



SLOVENSKI STANDARD
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Stroji za predelavo gume in plastike - Stroji za toplotno oblikovanje - Varnostne zahteve

Plastics and rubber machines - Thermoforming machines - Safety requirements

Kunststoff- und Gummimaschinen - Warmformmaschinen - Sicherheitsanforderungen

Machines pour les matières plastiques et le caoutchouc - Machines de thermoformage - Prescriptions de sécurité

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Plastics and rubber machines - Thermoforming machines - Safety requirements

Machines pour les matières plastiques et le caoutchouc -
Machines de thermoformage - Prescriptions de sécurité

Kunststoff- und Gummimaschinen - Warmformmaschinen -
Sicherheitsanforderungen

This European Standard was approved by CEN on 24 August 2008.

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EN 12409:2008 (E)**Foreword**

This document (EN 12409:2008) has been prepared by Technical Committee CEN/TC 145 "Plastics and rubber machines", the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

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 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

For relationship with EC Directive(s), see informative Annex ZA and B, which are an integral part of this document.

This document supersedes EN 12409:1999.

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 the United Kingdom.

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Introduction

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

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

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

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EN 12409:2008 (E)**1 Scope**

This European Standard deals with all significant hazards, hazardous situations and events relevant to thermoforming machines for continuous sheet and single sheets of thermoplastics materials, when they are used as intended and under conditions of misuse which are foreseeable by the manufacturer (see Clause 4).

A thermoforming machine may consist of a forming unit or a forming unit linked to one or more additional units. This standard covers the following units:

- continuous sheet unwind unit;
- single sheet feed unit;
- material intake;
- conveying equipment;
- heating unit;
- preheating unit;
- edge heating unit;
- component feeding/inserting unit;
- forming station;
- finishing station;
- stacking station;
- discharge station;
- residual sheet winding unit;
- sheet cutting unit.

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This European standard does not apply to units mounted upstream or downstream of the thermoforming machine:

- which have a separate control system; and/or
- are located separately.

NOTE 1 This European Standard specifies requirements for machines supplied as a single forming unit or a number of units designed to operate as a single machine. Additional units that may be introduced at a later stage should be considered separately applying relevant standards and taking into account any hazards arising through their interaction with the thermoforming machine.

This European Standard does not apply to units which are integrated into form, fill and seal machines. These are covered in EN 415-3:1999.

This European standard does not apply to units which incorporate heating systems which are fuelled by gas.

NOTE 2 Thermoforming machines generally do not create explosive atmospheres. In principle they therefore correspond with line F of Table 2 of the ATEX Guideline and consequently do not fall within the scope of Directive 94/9/EC.

This European Standard is not applicable to thermoforming machines which are manufactured before the date of its publication as EN.

2 Normative references

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.

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

EN 574:1996, *Safety of machinery — Two-hand control devices — Functional aspects — Principles for design*

EN 614-1:2006, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 626-1:1994, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principals and specifications for machinery manufacturers*

EN 953:1997, *Safety of Machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 982:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

EN 999:1998, *Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body*

EN 1037:1995, *Safety of machinery — Prevention of unexpected start-up*

EN 1088:1995, *Safety of machinery — Interlocking devices associated with guards — Principals for design and selection*

EN 1760-1:1997, *Safety of machinery — Pressure sensitive protective devices — Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61496-1:2004, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2004, modified)*

EN ISO 3744:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)*

EN ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

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EN ISO 11201:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)*

EN ISO 11204:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Method requiring environmental corrections (ISO 11204:1995)*

EN ISO 11688-1:1998, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

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

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

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

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

EN ISO 13850:2006, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

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

EN ISO 14122-1:2001, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels (ISO 14122-1:2001)*

EN ISO 14122-2:2001, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3:2001, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

EN ISO 14122-4:2004, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2004)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003 and the following apply.

3.1 thermoforming machine

machine which renders thermoplastic sheet material formable, by heating, and deforms it either by using vacuum or compressed air with or without the use of a stretching aid, for example, a stretching punch

3.2 continuous sheet unwind unit

unit where a continuous sheet roll is clamped and unwound as required by the manufacturing process

3.3 sheet roll

continuous sheet wound on a core with or without an integral shaft

3.4**single sheet feed unit**

unit which consists of a single sheet magazine and a handling device that picks up sheets individually and feeds them into the material intake of the thermoforming machine

3.5**material intake**

unit where the orientation and guidance of continuous sheet or single sheets takes place before being grasped by conveying equipment

3.6**conveying equipment**

device equipped with spikes or clamps, which conveys continuous sheet, or single sheets, in cycles, between various units of a thermoforming machine

EXAMPLE Chain conveyor.

