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Safety Requirements for Rubber Calenders & Plastics Calenders

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TABLE OF CONTENTS

Introduction	3
1. Scope	4
2. Normative references	4
3. Terms and Definitions	6
4. Risk examples	10
4.1 Mechanical risk	10
4.2 Electrical Risk	11
4.3 Heat risk	11
4.4 Noise Risk	11
4.5 Risk Caused by Ignoring the Ergonomic Principles	11
4.6 Risk Caused by Power Supply Failure	11
4.7 Risk Caused by Control System Failure	11
4.8 Slip, Trip and Fall Risks	11
5. Safety Requirements and Measures	12
5.1 Safety Requirements and Measures of Mechanical Risks	12
5.2 Safety Requirements and Measures of Electrical Risk	22
5.3 Safety Requirements and Measures of Heat Risk	23
5.4 Safety Requirements and Measures of Noise Risk	23
5.5 Safety Requirements and Measures of Risk Caused by Ignoring the Ergonomic Principles	24
5.6 Safety Requirements and Measures of Risk Caused by Power Failure	24
5.7 Safety Requirements and Measures of Risk Caused by Control System Failure	24
5.8 Safety Requirements and Measures of Slip, Trip and Fall Risk	25
6. Certification of Safety Requirements and Measures	25
7. Operation Information	28
7.1 Operating Instructions	28
7.2 Labels	30
Annex A(Informative annex)Examples of different types of calenders	31
Annex B (Informative annex) Examples of calendering technologies	32
Annex C(Informative annex)The risk caused by processing materials	34
Annex D (Informative annex) Calculation of the Suction Area Size (to rollers with the same diameter)	35
Annex E (Informative annex) Fixed protective device of the suction zone	36
Annex F(Informative annex) Example of Special Protection by Restricting Movement to Prevent Entering into the Suction Area	37
Annex G	38

Introduction

Chapter 5 [(except for 5.1.1.9e)], Chapter 6 and Chapter 7 [(except for 7.1.1e• ,7.1.2j), 7.1.2k) and 7.1.2m)] of the standard are mandatory, others are recommendatory. The modified version of the standard applies the European Standard EN 12301• 2000 *Safety Requirements for Rubber & Plastics Machine- Calenders* (English Version).

The standard has some technical discrepancies caused by citing the national Chinese standard; please see Annex G for Check List for Relevant Standards Quoted in the Standard. For ease of use, the standard has made the following editorial modifications:

- a) substituted “European standard Introduction” with “Introduction”;
- b) substituted “European standard” with “standard”;
- c) deleted the introduction of EN 12301• 2000;
- d) deleted the informative annex ZA of EN 12301• 2000;
- e) deleted “References”;
- f• added Annex G.

The Annexes A, B, C, D, E, F and G are informative.

The standard was put forward by China Petroleum and Chemical Industry Association.

The jurisdictional unit of the standard is National Rubber & Plastics Machine Standardisation Technical Committees (SAC/TC71).

The major organisations that participated in the drafting of this standard are Dalian Rubber & Plastics Machinery Corporation Limited and Beijing Research and Design Institute of Rubber Industry.

The major drafters of the standard are Huang Shulin, Li Xianglan, Yang Youren, Xia Xiangxiu and He Cheng.

Safety Requirements for Rubber Calenders & Plastics Calenders

1. Scope

The standard prescribes the safety requirements for rubber and plastics calenders.

The standard involves the definition, risk examples, safety requirements and measures, certification of safety requirements and measures and operation information in Safety Requirements for Rubber & Plastics Machine- Calenders.

The standard is applicable to calenders for processing rubbers and plastics (hereinafter referred to as “calenders”, including all the components fixed on the machine frame.

The standard is not applicable to:

- Two-roll calenders and extruders (roll end)
- Two-roll or three-roll calendering, laminating or embossing equipment (not the calenders), which are used as downstream equipment of the excluder in the film membrane production line.

The standard does not include the following risks:

- risk caused by the processed materials (see Informative Annex C);
- risk caused by processing explosive materials or materials liable to create explosive gas;
- fire ignition risk caused by touching the heat components of the calenders with explosive materials (e.g., fuel leaks);
- risk caused by electromagnetic, laser or ionising radiation;
- risk caused by installing the calenders in an explosive environment.

2. Normative references

The terms in the following documents become the terms of the standard by quoting it. For the quoted documents marked with date, all the modified lists following it (this does not include errors) or the modified version is not applicable to the standard. However, it is encouraged that the parties agree according to the standard to use the latest version of the documents. For the quoted documents not marked with date, the latest version is applicable to the standard.

GB 1251.1 Ergonomics - Danger signals for public and work areas - Auditory danger signals • GB 1251.1 • 2008 • ISO 7731 • 2003 • IDT •

GB/T 3767 Acoustics--Determination of sound power levels of noise sources using sound pressure-engineering methods in an essentially free field over a reflecting plane • GB/T 3767 • 1996 • equiv ISO 3744 • 1994 •

GB/T 3768 Acoustics-Determination of sound power levels of noise sources using sound pressure-Survey method using an enveloping measurement surface over a reflecting plane • GB/T 3768 • 1996 • equiv ISO 3746 • 1995 •

GB 4208-2008 Degrees of protection provided by enclosure (IP code) • IEC 60529 • 2001 • IDT •

GB 5226.1 • 2002 Safety of machinery—Electrical equipment of machines—Part 1: General Requirements • IEC 60204-1 • 2000 • IDT •

GB/T 6881.2 • 2002 Acoustics--Determination of sound power levels of noise sources—Engineering methods for small, movable sources in reverberant field--Part 1: Comparison method for hard-walled test rooms • ISO 3743-1 • 1994 • IDT •

GB/ T6881.3 • 2002 Acoustics--Determination of sound power levels of noise sources-using sound

pressure-Engineering methods for small, movable sources in reverberant field--Part 2: Methods for special reverberation test • ISO 3743-2 • 1994 • IDT •

GB/T 8196 • 2003 Safety of machinery—Guards—General requirements for the design and construction of fixed and movable guards • ISO 14120 • 2002 • MOD •

GB 12265.1 • 1997 Safety of machinery--safety distances to prevent danger zones being reached by the upper limbs

GB 12265.3 • 1997 Safety of machinery-Minimum gaps to avoid crushing of parts of the human body

GB/T 14574 Acoustics-Declaration and verification of noise emission values of machinery and equipment • GB/T 14574 • 2000 • equiv ISO 4871 • 1996 •

GB/T 15706.1 • 2007 Safety of machinery • Basic concepts general principles for design • Part 1: Basic terminology methodology • ISO 12100-1 • 2003 • IDT •

GB/T 15706.2 • 2007 Safety of machinery-Basic concepts general principles for design-Part 2: Technical principles • ISO 12100-2 • 2003 • IDT •

GB/T16404 • 1996 Acoustics-Determination of sound power levels of noise sources using sound intensity—Part 1: Measurement at discrete points • equiv ISO 9614-1 • 1993 •

GB/T16404.2 • 1999 Acoustics—Determination of sound power levels of noise sources using sound intensity—Part 2 • Measurement by scanning • equiv ISO 9614-2 • 1996 •

GB/T 16538 Acoustics - Determination of sound power levels of noise sources using sound pressure - Comparison method in situ • GB/T 16538 • 2008 • ISO 3747 • 2000 • IDT •

GB/ T 16754 • 2008 Safety of machinery—Emergency stop Principles for design • ISO 13850 • 1995 • IDT •

GB/T 16855.1 • 2005 Safety of machinery--Safety-related parts of control systems-Part1: General principles for design • ISO 13849-1 • 1999 • MOD •

GB/T17248.2 • 1999 Acoustics--Noise emitted by machinery and equipment--Measurement of emission sound pressure levels at a workstation and at other specified positions--Engineering method in an essentially free field over a reflecting plane • equiv ISO 11201 • 1995 •

GB/T17248.3 • 1999 Acoustics--Noise emitted by machinery and equipment-Measurement of emission sound pressure levels at a workstation and at other specified positions-Survey method in situ • equiv ISO 11202 • 1995 •

GB/T17248.4 • 1998 Acoustics--Noise emitted by machinery and equipment--Determination of emission sound pressure level at a workstation and at other specified positions from the sound power level • equiv ISO 11203 • 1995 •

GB/T17248.5 • 1999 Acoustics--Noise emitted by machinery and equipment--Measurement of emission sound pressure levels at a workstation and at other specified positions--Method requiring environmental corrections • equiv ISO 11204 • 1995 •

