

Rubber and plastics machines — Thermoforming machines — Safety requirements

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ICS 83.200

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Rubber and plastics machines – Thermoforming machines – Safety requirements

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

Gummi- und Kunststoffmaschinen – Warmformmaschinen –
Sicherheitsanforderungen

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 145 "Rubber and plastics machines - Safety", 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of an identical text or by endorsement, at the latest by March 2000, and conflicting national standards shall be withdrawn at the latest by March 2000.

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.

0 INTRODUCTION

This European Standard is a "C" standard, as defined in EN 292-1.

The extent to which hazards are covered is indicated in the scope of this standard. In addition machinery shall comply as appropriate with EN 292 for hazards which are not covered by this standard.

1. SCOPE

This standard specifies the essential safety requirements for the design and construction of thermoforming machines, for continuous sheet and single sheets, of all types. Significant hazards are listed in clause 4 and specific safety requirements and/or measures are listed in clause 5.

A thermoforming machine may consist of one or more units linked together. 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
- forming station
- finishing station
- stacking station
- discharge station
- residual sheet winding unit
- sheet cutting unit.

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

- which have a separate control and/or
- are located separately and/or
- have their own material intake

This standard does not apply to units which are integrated into form, fill and seal machines. These are covered in prEN 415-3:1996.

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

This standard applies to machines which are manufactured after the date of approval by CEN.

2 NORMATIVE REFERENCES

This European Standard includes by dated or undated reference provisions from other publications. These normative references are quoted 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.

EN 292-1: 1991	Safety of machinery Basic concepts, general principles for design Part 1: Basic terminology, methodology
EN 292-2: 1991 +A1: 1995	Safety of machinery Basic concepts, general principles for design Part 2: Technical principles and specifications
EN 294: 1992	Safety of machinery Safety distances to prevent danger zones being reached by the upper limbs
EN 349: 1993	Safety of machinery Minimum gaps to avoid crushing of parts of the human body
prEN 415-3:1996	Safety of Packaging machines - Part 3: Form, fill and seal machines; safety requirements
EN 418: 1992	Safety of machinery Emergency stop equipment, functional aspects Principles for design
EN 563: 1994	Safety of machinery, Temperatures of touchable surfaces, - Ergonomics data to establish temperature limit values for hot surfaces
EN 574:1996	Safety of machinery Two-hand control devices - Functional aspects - Principles for design

EN 614-1: 1995	Safety of Machinery, Ergonomic Principles for Design Part 1: Definitions 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 811:1996	Safety of Machinery - Safety distances to prevent danger zones being reached by the lower limbs
EN 953:1997	Safety of Machinery - Guards - General requirements for the design and construction of fixed and movable guards
EN 954-1:1996	Safety of Machinery - Safety related parts of control systems - Part 1: General principles for design
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 60204-1: 1997	Safety of Machinery - Electrical equipment of machines - Part 1: General requirements - (IEC 204-1:1992, modified)
EN 60529:1991	Degrees of protection provided by enclosures (IP-Code)
EN 61496-1:1997	Safety of Machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests
EN ISO 3744:1995	Acoustics: Determination of sound power levels of noise sources; Engineering methods for free-field conditions over a reflecting plane. (ISO 3744:1994)

EN ISO 11201:1995 Acoustics; Noise emitted by machinery and equipment; Measurement of emission sound pressure levels at the workstation 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 the workstation and 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

3. DEFINITIONS

For the purposes of this standard, the following definitions apply:

- 3.1 thermoforming machine:** A machine which renders thermoplastic sheet material formable, by heating, and deforms it either by using vacuum or compressed air or any other stretching aid.
- 3.2 continuous sheet unwind unit:** A unit where a continuous sheet roll is clamped and unwound as required by the manufacturing process.
- 3.3 sheet roll:** Continuous sheet wound onto a core.
- 3.4 single sheet feed unit:** A unit which consists of a single sheet magazine and a handling device. The handling device removes sheets individually and feeds them into the material intake of the thermoforming machine.
- 3.5 material intake:** A unit where the orientation and guidance of continuous sheet or single sheets takes place before being grasped by conveying equipment.
- 3.6 conveying equipment:** A device which conveys continuous sheet, or single sheets, in cycles, between various units of a thermoforming machine. A thermoforming machine may include one or more conveying devices.
- 3.7 heating unit:** A device which heats the thermoplastic material prior to forming. The heating may be integrated into the forming station.

The device may consist, for example, of:

- heating radiators
- contact heating plates
- contact heating rolls
- hot air installations

3.8 pre-heating unit: A device which heats the thermoplastic material upstream of the heating system.

The device may consist, for example, of:

- heating radiators
- contact heating plates
- contact heating rolls
- hot air installations

3.9 edge heating unit: A device which heats the edges of the continuous sheet or single sheets before they are grasped by the conveying equipment.

The device may consist, for example, of:

- heating radiators
- contact heating plates
- hot air installations

3.10 forming station: The unit where thermoplastic continuous sheet or single sheets are formed.

This 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
- feed additional parts into the forming station, e. g. labels or inserts

3.11 mould: The mould in which the continuous sheet or a single sheet get their final shape.

3.12 stretching punches: A mechanical aid to support the forming process.