3.7**heating unit**

device which heats the thermoplastic material prior to forming

EXAMPLE Heating radiators, contact heating plates, contact heating rolls or hot air installations.

NOTE The heating may be integrated into the forming station.

3.8**pre-heating unit**

device which heats the thermoplastic material upstream of the heating system

EXAMPLE Heating radiators, contact heating plates, contact heating rolls or hot air installations.

3.9**edge heating unit**

device which heats the edges of the continuous sheet or single sheets before they are grasped by the conveying equipment

EXAMPLE Radiators, contact heating plates or hot air installations.

3.10**component feeding/inserting unit**

device for feeding/inserting components other than sheet material

3.11**forming station**

unit where thermoplastic continuous sheet or single sheets are formed and that includes all devices which:

- actuate closing, clamping and opening of moulds;
- serve as forming aids, e. g. stretching punches, pre blow boxes etc.;
- locate or clamp thermoplastic sheet during the forming process

3.12**mould**

component in which the continuous sheet or a single sheet is formed

3.13**stretching punch**

mechanical aid to support the forming process

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EN 12409:2008 (E)**3.14****clamping frame**

frame clamping the continuous sheet or single sheet at the edges during the forming process

3.15**platen**

part of the machine to which a mould is fixed

3.16**ejector**

device used to push the finished formed parts out of the mould

3.17**finishing station**

one or more units where formed parts are punched, cut out, locally formed e. g. rim rolled, or mechanically worked using a tool

NOTE The finishing station may be combined with the forming station.

3.18**stacking station**

unit where formed or cut-out parts are stacked to form larger units prior to removal from the machine

3.19**stacking cage**

device receiving and stacking the finished parts

3.20**stacking loader**

device pressing the finished parts into the stacking cage

3.21**stacking unloader**

device pushing the finished and stacked formed parts out of the stacking cage

3.22**discharge station**

zone where formed sheet or formed parts, either individually or in larger units, are discharged from the thermoforming machine

3.23**residual sheet winding unit**

unit where residual sheet, from the finishing station, is wound up

3.24**sheet cutting unit**

guillotine or other cutting device which cuts sheet in the longitudinal or transverse direction

NOTE Sheet may, for example, be cut either before or after the forming station, so as to split formed parts, or after the finishing station, so as to improve scrap handling.

3.25**whole body access**

access where there is sufficient space for an operator to remain in an enclosed area with interlocked guards closed and/or other protective devices initiated to prevent access

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3.26**acknowledge switch**

manually operated switching mechanism, e. g. a key switch, by which the control system is informed, after the opening and closing of guards and/or the actuation of other protective devices, that a danger zone where whole body access is possible is clear before the machine can be started

3.27**cyclic manual intervention**

intervention by the operator during each working cycle

3.28**non-cyclic manual intervention**

intervention which occurs only occasionally during the machine operation, e. g. intervention for machine adjustment during continuous operation in automatic mode

4 List of significant hazards**4.1 General**

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

4.2 Hazards relating to all units

NOTE Hazards and danger zones specific to individual units are described in 4.3.

4.2.1 Mechanical hazards

Crushing, shearing, impact, drawing-in or trapping hazards by dangerous movements of machine parts, for example, platen, dies, clamping frames, drive and power transmission systems.

4.2.2 Hazards due to electrical energy

Hazards due to electrical shock or burns caused by direct or indirect contact with live parts.

4.2.3 Hazards due to failure/malfunction of the control system

Crushing, shearing, impact, drawing-in or trapping hazards due to unexpected movements, unexpected start-up (see also 4.2.12) or continuing operation.

4.2.4 Hazards resulting from failure of an energy supply

Crushing, shearing, impact, drawing-in or trapping hazards due to sudden fall of raised parts due to gravity, for example sheet roll, platen, clamping frame or stacking unit.

4.2.5 Hazards due to failure/malfunction of pneumatic equipment

- Impact hazards due to whiplash of hoses resulting from fracture of flexible hoses.
- Impact, crushing shearing, drawing-in or trapping hazards resulting from unexpected movement of machine parts.