GB/T 17454.1 • 1998 Safety of machinery-Pressure sensitive protective device-Part 1: General principles for the design and testing of pressure sensing mats and pressure sensing floors

GB/T 17888.1 Safety of machinery - Permanent means of access to machinery - Part 1: Choice of a fixed means of access between two levels • GB/T 17888.1 • 2008 • ISO 14122-1 • 2001 • IDT •

GB/T 17888.2 Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways • GB/T 17888.2 • 2008 • ISO 14122-2 • 2001 • IDT •

GB/T 17888.3 Safety of machinery - Permanent means of access to machinery - Part 3: Stairs, stepladders and guardrails • GB/T 17888.3 • 2008 • ISO 14122-3 • 2001 • IDT •

- GB/T 17888.4 Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders
• GB/T 17888.4• 2008•
- ISO 14122-4• 2004• IDT• GB/T 18153-2000 Safety of machinery--Temperatures of touchable surfaces--Ergonomics data to establish temperature limit values for hot surfaces GB/T 18209.1 Safety of machinery--Indication, marking and actuation--Part 1:Requirements for visual, auditory and tactile signals• GB/T 18209.1• 2000• IEC 61310-1• 1995• IDT•
- GB/T 18831• 2002 Safety of machinery--Interlocking devices associated with guards--Principles for design and selection (ISO 14199• 1998• MOD)
- GB/T 19436.1• 2004 Electrical safety of machinery—Electro-sensitive protective equipment—Part 1: General requirements and tests• IEC 61496-1• 1997• IDT•
- GB/T 19670 Safety of machinery--Prevention of unexpected start-up (GB/T 19670• 2000• ISO 14118• 2000• MOD)
- GB/T 19876• 2005 Safety of machinery--Positioning of protective equipment with respect to the approach speeds of parts of the human body (ISO 13855• 2002• MOD)
- EN 614-1• 1995 Safety of machinery• ergonomics Principles for design Part I: Basic terminology and general principles
- ISO 11688-1• 1998 Acoustics— Recommended practice for the design of low-noise machinery and equipment Part I: planning
- ISO 11688-2• 1999 Acoustics—Recommended practice for the design of low-noise machinery and equipment Part II: Introduction to the physics of low-noise design.

3. Terms and Definitions

The following terms and definitions are applicable to this standard.

3.1

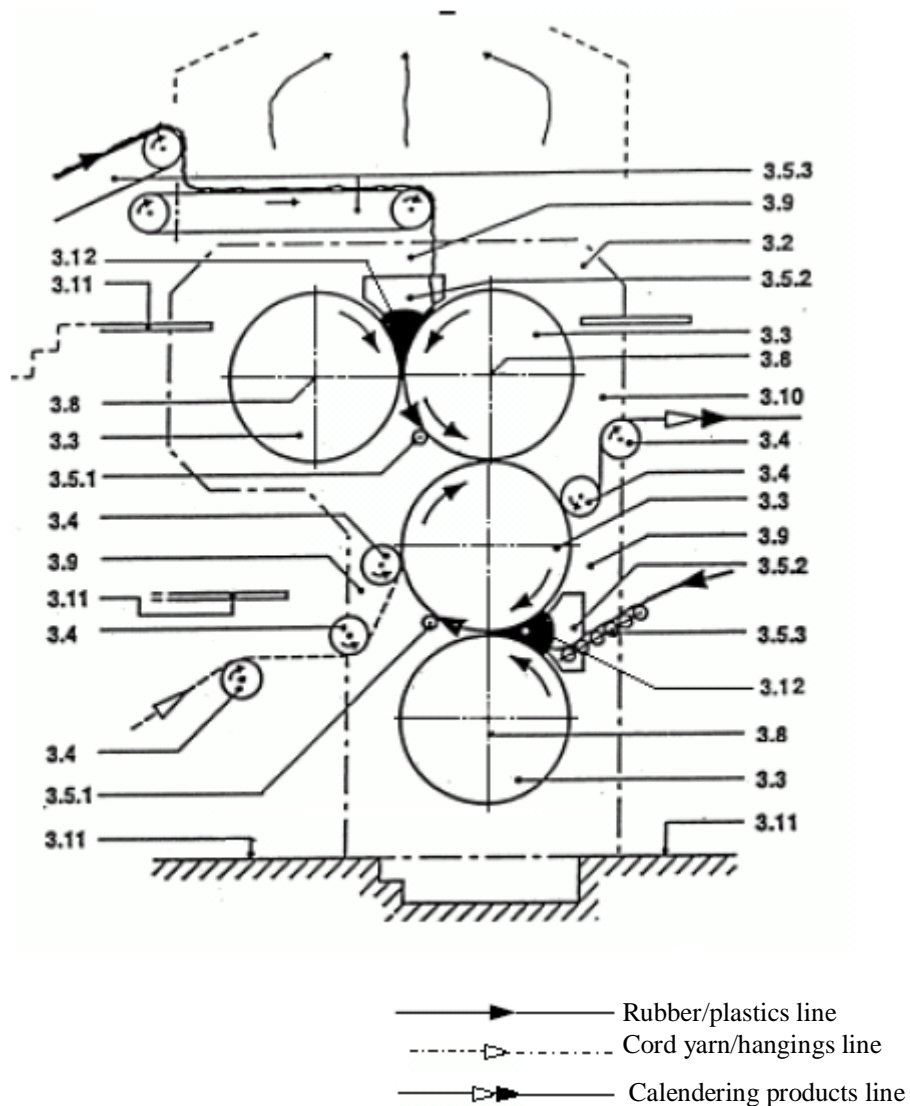
Calender

The machine that is used to process rubber, plastics, mucilage or dispersoid by stretching the materials between two or more rolls. The two ends of the rolls are supported by the machine frame.

Examples of possible operating processes:

- Sheet materials or section materials for calendering rubber and plastics;
- Sending one piece (layer) or more pieces (layers) to the conveyer belt;
- Using heat or adhesive to laminate two or more layers of rubber or plastic sheet materials.
- Plastic printing.

Table 1 shows a typical calendering process, position of most components and the partition of each zone. The labels in the chart relate to the corresponding sub-item number in Chapter 3.



- 3.2 • Machine frame; 3.3 • Calendering roll; 3.4 • Secondary roll •
- 3.5.1 • Cutting device; 3.5.2 • flaps • 3.5.3 • feeding device;
- 3.8 • roll gap adjusting device • 3.9 • feeding zone; 3.10 • discharging zone •
- 3.11 • working zone; 3.12 • suction zone of the calendering rolls.

Chart 1 Fibre hangings (fabrics or wire netting) Example of four-roll calender processing materials with double-surface painting technology

3.2

Frame

Components used by the calenders to fix calendering roll bearing, some secondary rolling and secondary devices.

3.3

Calender roll

Rolls with a smooth surface, processed by surface polishing or abrasive blasting. They are supported in the air and located by the direct bearing on the frame, according to the relationship between the rolls. Holes can be bored on the rolls to control their temperature by fluid circulation.

3.4

Auxiliary roller

The roll used in the calendering technology, different from the calendering rolls. It can be driven and the temperature of it can be adjusted. Types of auxiliary roller include pressure roll, painting roll, drawing directing roll, tension roll, stripping roll, flattening roll, dragging roll and so on.

3.5

Auxiliary equipment

The following auxiliary equipment is introduced in the standard:

3.5.1

Cutting equipment

Cut the edge of the sheet material and finish it to a certain width. The material can be cut into two or more width dimensions; the following are examples of different types of cutting devices:

- Fixed knife (metal wire or blade);
- Rotary knife (cutting plate).

3.5.2

Flaps

Baffles fixed on both sides of the feeding zone to determine the width of the calendered sheet, limit the placement of the material and prevent the materials from exceeding the normal operating zone.

3.5.3

Feeding device

The devices used to insert and distribute materials in the feeding zone, such as work bench, grid, charging groove or alternate conveyer types.

3.6

Calender roll velocity

The unit of the linear velocity of the roll V is m/ min. The following velocities shall be used in the standard:

- Low roll velocity V_1 when starting manufacture;
- The maximal roll velocity V_{\max} provided by the manufacturer;
- Normal manufacture velocity V_p , which is between V_1 and V_{\max} ;
- Step-down roll velocity V_r , the roll velocity when the operator is required to approach the roll in the manufacturing process.

3.7

Parking angle

The angle created during the time when the high-speed calender roll starts the safety device or emergency stop device until the roll stops.

The angle is measured when the calender is idling and the roll is rotating in V_{\max} (see 3.6).

