and control systems;
- systems to cover ergonomic requirements and
- washing and agitating systems.

#### 3.2 Components

Workpieces or any other object immersed in the salt bath.

### 4 LIST OF HAZARDS

An assessment of the foreseeable risks arising from the use of the industrial thermoprocessing equipment has been carried out when this standard was elaborated.

The clause has been condensed into a table (see table 1). It summarises those areas which require consideration by the manufacturer. For ease of reference the table indicates the need for safety features or instructions in columns. The table shall only be used in conjunction with clauses 5 and 7 where further detail is given.

Table 1 shows the Hazard, Hazardous Situation, Preventative Measures and the Verification Means (as pointed out in clause 6) identified for the equipment type described in this part to this standard.



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

1 Item	2 Hazard	3 Hazardous situations	4 Preventative measures	5 Re- ferences	6 Verifi- cation means <sup>*)</sup>
<b>1</b>	<b>Mechanical</b>				
1.1	Crushing/ Shearing/ Entangle- ment	Mechanical handling system - lift - continuous metal conveyor belt - continuous feeding equipment for wire/strip	For all cases, fit fixed guard or provide protective fence and interlocking or light beam to prevent unauthorised entry to danger zone.	EN 746-1:1997, 2.2/2.3 and 2.4 EN 292-2:1991, 4.1.2, 4.2.2.2 EN 292-1:1991, 3.22.1	1 1 1
1.2	Slip/Trip	- floor surface - walkway - spilled fluids (e.g. water/salt)	Provide non-slip surfaces and/or checkered plate/wire mesh walkway surfaces.  Ensure that information for use contains advice on good housekeeping	EN 746-1:1997, 5.2.11	1 1 1 1
1.3	Falls	- into bath - onto equipment	Fit protective fencing	5.4	1
1.4	Drawing-in	- strip processing equipment - washing and agitating system	For both cases, fit fixed guard or provide protective fence and/or interlocking or light beam to prevent unauthorised entry to danger zone.	EN 746-1:1997, 2.2/2.3 and 2.4 EN 292-2:1991, 4.1.2, 4.2.2.2 EN 292-1:1991, 3.22.1	1 1
1.5		Breakage of fastening points of pot or tank during transportation  Injury to persons	Design to give adequate strength and corrosion resistance	5.9 7.2.9	1 and 3
<b>2</b>	<b>Thermal</b>				
2.1		High pressure liquid injected into molten salt	Use electric or pneumatic systems wherever possible  Avoid use of hydraulic systems near the molten salt	5.2 5.6	1  1
2.2		Molten salt break-through due to the loss of stability of metal or ceramic pot or tank	Design furnace either to prevent molten salt flowing out of the casing or to convey the molten salt to a no danger zone	5.3	1 and 2

(continued)

<sup>\*)</sup> see Note to clause 6 for explanation of numbers

**Table 1: (continued)**

1 Item	2 Hazard	3 Hazardous situations	4 Preventative measures	5 Re- ferences	6 Verifi- cation means <sup>*)</sup>
2.3		Breakage of thermocouple protection tubes	Design for effective safe shut down	5.10	1 and 3
2.4		Breakage or leakage in cooling systems	Prevent cooling system blockage.  Preferably use external cooling.  Preferably use air cooling  Do not use internal cooling with liquids above 250 °C bath temperature.  In closed cooling systems set safety device to avoid overpressure.	5.2 5.5	1 and 2  1  1  1 and 2  1 and 2
2.5		Foreign liquids entering the molten salt	Process parts/tools to be dry.  Refill with dry salts.  Prevent drips of water into bath.  Protective equipment to be used.	5.2 5.6 7.2	1  1  1 and 2  1
2.6		Components with closed hollows or tube-like components immersed in molten salt  Poorly designed workpiece supports can trap salt and cause explosions	Do not immerse closed hollow or tube like components in salt bath or design such components to have sufficient strength to prevent bursting.  Design of workpiece supports	7.2.7  5.12	1  1 and 2
2.7		Persons falling into bath	Provision of guards  Design of enclosure  Use covers	5.4 7.2.11	1  1  1
2.8		Contact by person with hot cooling fluid	Protect outlets	5.5	1

(continued)

<sup>\*)</sup> see Note to clause 6 for explanation of numbers

**Table 1: (concluded)**

1 Item	2 Hazard	3 Hazardous situations	4 Preventative measures	5 Re- ferences	6 Verifi- cation means <sup>*)</sup>
2.9		Salt splashing	Design of agitator system  Handling of components/tools  Protective equipment	5.6 7.2.2	3  1  1
2.10		Pressure build-up during remelting after solidification of salt bath surface	Design of heating system  Instruction handbook  Maintenance of the salt bath	5.11 7.2.8	1 and 2  1  1
2.11		Overheating of bath	Design of salt bath equipment	5.7	1 and 2
<b>3</b>	<b>Materials and Substances</b>				
3.1		Inhalation of fumes, dusts and gases emitted from salt	Design effective exhaust system	5.8	1 and 3
<b>4</b>	<b>Neglecting ergonomic principles</b>				
4.1		Unhealthy posture or excessive efforts causing impaired judgement or poor visibility during charging or discharging	The equipment shall be designed in such a way that there is no hindrance to technical aids and possibility for good working postures	5.13	1

## 5 SAFETY REQUIREMENTS AND/OR MEASURES

### 5.1 General

The manufacturer of the equipment shall be required to meet the conditions detailed in this part to this standard.

See EN 746-1 and EN 746-2 for general safety requirements relating to Thermoprocessing Equipment.

Machinery shall comply with the provisions of this clause. They also shall comply with EN 292:1991 for hazards which are relevant but not significant and which are not covered by this standard.

In addition equipment shall comply as appropriate, with other relevant parts of this standard listed in clause 2 (e.g. EN 746-8:2000) as well as with EN 292:1991 for hazards which are not covered in these standards.

<sup>\*)</sup> see Note to clause 6 for explanation of numbers