SLOVENSKI STANDARD
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Rubber and plastic machines - Calenders - Safety requirements

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Gummi- und Kunststoffmaschinen - Kalander -Sicherheitsanforderungen

Machines pour le caoutchouc et les matieres plastiques - Calandres - Prescriptions de sécurité

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83.200	Oprema za gumarsko industrijo in industrijo polimernih materialov	Equipment for the rubber and plastics industries

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Rubber and plastics machines - Calenders - Safety requirements

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

Gummi- und Kunststoffmaschinen - Kalander - Sicherheitsanforderungen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

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of an identical text or by endorsement, at the latest by January 2001, and conflicting national standards shall be withdrawn at the latest by January 2001.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

The annexes A to F are informative.

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.

Introduction

This European standard is a type C standard as described in EN 292.

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 European standard specifies safety requirements relating to the design and construction of multi-roll calenders intended for the processing of rubber or plastics.

This standard concerns the calender alone. including all components fixed to its frame.

Annex A shows examples of various types of calenders and annex B shows examples of calendering processes.

The following machines are excluded:

- two-roll calenders forming an integral unit with an extruder (roller head);
- two or three-roll polishing , laminating or embossing units (which are not calenders) installed downstream of extruders in film processing lines.

This standard deals with the significant hazards listed in clause 4.

The following hazards are not dealt with:

- hazards generated by the materials being processed (see informative annex C);
- hazards generated by the processing of explosive materials, or materials which give rise to an explosive atmosphere;
- fire hazards due to ignition of flammable materials by contact with hot parts of the calender (e.g. in case of oil leakage);
- hazards due to electromagnetic, laser or ionising radiation;
- hazards generated if the calender is installed in an explosive atmosphere.

This standard applies to machinery manufactured after the date of approval of this standard by CEN.

2 Normatives references

This European Standard incorporates by dated or undated reference, 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.

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 (and Amendment A1:1995).*

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.*

EN 418:1992, *Safety of machinery - Emergency stop equipment, functional aspects - Principles for design.*

EN 457:1992, *Safety of machinery - Auditory danger signals - General requirements, design and testing (ISO 7731:1986, modified).*

EN 563:1994, *Safety of machinery - Temperature 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 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 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 - Principles 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 sensing mats and pressure sensitive floors.*

prEN 12437-1:1996, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 1: Choice of a fixed means of access between two levels.*

prEN 12437-2:1996, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 2: Working platforms and gangways.*

prEN 12437-3:1996, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 3: Stairways, stepladders and guard-rails.*

prEN 12437-4:1996, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 4: Fixed ladders.*

EN 60204-1:1997, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:1997).*

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

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

EN 61496-1:1998, *Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests (IEC 61496-1:1997).*

EN ISO 3743-1:1995, *Acoustics - Determination of sound power levels of noise sources - Engineering methods for small movable sources in reverberant fields - Part 1: Comparison method for hard-walled test rooms (ISO 3743-1:1994).*

EN ISO 3743-2:1996, *Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering methods for small movable sources in reverberant fields - Part 2: Methods for special reverberation test rooms (ISO 3743-2:1994).*

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 3746:1995, *Acoustics - Determination of sound power levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:1995).*

EN ISO 4871, *Acoustics - Determination and verification of noise emission values of machinery and equipment (ISO 4871:1996).*

EN ISO 9614-1:1995, *Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 1: Measurement at discrete points (ISO 9614-1:1993).*

EN ISO 9614-2:1996, *Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning (ISO 9614-2:1996).*

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

EN ISO 11202:1995, *Acoustics - Noise emitted by machinery and equipment - Measurement of emission sound pressure levels at the work station and at other specified positions - Survey method in situ (ISO 11202:1995).*

EN ISO 11203:1995, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at the work station and at other specified positions from the sound power level (ISO 11203:1995).*

EN ISO 11204:1995, *Acoustics - Noise emitted by machinery and equipment - Measurement of emission sound pressure levels at the 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).*

prEN ISO 11688-2:1999, *Acoustics - Recommended practice for the design of low-noise machinery and equipment- Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998).*