The following parking angles shall be used in the standard:

- given parking angle \bullet : the parking angle given by the machine manufacturer;
- the maximal parking angle \bullet_{\max} : the upper value of the parking angle;
- step-down parking angle \bullet_r : the parking angle acquired when the roll is rotating in the step-down roll velocity V_r .

3.8

Roll gap adjusting device

Device to change the relative position of the rolls by increasing or decreasing the roll gap.

3.9

Feeding zone

The zone where material (rubber or plastics) or other items (hangings, textiles and fabrics) are fed into the calenders. There can be one or more feeding zones on one calender.

3.10

Discharge zone

The zone where calendering products are discharged.

3.11

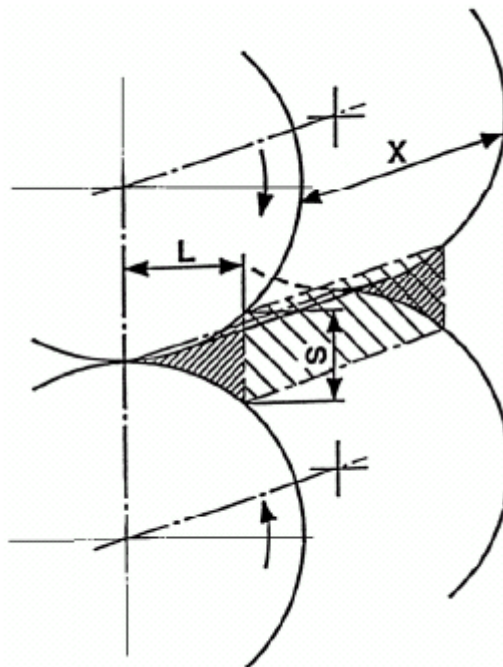
Working zone

The area where the operator carries out the normal operation. There can be one or more operation zones on one calender.

3.12 Suction zone at the calender rolls

Suction zone means the zone that gets easily entangled and ground when two calendering rolls approach each other and relatively rotate toward the roll gap. Suction zone also means the space enclosed by the length L of roll and cross-sectional dimension S and L (see Chart 2):

- • When the rolls theoretically approach each other, 12mm is adopted, and the diameter of the roll is not considered;
- • $L = \sqrt{6D}$ When the diameters D of the two rolls are different, the bigger one shall be adopted. A formula to calculate L is given in Annex D
- • No matter how large the roll gap is, L is always unchangeable.



X, S and L: specify the dimension of the suction zone

Chart 2 Suction zone of calendering rolls

3.13

Danger zone at the calender rolls

A danger zone will exist on the calender roll when entering into the suction zone described in 3.12 which protective devices installed near the centre of the zone cannot prevent.

The danger zone is located in the side of the roll, a space enclosed by the roll length X and shadow

section (see Chart 3 and 7a).

The part is decided by the following dimensions:

- • the straight line size S at the entry of the suction zone (see 3.12);
- • two circular arcs on the calender rolls determined by the given parking angle α (see 3.7);
- • the circle centre of the bigger circular arc is the midpoint of straight line dimension S , its radius F is the arc length on the calender rolls determined by the given parking angle α .

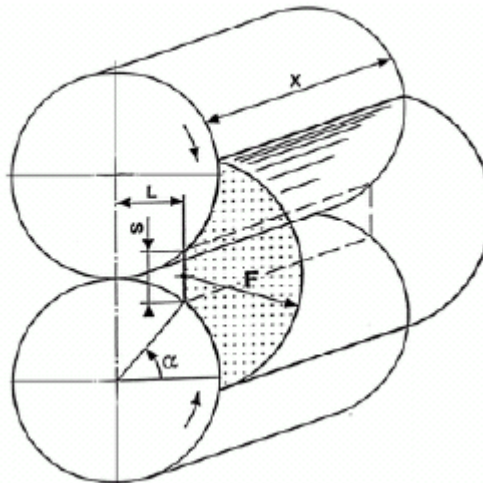


Chart 3 Danger zone of calendering rolls

4. Risk examples

4.1 Mechanical risk

In Chart 4, a four-roll calender is used as an example; the location of the major mechanical risk is pointed out. The labels in the chart correspond to the sub-item number in Chapter 4.

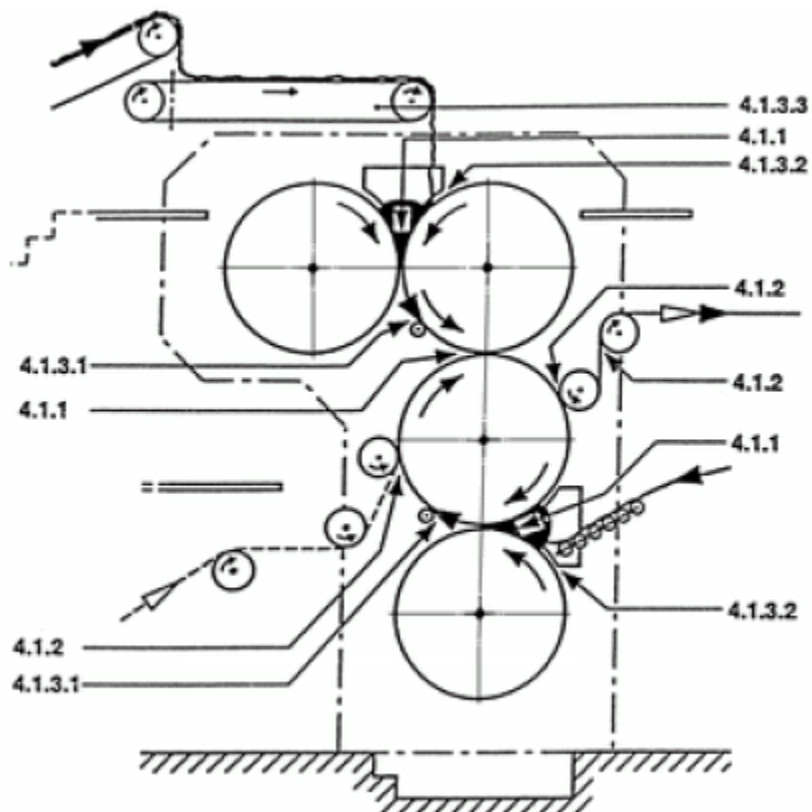


Chart 4 Taking a four-roll calender as an example, the location of major mechanical risk

4.1.1 Entangling and grinding risks between the calendaring rolls or between the calendaring rolls and materials

The risks can be caused by the following•

- • when starting;
- • when it operates toward the positive direction in normal operation;
- • toward the reverse;
- • in cleaning or clear-up operations;
- • in setting, process transferring, fault clearance and maintenance operations.

4.1.2 Entangling and grinding risks between the auxiliary rolls

4.1.3 Risk caused by auxiliary equipment

4.1.3.1 Cutting risk caused by cutting device.

4.1.3.2 Cutting and grinding risks between flaps and calendaring rolls.

4.1.3.3 Impacting and extruding risks caused by alternate feeding conveyer.

4.2 Electrical Risk

4.2.1 Electric shock or burn caused by directly or indirectly touching the conductive parts.

4.2.2 Electric shock or fire caused by electrostatic charge.

4.3 Heat risk

4.3.1 Burns caused by touching the heat components of calender or other hot materials.

4.3.2 Scalding caused by hose or hose component cracking and hot conducting liquid ejects.

4.3.3 Burns caused by infrared radiation.

4.4 Noise Risk

Risk caused by noise, such as hearing impairment, language communication interference or hearing influence.

4.5 Risk Caused by Ignoring the Ergonomic Principles

Risk caused by overusing human resources in replacing the painting roll or roller.

4.6 Risk Caused by Power Supply Failure

Entangling and grinding risks caused by safety device fault and power supply failure.

4.7 Risk Caused by Control System Failure

Mechanical risk caused by malfunction of safety related components of the control system.

The risk can be caused by the following:

- • unexpected start;
- • control mode failure, including setting, start, process transferring, cleaning, fault clearance, maintenance and reverse operation;
- • unexpected velocity change;
- • failure of one or more safety devices.

4.8 Slip, Trip and Fall Risks

Slip, trip and fall risks caused when operators are on, going to or leaving the operating zone.

5. Safety Requirements and Measures

5.1 Safety Requirements and Measures of Mechanical Risks

5.1.1 Risks on the calendering roller

5.1.1.1 Place safety protection at the entry of the suction zone to avoid entering into the suction zone described in 3.12

At least one of the following options must be adopted to avoid entering into the suction area:

a) according to the requirements in 3.2 of GB/T 8196• 2003, a fixed protective device shall be set along the whole roll. The device shall conform to the following principle:

- • The distance between the protection and the surface of the roller shall be no more than 6mm;
- • the angle between the protection and the section of the roller shall be no less than 90°.