3.13 clamping frame: A frame clamping the continuous sheet or single sheet at the edges during the forming process.

3.14 platen: A part of the machine to which a mould is fixed.

3.15 ejector: A device used to push the finished formed parts out of the mould.

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

3.17 stacking station: A unit where formed or cut-out parts are stacked to form larger units prior to removal from the machine.

3.18 stacking cages: A device receiving and stacking the finished parts.

3.19 stacking pusher: A device pressing the finished parts into the stacking cage.

3.20 stacking slides: A device pushing the finished and stacked formed parts out of the stacking cage.

- 3.21 discharge station:** A zone where formed sheet or formed parts, either individually or in larger units, are discharged from the thermoforming machine.
- 3.22 residual sheet winding unit:** A unit where residual sheet, from the finishing station, is wound up.
- 3.23 sheet cutting unit:** Guillotine or other cutting device which cuts sheet in the longitudinal or transverse direction. Sheet may, for example, be cut:
- before or after the forming station, so as to split formed parts
 - after the finishing station, so as to improve scrap handling
- 3.24 acknowledge switch:** A manually operated switching mechanism e.g. a key switch, by which the control system is informed, after the opening and closing of guards, that a danger zone where whole body access is possible, is clear.
- 3.25 cyclic manual intervention:** Intervention in each working cycle.
- 3.26 non-cyclic manual intervention:** Intervention which occurs only occasionally during the machine operation.

4. HAZARDS AND DANGER ZONES

4.1 Hazards and danger zones relating to all units

NOTE : Hazards and danger zones specific to individual units are described in 4.2.

4.1.1 General hazards and danger zones

4.1.1.1 Hazards resulting from access to danger zones.

4.1.1.2 Hazards resulting from access to danger zones required for process reasons

4.1.1.3 Hazards resulting from whole body access behind guards

4.1.1.4 Hazards resulting from drive and power transmission systems

Crushing, shearing, impact, drawing in or trapping by dangerous movements of the power transmission system, for example, shafts, belts, chains, bars, levers, clutches and gears.

4.1.2 Hazards due to electrical energy

Electrical shock or burns caused by direct or indirect contact with live parts.

4.1.3 Hazards due to failure/malfunction of the control system

Hazards due to unexpected movements, unexpected start up (see also 4.1.12) or continuing operation.

4.1.4 Hazards resulting from failure of an energy supply

Hazards due to sudden fall of raised parts due to gravity, for example sheet roll, platen, clamping frame or stacking unit.

4.1.5 Hazards due to failure/malfunction of pneumatic equipment

Impact due to whiplash of hoses resulting from fracture of flexible hoses.

Impact, crushing shearing, drawing-in or trapping resulting from unexpected movement of machine parts.

4.1.6 Hazards resulting from failure/malfunction of hydraulic equipment

Impact due to whiplash of hoses resulting from fracture of flexible hoses.

Impact, crushing, shearing, drawing-in or trapping resulting from unexpected movement of machine parts.

Release of fluid under pressure resulting from fracture, for example of a pipe or hose.

Hazards due leakage, for example slipping, burning or fire.

4.1.7 Hazards resulting from inadequate emergency precautions

4.1.8 Hazards resulting from noise

4.1.9 Hazards resulting from inhalation of health hazardous fumes or gases during normal operation.

4.1.10 Hazards due to hot surfaces

Burning due to accidental contact with hot surfaces.

4.1.11 Hazards due to unsuitable ergonomics

Strain of the human body resulting from:

- unsuitable body position
- repetitive actions
- excessive lifting

4.1.12 Hazards due to unexpected start up

- impact
- crushing
- shearing
- drawing-in or trapping

resulting from unexpected movement of machine parts.

4.1.13 Hazards resulting from inadequate systems and operations during setting

- impact
- crushing
- shearing
- drawing-in or trapping

resulting from unexpected movement of machine parts of this or adjacent units.

4.2 Specific hazards and danger zones relating to individual units

4.2.1 Continuous Sheet Unwind Unit

4.2.1.1 Mechanical Hazards

4.2.1.1.1 Hazards during movement of roll lifting devices

- crushing
- shearing

4.2.1.1.2 Hazards in the area between sheet roll support shafts and their bearings during loading

- crushing
- shearing

4.2.1.1.3 Hazards between rotating haul off rolls and by moving parts of haul off roll drives

- drawing-in or trapping

4.2.1.1.4 Hazards due to sheet rolls and shafts falling from their bearing

- impact
- crushing

4.2.1.1.5 Hazards due to sheet rolls falling from shafts fixed at one end

- impact
- crushing

4.2.1.1.6 Hazards due to instability of the unwind unit causing it to fall over

- impact
- crushing

4.2.1.2 Hazards due to electrostatic charges

- electrical shock or ignition due to discharge of electrostatic charges, which may occur during unwinding of some materials

4.2.2 Single Sheet Feed Unit

4.2.2.1 Mechanical Hazards

4.2.2.1.1 Hazards during movement of a handling device, sheets or parts of a single sheet magazine

- crushing
- shearing
- impact

4.2.2.1.2 Hazards during the feeding of sheet to a material intake or conveying system

- drawing in or trapping

4.2.2.2 Hazards due to electrostatic charges

- electrical shock or ignition due to discharge of electrostatic charges, which may occur during separation of some materials