ISO/DIS 3747:1998, *Acoustics - Determination of sound power levels of noise sources using sound pressure - Comparison method for use in situ.*

3 Definitions

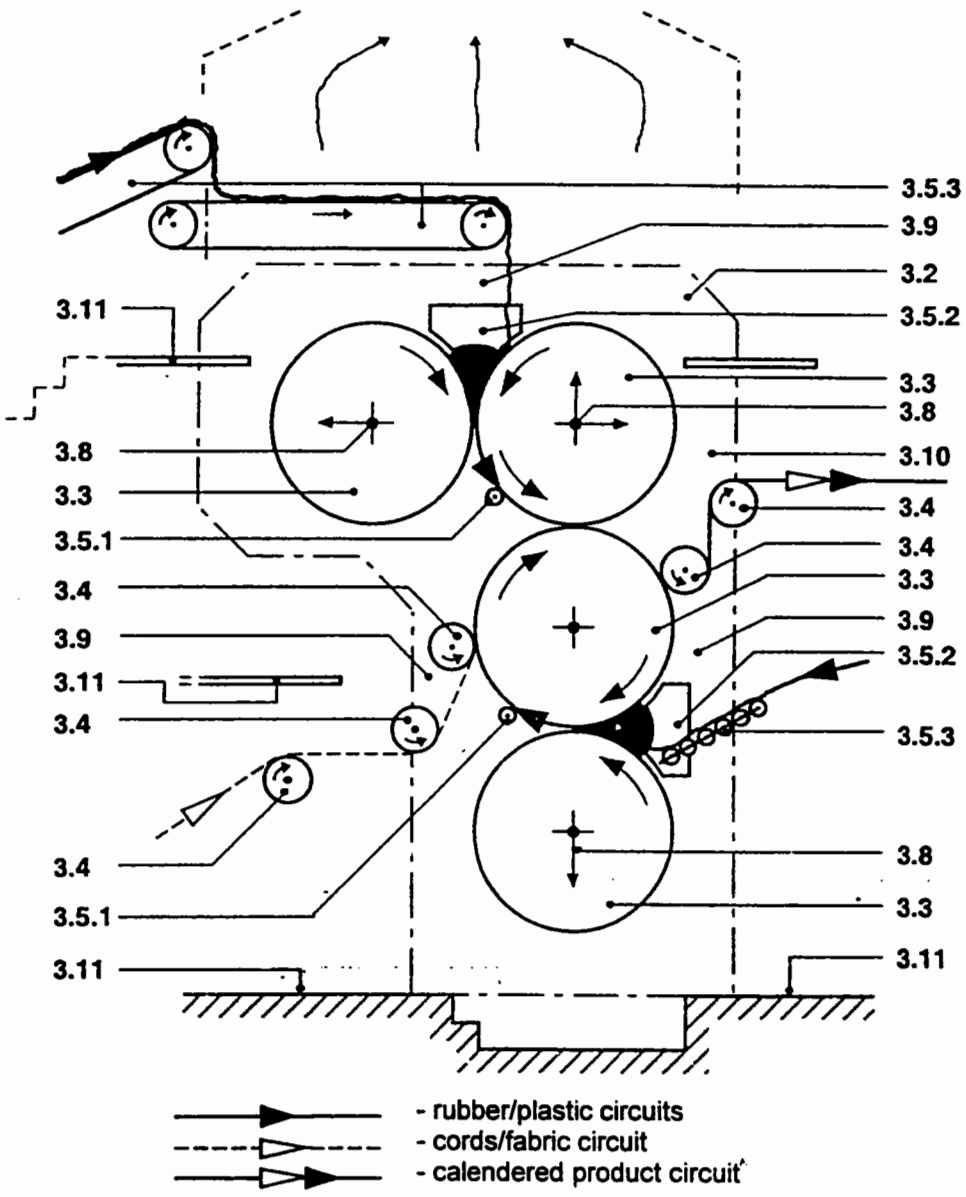
For the purposes of this standard the following definitions apply:

3.1
calender
a machine for processing rubber, plastics, solutions or dispersions by continuous drawing between two or more rolls. The rolls are supported at both ends by a frame.