The layout examples are provided in Informative Annexes E and F. The examples can be adopted in other layouts besides the circle cross section. For protective devices with an opening, the safe distance shall be determined according to Table 3 or Table 4 in GB 12265.1• 1997. If the protective device needs to be moved away (for reasons like cleaning or setting), it shall be designed with an interlock protection pattern with a protective lock (according to the requirements in 3.6 of GB/T 8196• 2003).

b) Position the feeding device to make it serve as a fixed protection mentioned above. An interlock must be equipped, which ensures that the roller can rotate only when the feeding device is properly located.

5.1.1.2 Place protection outside the suction zone to avoid entering it

When the protective methods introduced in 5.1.1.1 cannot be adopted because of processing reasons, at least one of the following measures shall be adopted to avoid entering into the suction zone:

a) Protective device to avoid entering into the suction zone

- • According to the requirements in 3.6 of GB/T 8196• 2003, 3.6, interlocking devices associated with guards shall be applied;
- • according to the interlock protection requirements in 3.5 of GB/T 8196• 2003, it must be located according to GB/T 19876• 2005;
- • the type of interlock protection device shall be selected according to GB/T 18831• 2002.

b) Roller-stop tripping device:

- • machine-driven tripping device:

1) tripping bar (see 5.1.1.4);

2) Other devices, such as voltage-dependent mat selected according to GB/T 17454.1• 1998 and located according to GB/T 19876• 2005.

- • Non-machine-driven tripping device, such as light-electricity device according to GB/T 19436.1• 2004 and located according to GB/T 19876• 2005.

The distance calculated according to GB/T 19876• 2005 shall be measured from the entry of the suction area.

If an interlock protection device or a non-machine-driven tripping device has been located, but the operator can still stand between the protective device or tripping device and calender, other safe measures (such as the sensitive protective device) must be taken to prevent the operator from taking the risk when standing there.

5.1.1.3 The performance of protection and safety devices is listed in 5.1.1.2

5.1.1.3.1 Stop of the calendering roller

Intentionally or unintentionally, once the interlock protection is open or tripping device is started, in the parking angle described in 3.7, the roller must stop when any part of the operator’s body touches the safety device.

Once the fingers of the operator touch the danger zone described in 3.13, the brake shall start immediately; the roller shall stop before the fingers touch the suction zone described in 3.12 (see chart 5a, 5b, 5c).

If the power fails during braking, the roller shall stop in the maximal parking angle $\alpha_{max}(120^\circ)$ (see 3.7).

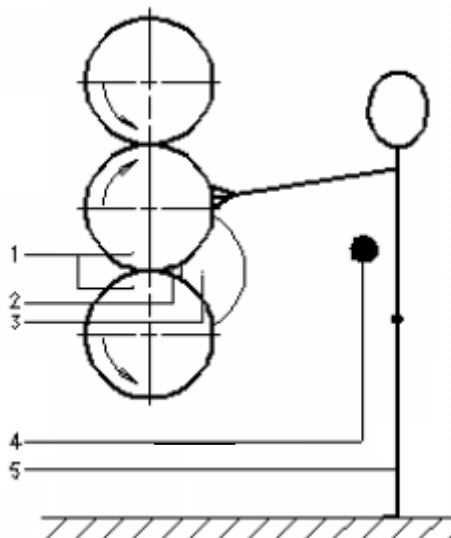
When the maximal velocity of the calendering roller V_{max} (see 3.6) exceeds 120 m/ min, α_{max} may increase to the maximal value (160°) with the increase of V_{max} .

For example, when the maximal velocity of the calendering roller $V_{max}=140m \cdot \text{min}$, then

$$\alpha_{max}=120^\circ \times \frac{140m/\text{min}}{120m/\text{min}} = 140^\circ$$

When the speed exceeds 160 m • min, the roller cannot stop when the angle is equal to or smaller than 160°. In this case, an interlock protection with protective lock shall be used.

Also see 7.1.1 b • and 7.1.2 a • .



1 • calendering roller; 2 • suction zone; 3 • danger zone; 4 • tripping bar; 5 • operator.

Chart 5a The operator’s fingers are outside the danger zone

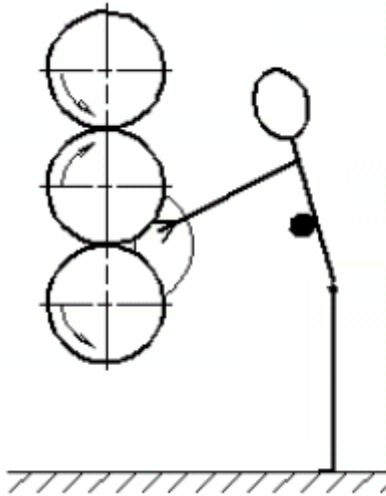


Chart 5b The fingertips are in the danger zone:

Brake because the body of the operator starts the tripping bar

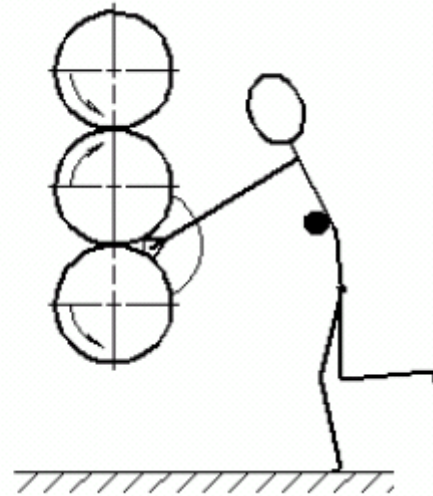


Chart 5c The fingertips are in the suction zone:

calendering machine has stopped

Chart 5 Brake the calendering machine by starting the tripping device (when the tripping bar described in 5.1.1.4 is used)

5.1.1.3.2 Roller separation

Intentionally or unintentionally, when the tripping device is started or the roller separation interlock protection is open, the rollers shall separate after the calendering rollers stop. The following methods can be used:

—Automatically; or

—use a specific manual control method, which can act without being manually reset. The quicker the rollers separate, the better; the larger the distance is, the better (no less than 30mm).

Roller separation shall not create extra risks. After the separation, the roller shall stay in the open position, without the possibility of being unintentionally closed. It can only be removed manually.

See 5.6.

Note: A device can be provided so that the operator can use it to stop the automatic separation of the rollers.

5.1.1.3.3 Reverse assistant action

Because of the opening of the interlock protection or intentional/unintentional start of the tripping device, the calendering roller will stop subsequently. By starting a special stop-move controlling device (according to the requirements in 3.26.3 of GB/T 15706.1• 2007), a reverse movement of the rollers can be carried out. The goal is to rescue those who are entangled in the rollers or between the roller and the materials.

It is not necessary to manually restart the controlling device or depend on the methods to select the position of the switch (introduced in 5.1.1.7) to make it effective. “Reverse assistant action” shall be labelled clearly on it. The velocity of the reverse motion of the roller shall be no more than 5 m/ min. Once the manual control stops, reverse assistant action will stop because of the brake. The visual and acoustic warning signals are given in 5.1.1.7 and 5.1.1.8.

See 7.1.2 b).

5.1.1.4 Application of bar-type mechanical-driven tripping device

5.1.1.4.1 Function

The tripping bar is a horizontal stiffener, when any part of the body touches it intentionally or unintentionally, it will:

- stop the calendaring rollers as described in 5.1.1.3.1;
- separate or allow the separation of the rollers as described in 5.1.1.3.2; and
- allow the roller to reversely operate as described in 5.1.1.3.3.

The tripping bar shall meet the following requirements:

- when the operator's body moves toward the roller for a displacement no more than 10mm, the tripping bar shall be started; the reaction time of the bar t_1 shall be less than 50ms (according to the requirements in 3.2 of GB/T 19876-2005);
- The force required by the driven bar shall be no more than 200N;
- When the “push” action happens along the bar, the bar has a displacement of 10mm to implement the stop action for at least one placement of sensor (see the requirements in 5.1 of GB/T 18831• 2002);
- The signals transmitted through the sensors on the positions are controlled by the hardware system, the circuit of which is composed of the electrical hardware;
- Restart shall not be caused when the tripping bar resets.

See 7.1.2 a) and 7.1.2 d).

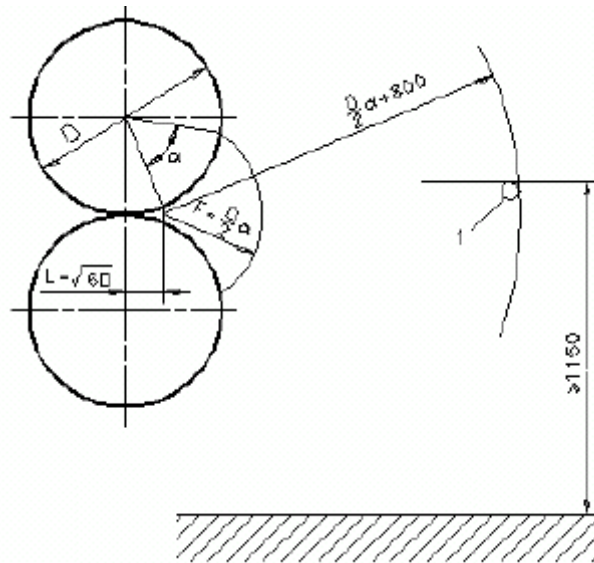
To avoid entering into the suction zone from beneath the tripping bar, a fixed protective plate shall be used to provide protection. The design of the plate shall prevent the feet from stepping into the suction zone.

Also, on the working side, from the side of the calender to the end of each roller, side protection shall be set according to the safe distance in Tables 2, 3, and 4 of GB 12256.1• 1997.

5.1.1.4.2 Positioning

The tripping bar shall be extended to the whole length of the roller.

It shall be installed at a height that is no lower than 1150mm from the horizontal plane. The plane is the standing surface of the operator and positioned according to Chart 6.



1---Tripping bar (at the stop position);

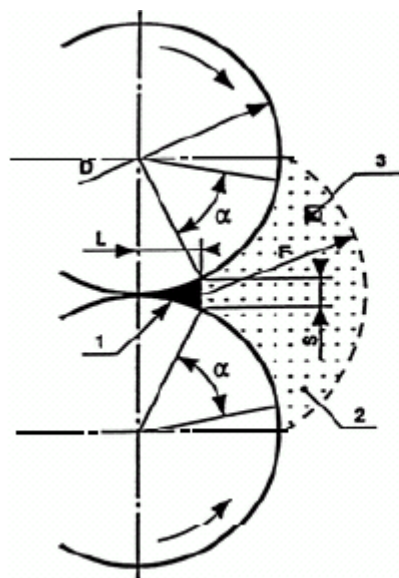
L---The depth of the suction zone (see 3.12 and Annex D);

F---The length is equal to the stop arc of the Vmax. (Linear dimension, the unit is mm; the unit of α is radian).

Chart 6 Position of the tripping bar

5.1.1.5 Decreasing the danger zone described in 3.13

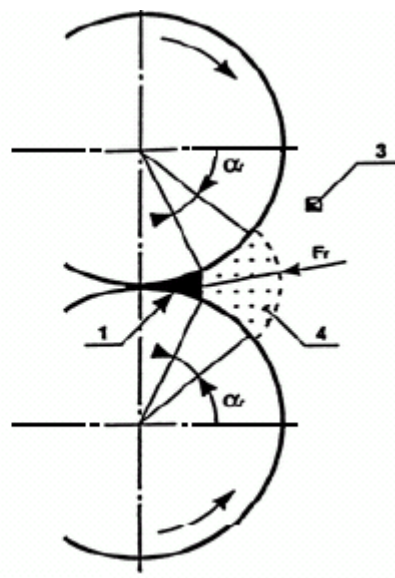
—By reducing the roller velocity from V_{max} to V_p or V_r (see 3.6), the danger zone can be reduced. The parking angle α is also reduced to α_r . The danger zone is shown in Chart 7b.



F• the arc length of α

$$F = \frac{\pi}{360} D \alpha \quad (\text{the unit of } \alpha \text{ is degree})$$

$$F = \frac{D}{2} \alpha \quad (\text{the unit of } \alpha \text{ is degree})$$



F_r • the arc length of α_r

$$F_r = \frac{\pi}{360} D \alpha_r \quad (\text{the unit of } \alpha_r \text{ is degree})$$

$$F_r = \frac{D}{2} \alpha_r \quad (\text{the unit of } \alpha_r \text{ is degree})$$

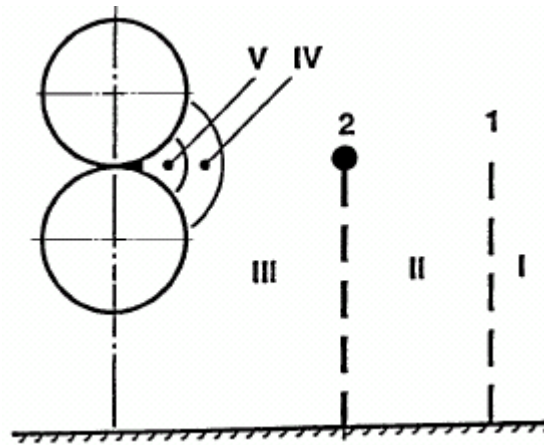
1• Suction zone; 2• danger zone; 3• approach point required; 4• reduced danger zone.

Chart 7a Dimension of the danger zone

Chart 7b Dimension of the reduced danger zone

Chart 7 Danger zone and reduction of the danger zone

—Combining the two safety devices shown in Chart 8 can avoid entering into the reduced danger zone.



1—Safety device 1 (the farther device, protective or safety device introduced in 5.1.1.2);

2—Safety device 2 (the nearer device, tripping bar introduced in 5.1.1.4).

I Zone—Free zone, the body is inside the zone, but the upper arm cannot extend to the IV Zone;

II Zone—When the roller moves with low velocity V_r , the body is allowed to be inside the zone;

III Zone—When the roller moves with a velocity greater than V_r , the upper arm is allowed to be inside the zone;

IV Zone—Danger zone (3.13), when the roller moves with reduced velocity V_r , the upper arm is allowed to extend to the zone;

V Zone—reduced danger zone, in each case, it is not permitted to enter into this zone.

Chart 8 The combination of the two safety devices

The combined safety device shall have the following functions:

—When the roller rotates with a velocity larger than V_r , the operator can move from I Zone to II Zone to drive the safety device to stop the calendering roller. When the roller rotates with the velocity V_r , the operator shall move from I Zone to II Zone without giving the stop command.

—When the upper arm reaches the V Zone, the active driven safety device 2 shall make the calendering roll stop. The device is the tripping bar described in 5.1.1.4, with the position shown in Chart 6. • shall be replaced by •_r.

—After the operator returns to I Zone from II Zone, the rotation speed of the calendering rollers can increase from V_r to V_p by manual control. After the operator returns to I Zone from II Zone, he/she can start the verifying switch set in I Zone to send out the signals. The switch cannot be operated in II Zone. To send a verifying signal in II Zone, observation tools can be used if necessary.

See 7.1.2 c).

5.1.1.6 Emergency stop device

The emergency stop device shall conform to the requirements in GB 16754• 2008, in which the Type 1 parking is applicable to electric braking; Type 0 parking is applicable to simple mechanical braking (irrelevant to electric power), an emergency stop manipulator shall be equipped on the control panel of the calendering machine; other emergency stop manipulators shall be equipped near the working area and on each side of the working area.

The action of any emergency stop manipulator shall:

- Stop the calendaring roller according to the requirements in 5.1.1.3.1;
- Allow the calendaring roller to separate according to the requirements in 5.1.1.3.2;
- Allow reverse assistant actions according to the requirements in 5.1.1.3.3;
- Trigger the visual and auditory signals and manually reset.

One of the following emergency stop types shall be adopted:

——Push-button operated switch;

- • Staying operated switch;
- • Foot- or knee-operated switch.

See requirements in 10.7 of GB/ T 5226.1-2002.

5.1.1.7 Positive direction or reverse (if any) start

The calendaring machine shall be equipped with a pattern selector according to the requirements in 4.11.10 and 5.5.2 in GB/T 15706.2• 2007:

- • Parking;
- • Low-speed positive direction movement;
- • Positive direction movement in manufacturing speed;
- • Reverse movement (if any).

Start is allowed only after sending out the audio alarm signals conforming to the requirements in GB 1251.1 and GB 18209. 1, the signals shall last until the rollers rotate to 5s.

To start, some protective devices shall be removed. The safety of the operator shall be guaranteed through controlling methods, according to the requirements in 4.11.9 of GB/T 15706.2• 2007.

See 7.1.2 f).