The processing operations may be, for example:

- continuous calendering of sheets or profiles of rubber or plastics;
- application of one or more sheet(s) or layer(s) onto a web;
- laminating of two or more sheets of rubber or plastics under pressure or by using heat or adhesive;
- embossing of plastics.

Figure 1 shows a typical calendering sequence and the positions of most of the components and zones defined hereafter. In this illustration the reference numbers correspond to the subclause numbers of clause 3.



3.2	Frame	3.5.3	Feeding devices
3.3	Calender rolls	3.8	Nip adjusting devices
3.4	Secondary rollers	3.9	Feed zones
3.5.1	Cutting devices	3.10	Discharge zone
3.5.2	Stock guides	3.11	Working zones

Figure 1 – Example of a 4-roll calender showing the materials circuit for bilateral coating of (textile or metallic) fabric or cords.

Annex A shows examples of various types of calenders.

Annex B shows examples of various calendering processes.

3.2
frame
fixed part of the calender housing the calender roll bearings, some of the secondary roller bearings and ancillary equipment

3.3
calender roll
a roll with an even, polished or sandblasted surface which is held in place and positioned in relation to other calender rolls by guide bearings in the frame. The roll may be counterbored or drilled to enable its temperature to be controlled by fluid circulation

3.4
secondary roller
a roller, other than a calender roll, which is used in the calendering process. It may be driven and may be temperature regulated. Examples of secondary rollers are: pressure rollers, embossing rollers, filament guide rollers, tension rollers, stripper rollers, crease removing rollers, take-off rollers

3.5
ancillary equipment
the following ancillary equipment is dealt with in this standard:

3.5.1
cutting equipment
equipment for trimming the edges of the sheet to a specified width. This equipment can also cut the sheet into two or more widths. There are different types of cutting equipment for example:

- fixed knives (wires or blades);

- rotating knives (cutting discs)

3.5.2
stock guides

devices located on either side of the feed zone which determine the width of the sheet to be calendered and retain the stock thus preventing it from extending beyond the normal working area

3.5.3
feeding device
equipment for feeding and distributing the stock in the feed zone for example: table, grid, chute, conveyor, reciprocating feed conveyor

3.6
calender roll speed

circumferential speed of rolls v expressed in m/min. The following speeds are used in this standard:

- slow speed v_l: roll speed for production start-up;

- maximum speed v_{max}: highest roll speed given by the manufacturer;

- production speed v_p: speed between v_l and v_{max};

- reduced speed v_r: roll speed used when approach by the operator is necessary for production purposes

3.7
stopping angle
the angle through which the fastest calender roll rotates during the time between actuation of the safety device or emergency stop actuator and bringing the rolls to rest by braking

This angle is measured with the calender running empty and the cylinders rotating at maximum speed v_{max} (see 3.6).

The following stopping angles are used in this standard:

- specified stopping angle α: the stopping angle specified by the machine manufacturer;
- maximum stopping angle α_{max}: the upper limit value of the stopping angle;
- reduced stopping angle α_r: the stopping angle achieved when the rolls are rotating at the reduced speed v_r.

3.8
nip adjusting device
a device for changing the relative position of the rolls to each other by increasing or decreasing the roll nip

3.9
feed zone
zone in which stock (rubber or plastic etc) and/or material (cords, web, fabric etc) is fed into the calender. A calender may have one or more feed zones

3.10
discharge zone
zone in which the calendered product is discharged

3.11
working zone
area of the calender where the operators carry out their normal duties. A calender may have several working zones

3.12
trapping zone at the calender rolls
a trapping zone exists when two calender rolls close to each other rotate in opposite directions towards the nip, thus creating a drawing-in and crushing hazard

The trapping zone is the volume circumscribed by the length *X* of the rolls and by the cross-section dimensioned *S* and *L* (see figure 2):

- *S* shall be taken as 12 mm when the rolls are theoretically in contact, irrespective of the roll diameter;
- $L = \sqrt{6D}$; where the roll diameters are different *D* shall be taken as the larger diameter. An example for the calculation of *L* is given in annex D;
- *L* remains constant irrespective of the nip between the rolls