5.1.1.8 Reverse operation (if any)

Selecting the reverse movements on the pattern selector shall trigger a flashing light signal to the new suction zone created by the reverse movement. The signal will last as long as the selector switch is kept in that pattern.

According to the requirements in 3.26.3 of GB/T 15706.1• 2007, the reverse movement shall be operated by keeping the stop-move controlling device running; the speed shall be no more than 5 m/ min.

It is important that, when the calender implements reverse movement, the operator can clearly observe the new dangerous area created. According to the specification of the calender, some visible auxiliary measures can be taken such as the use of mirrors and monitors.

Once manual control is lost, the reverse movement must stop immediately under the function of the braking device.

5.1.1.9 Cleaning of the calender rollers

Cleaning of the calender rollers:

a) In the process of cleaning, the risk of entangling and grinding must be avoided. The designated calender shall be cleaned by using the following methods:

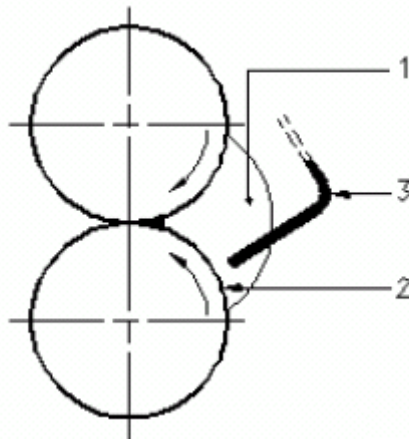
- • When the rollers are in a static state, or:

- • on the discharging side of the roller, or:
- • on the charging side of the roller, except for the outer danger area determined in 3.13.

If any of these methods cannot be adopted, the calender shall be equipped with cleaning devices (such as tools, operating devices, manipulators) to make sure that the operator can safely clean the roller in the danger zone determined in 3.13.

b) When the methods in a) cannot be adopted because of technical reasons and interference in the danger zone, one of the following devices shall be provided to avoid approaching the suction area determined in 3.12:

1) set a specific protective device for cleaning in a place a certain distance away (according to the prescriptions in GB 12265.1• 1997 and 5.1.1.1 of the standard) from the suction zone (see Chart 9). The protective device can replace the protective or safety device determined in 5.1.1.2.



1• • danger zone; 2• • cleaning-up zone; 3• • specific protective device for cleaning.

Chart 9 Sketch map of specific protective device for roller danger zone

2) Only when a single layer has been sent into the roll gap and the first contact point between the sheet and roller surface is outside the dangerous zone in 3.13, the tripping bar in 5.1.1.4.1 shall be positioned according to Chart 10;

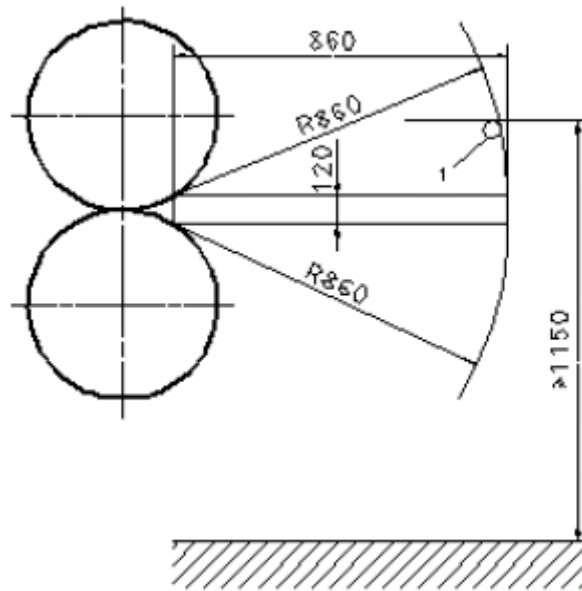


Chart 10 Position according to the tripping bar introduced in 2) of 5.1.1.9.b•

c) If it is easy to enter into the suction zone from the clean-up working station, safety protective devices shall be set according to the requirements in 5.1.1.1 or 5.1.1.2;

d) The manufacturer shall provide clean-up safety measures;

Note: according to the permanent safety methods in GB/T 17888.1• GB/T 17888.4;

e) Use the ergonomic principles as much as possible (see EN 614-1• 1995);

f) The operating instructions shall provide comprehensive information about safe clean-up steps, see 7.1.2f).

5.1.1.10 Setting, process transferring, fault clearance and maintenance

The requirements in 5.2.4 of GB/T 15706.2• 2007 shall be conformed to.

The operating instructions shall provide the safe work instructions, see 7.1.2f).

5.1.2 The risks of auxiliary roll

The following one or more methods shall be adopted to avoid these risks:

—Determine the distance according to the requirements in Table 2 and 4.2.2 in GB 12265.1• 1997;

—The position of the auxiliary roll shall conform to the distance required in GB 12265.3• 1997;

—The fixed protective device shall be determined according to the requirements in 3.2 of GB/T 8196• 2003 or 5.1.1.1 in the standard;

—according to the interlock protective device required in 3.5 of GB/T 8196-2003 or the interlocking devices associated with guards required in 3.6 of GB/T 8196• 2003, the selection of the interlocking device type shall conform to the requirements in GB/ T 18831• 2002;

—tripping device required in 5.1.1.2 b) of the standard.

Because of the opening of the interlock protection or intentional/unintentional start of the tripping device, the calendaring roller will stop subsequently to ensure that it conforms with the distance required

in GB 12265.3 • 1997. The interlock protective device or the tripping device shall be positioned according to the requirements in GB/T 19876• 2005.

After the separation, the roller shall be fixed safely in the open position to avoid being unintentionally closed. Removal can only be done through manual operation.

5.1.3 The risk of auxiliary devices

5.1.3.1 Cutting device

Except for cutter trimmer positioning to ensure its safety, the blade shall be protected in the following ways to prevent unintentional contact:

- a) On the rest position, the trimmer shall withdraw into the protective cover;
- b) On the working position, the components that are not used to cut shall be protected in the

following ways:

——according to the requirements in 3.2.2 of GB/T 8196• 2003, set the protective device according to the safe distance required by Table 2 in GB 12265.1• 1997;

——according to the requirements in 3.2.1 of GB/T 8196• 2003, set the enclosed protective device.

See 7.1.2 h).

5.1.3.2 Flap

The interval between the flap and the roller shall be no more than 4mm.

5.1.3.3 Alternate feeding conveying device

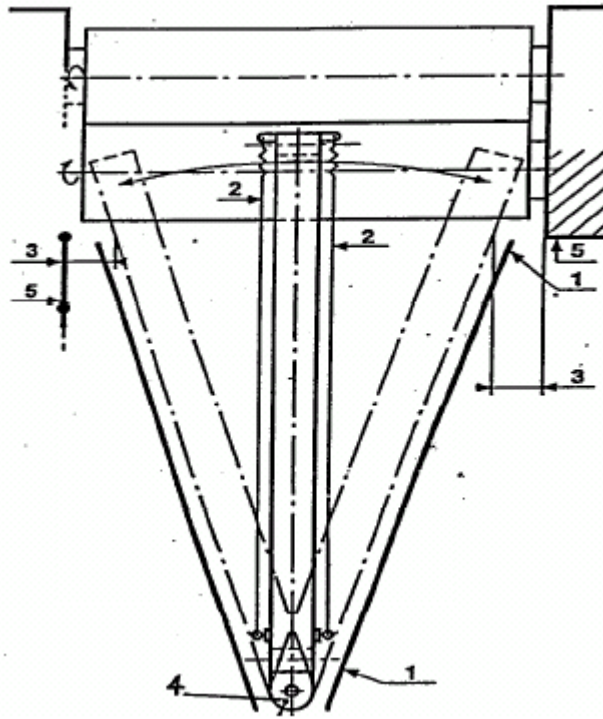
One or more of the following protective methods shall be provided:

——Fixed protective device that meets the requirement in 3.2 of GB/T 8196• 2003;

——Tripping device meets the requirement in 5.1.1.2 b) of the standard.

——The minimal interval between the conveying device and fixed components shall meet the requirements in GB 12265.3• 1997;

——The driving force limit of alternate motion of the conveying device is limited at 150N.



1 • • fixed protective cover; 2 • • tripping device; 3 • • application; 4 • • limitation of the driving force; 5 • • fixed components.

Chart 11 Example of the protective methods of alternate feeding conveying device

5.2 Safety Requirements and Measures of Electrical Risk

5.2.1 Electric shock or fire directly or indirectly caused by the active components

The electrical device shall meet the requirements in GB 5226.1• 2002 and the following requirements.

5.2.1.1 Power supply cut-off (isolation) device

Power supply cut-off device shall meet the requirements in 5.3.2 of GB 5226.1• 2002.

5.2.1.2 Direct contact protection

The lowest protective level shall be adopted:

- • active components in the protective cover: IP2X (according to the requirements in GB 4208• 2008);
- • the upper surface of the protective cover that is easy to touch: IP4X (according to the requirements in GB 4208• 2008).

When the protective cover is open, the lowest protective level shall be adopted:

- • According to the requirements in 6.2.2a) of GB 5226.1• 2002: the active components inside are IP1X (according to the requirements). When reset or adjusted, the active components may be in contact with the device, the protection level shall be IP2X (according to the requirements in GB 4208• 2008);
- • According to the requirements in 6.2.2b) of GB 5226.1• 2002: IP2X (according to the requirements in GB 4208• 2008);
- • According to the requirements in 6.2.2c) of GB 5226.1• 2002: IP2X (according to the requirements in GB 4208• 2008).

See requirements in 6.2 of GB/ T 5226.1-2002.

5.2.1.3 Indirect contact protection

The following measures shall be taken for indirect contact protection:

- • protect by automatically cutting the power supply; or
- • protective insulation or equivalent insulation; or
- • electric separation protection.

See requirements in 6.3 of GB/ T 5226.1-2002.

5.2.1.4 Determination of the lead

The lead shall be determined according to the requirements in 14.2 of GB 5226.1• 2002.

5.2.1.5 Test and identification

Testing and identifying method shall be selected according to the requirements in 19 of GB 5226.1• 2002.

5.2.2 Electric shock or fire caused by static electricity discharge

See requirements in 5.5.4 of GB/ T 15706.2--2007.

Proper measures shall be adopted; for example, form or use the connected and grounded conductor surface or use an ionisation device, see 7.1.2i• .

5.3 Safety Requirements and Measures of Heat Risk

5.3.1 Burn caused by touching the heat components of calender or hot materials

In order to avoid getting burnt by unintentionally touching the heat components of the calender, fixed protective devices, heat shields or heat insulation described in 3.2 or GB/T 8196• 2003 shall be installed at the components that are easy to touch (the highest surface temperature may exceed the limit described in GB/T 18153• 2000); at the areas that are easy to touch, active protective devices or tripping devices shall be used to provide protection. For these heat components, warning signals shall be placed on the protective devices or tripping devices.

If hot materials are easy to touch outside the heat components' protective device, warning signals shall be placed near the contact point. A detailed introduction shall be provided in the operating instructions, see 7.1.2j) and 7.2.

5.3.2 Scalding caused by ejection of hot fluid

To prevent the operator from being scalded when the hose pipe breaks, an enclosed protective cover or shield shall be installed to protect personnel working at or passing by the area.

For the end of the high-pressure-liquid conveying hose, an auxiliary confining device shall be equipped according to the requirements in 4.10 of GB/T 15706.2• 2007.

5.3.3 Burn caused by infrared radiation

These risks can be eliminated by installing protective covering or isolation.

5.4 Safety Requirements and Measures of Noise Risk

5.4.1 Reduce the noise through design

The machine shall be designed according to the requirements in 4.2.2 in GB/T 15706.2• 2007. Meanwhile, during the design stage, use relevant materials and technical measures to control the noise.

The major noise sources are:

- the driving part of the electromotor;
- dynamic force transferring system;
- air-controlling system;
- pressure-reducing valve/discharging system;
- air-exhaust system;

- hydraulic device;
- controlling valve;
- pipeline.

For example, the following measures can be taken:

- silencer;
- low-noise machine elements (for example: pump, blower, electric motor and gearwheel);
- vibration reduction;
- shock resistant installation;
- sound isolator. See 7.1.1e), 7.1.2 k), 7.1.2 l) and 7.1.2 m).

5.4.2 Determination of the noise value

In case there are no noise test methods, one of the following methods shall be used to determine the noise transmission value:

- • Determine the sound pressure level of the working station/area according to the requirements in GB/T 17248.2• 1999 or GB/T 17248.3• 1999 or GB/T 17248.4• 1998 or GB/T 17248.5• 1999. If applicable, Level 2 precision method shall be used (according to the requirements in GB/T 17248.2• 1999 or GB/T 17248.5• 1999).

If the noise in the working station/area cannot be determined, according to the requirements in 5.4.2 of GB/T 15706.2• 2007:

- • If the equivalent continuous A-weighted sound pressure level in the working station/area exceeds 85 dB• A• , the sound power level shall be determined according to the requirements in GB/T 6881.2• 2002 or GB/T 6881.3-2002 or GB/T 3767 or GB/T 3768 or GB/T 16538 or GB/T 16404-1996 or GB/T 16404.2• 1999. If applicable, Level 2 precision method shall be used. The preferred method for determining the sound power level shall conform to GB/T 3767.

See 7.1.1 d).

5.5 Safety Requirements and Measures of Risk Caused by Ignoring the Ergonomic Principles

Because felt-wrapped rolls or rollers need to be replaced regularly, a mechanical processing device shall be equipped to provide assistance, see 7.1.2 n).

5.6 Safety Requirements and Measures of Risk Caused by Power Failure

A mechanical contactor of any roller-driven electromotor may open because of power failure; all the rollers may stop according to the requirements in 5.1.1.3.1.

The calender shall be equipped with a device which does not rely on the normal power supply to ensure that the rollers can separate according to the requirements in 5.1.1.3.2 even in case of power failure.

5.7 Safety Requirements and Measures of Risk Caused by Control System Failure

5.7.1 Safety relevant to the components of the controlling system

B Type in GB/T 16855.1• 2005 shall not be selected to be the relevant safety components in the controlling system. Components with Safety Level 3, including devices used to trigger, operate and start the braking system, shall be selected for the following device controlling systems:

- • interlock protective device (all the relevant sub-items of 5.1);
- • interlocking devices associated with guards (all the relevant sub-items of 5.1)

- • interlock of feeding device (5.1.1.1);
- • tripping bar (5.1.1.2 b), 5.1.1.4, 2) in 5.1.1.9 b);
- • other machine-driven tripping devices, such as the pressure sensor (5.1.1.2 b)•
- • non-machine-driven tripping device, (such as light-electricity device).

5.7.2 Unexpected start

Prevent unexpected start according to the requirements of 5.4 in GB/T 19670 and GB 5226.1• 2002.

5.8 Safety Requirements and Measures of Slip, Trip and Fall Risk

Safety measures shall be taken according to the following standards:

- • The requirements in 4.14 of GB/T 15706.2• 2007;
- • The requirements in 5.5.6 of GB/T 15706.2• 2007;
- • The requirements of GB/T 17888.1 • GB/ T 17888.4.

6. Certification of Safety Requirements and Measures

6.1 Conformity verification of safety requirements and measures according to Table 1

Table 1 Verifying methods

Terms	Safety measures	Verifying methods				Reference standard
		Appearance examination	Function test	Measurement	Calculation	
5.1.1.1	Fixed protective device	•		•		GB 12265.1• 1997 GB/T 8196• 2003
	Fixed protective lock (used to protect the interlocking devices associated with guards)	•	•			GB/T 8196• 2003
	Feeding device	•	•	•		GB 12265.1• 1997
5.1.1.2	Interlock protection with protective lock	•	•			GB/T 8196• 2003 GB/T 18831• 2002
	Interlock protection	•	•	•	•	GB/T 8196• 2003 GB/T 19876• 2005 GB/T 18831• 2002
	Machine-driven tripping device ——Tripping bar ——Other devices, such as pressure sensor	•	•	•	•	See 5.1.1.4 in the Table GB/T 19876• 2005 GB/T 17454.1• 1998
	Non-machine-driven tripping device, such as light-electricity device	•	•	•	•	GB/T 19876• 2005 GB/T 19436.1• 2004
5.1.1.3.1	Stop of the calendering roller		•	•	•	
	Interlocking devices associated with guards	•	•	•		GB/T 8196• 2003 GB/T 18831• 2002
5.1.1.3.2	Roller separation	•	•	•		
5.1.1.3.3	Reverse salvage action	•	•	•		
5.1.1.4	Tripping bar	•	•	•	•	GB 12265.1• 1997 GB/T 18831• 2002
	Auxiliary fixed protection	•		•		GB 12265.1• 1997 GB/T 8196• 2003
5.1.1.5	Safety device 1					See 5.1.1.2 in the Table
	Safety device 2					See 5.1.1.4 in the Table
	The combination of the two safety devices	•	•	•	•	
5.1.1.6	Emergency stop device	•	•	•		GB 16754• 2008 GB 5226.1• 2002
5.1.1.7	Pattern selector	•	•			GB/T 15706.2• 2007
	Sound alarm signal		•	•		GB 1251.1 GB/T 18209.1
	Other control methods in the situations of removing or replacing the safety devices	•	•			GB/T 15706.2• 2007
5.1.1.8	Flashing light signals	•	•			
	Keep moving stop-move controlling device	•	•	•		

Table 1 (Continued)

Terms	Safety measures	Verifying methods				Reference standard
		Appearance examination	Function test	Measurement	Calculation	
5.1.1.9	Clean-up	•	•	•		GB 12265.1• 1997 EN 614-1 See 5.1.1.1, 5.1.1.2 and 5.1.1.4 in the Table
5.1.1.10	Setting, process transferring, fault clearance and maintenance	•	•			GB/T 15706.2• 2007
5.1.2	Distance			•		GB 12265.1• 1997
	Location			•		GB 12265.3• 1997
	Fixed protection	•		•		GB/T 8196• 2003 See 5.1.1.1 in the Table
	Interlock protection	•	•	•	•	GB 12265.3• 1997 GB/T 8196• 2003 GB/T 19876• 2005 GB/T 18831• 2002
	Interlocking devices associated with guards	•	•			GB/T 8196• 2003 GB/T 18831• 2002
	Tripping device	•	•	•	•	GB/T 8196• 2003 GB/T 19876• 2005 See 5.1.1.2 in the Table
5.1.3.1	Cutter trimmer on the rest position	•				
	Fixed distance protection	•		•		GB 12265.1• 1997 GB/T 8196• 2003
	Fixed protective cover	•				GB/T 8196• 2003
5.1.3.2	Flap			•		
5.1.3.3	Fixed protective device	•				GB/T 8196• 2003
	Tripping device					See 5.1.1.2 in the Table
	Minimal interval			•		GB 12265.3• 1997
	Driving force limitation			•		
5.2	Electrical risk	•	•	•		GB/T 15706.2• 2007 GB 5226.1• 2002 GB 4208• 2008
5.3.1	Fixed protection, heat insulation	•		•		GB/T 18153.2• 2000
	Warning label	•				
5.3.2	Sealed protective cover or screen	•				
	Restricting device	•				GB/T 15706.2• 2007
5.3.3	Shield	•				
	Distance	•				

Table 1 (Continued)

Terms	Safety measures	Verifying methods				Reference standard
		Appearance examination	Function test	Measurement	Calculation	
5.4	Noise	•		•		GB/T 15706.2• 2007 GB/T 14574 GB/T 6881.2• 2002 GB/T 6881.3• 2002 GB/T 3767 GB/T 3768 GB/T 16538 GB/T 16404• 1996 GB/T 16404.2• 1999 GB/T17248.2• 1999 GB/T 17248.3• 1999 GB/T 17248.4• 1998 GB/T17248.5• 1999 ISO 11688-1• 1998 ISO 11688-2• 1999
5.5	Mechanical conveying device	•	•			
5.6	Stop of the roller		•			See 5.1.1.3.1 in the Table
	Auxiliary separating device independent from power supply	•	•			See 5.1.1.3.2 in the Table
5.7.1	Safety of the components related to the control system		•			GB/T 16855.1• 2005
5.7.2	Unexpected start		•			GB/T 19670 GB 5226.1• 2002
5.8	Safe approaching method	•		•		GB/T 15706.2• 2007 GB/T 17888.1• GB/T 17888.4

6.2 The function test in Table 1 involves verifying the function and effectiveness of the protective device and safety device•

- Operating instructions;
- Design materials related to safety;
- Chapter 5 of the standard and requirements of other standards provided.

7. Operation Information

Operation information shall conform to the prescription in Chapter 6 of GB/T 15706.2• 2007.

7.1 Operating Instructions

Operating instructions provided shall conform to the requirements in 6.5 of GB/T 15706.2• 2007 and include the following instructions relating to the safety of calenders.

7.1.1 Instructions relating to machine design

Instructions relating to machine design are as follows:

- a• Low-velocity value v_1 , step-down velocity value v_r , the maximal velocity value v_{max} ;
- b• Parking angle α , α_{max} and α_r (if applicable);
- c) The user shall not change the detailed safety device position;
- d) Noise transmitting announcement conforming to the requirements in 6.5.1c) of GB/T 15706.2• 2007 and prescriptions in GB/T 14574, the announcement shall be duplicated one prescribed in GB/ T 14574, see 5.4.2 for the test.
- e) If applicable, the machine shall be equipped with a sound insulation cover, noise protection screen or silencer.

7.1.2 User guidance

User guidance:

a) Instructions relating to the measuring process and method of the parking angle and the frequency of the stop test, the guidance explains the measuring methods adopted in readjusting the stop system to ensure that:

- The parking angle measured is no more than parking angle • prescribed;
- The parking angle measured shall be no more than α_{max} in case of power failure (see 5.1.1.3.1);

If the stop system includes a machine stop and an electrical stop, the operating instructions shall include the test for the whole stop system and the individual test for the machine system.

- b) Saving measurements for reverse assistant actions (see 5.1.1.3.3);
- c) Instructions about methods and frequency of tripping bar function test (see 5.1.1.4), or instructions relating to the two safety devices' combination (see 5.1.1.5);
- d) The tripping bar shall be used correctly and not used for normal parking.
- e) For definition of dangerous zones and requirements for alarms in 7.2, it is stressed that the operator is not permitted to stand on the dangerous ground or workbench after installation of the calender is finished;
- f) Instruction about the start, setting, process transferring, fault clearance and maintenance of the machine
 - g) Safety process of roller cleaning (see 5.1.1.9);
 - h) Safety process of fixing and changing the cutter trimmer (see 5.1.3.1);
 - i) Instruction about grounding requirement because of static danger;
 - j) If applicable, directions about personal safety devices shall be provided, such as protective gloves to prevent hands from burning by touching the heat components of the calender or other hot materials.
 - k) If applicable, adopt sound insulation cover, sound insulation room, or operating and maintenance patterns to decrease noise;
 - l) To decrease the noise, take some measures in installation and assembly, such as an anti-vibration device;
 - m) If applicable, personal hearing protection shall be provided;
 - n) Safety process in changing the rollers;
 - o) Application instructions of the roller separating device irrelevant to the normal power supply mentioned in 5.6.

7.2 Labels

Labels shall be made according to the requirements in 6.4 of GB/T 15706.2• 2007.

The following labels shall be included for each calender:

- Name of the manufacturer and supplier;
- Label of mandatory requirement;
- Design sequence number or type number;
- Serial number or machine code;
- Warning label of hot surface.

Also, tripping bars shall be installed on the calender according to 5.1.1.4;

——The definition of a dangerous zone shall be clear and marked with a consistent line (arc) on the frame on the two sides of the roller, the line width shall be no less than 10mm and broaden to the horizon of the surface of the roller;

——On the machine near the tripping bar, a warning label reading “When the tripping bar is not started, crossing the boundary is dangerous.” shall be placed.

Annex A(Informative annex)Examples of different types of calenders

From Chart A.1 to Chart A.5, the rollers can be different.

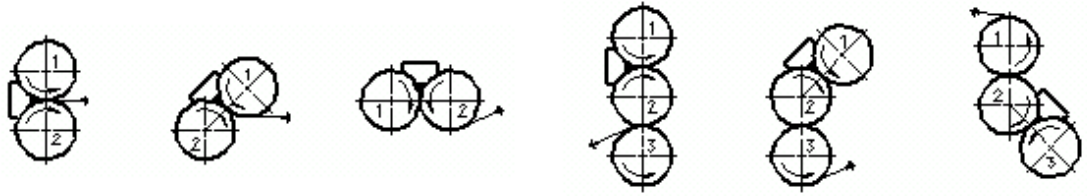


Chart A.1 Two-roll calender

Chart A.2 Three-roll calender

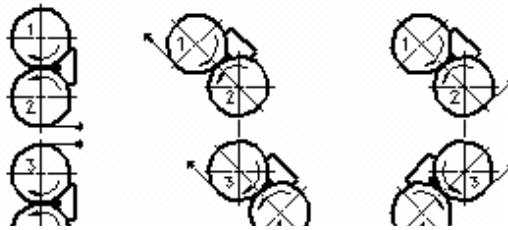


Chart A.3.2 • 2-roll calender

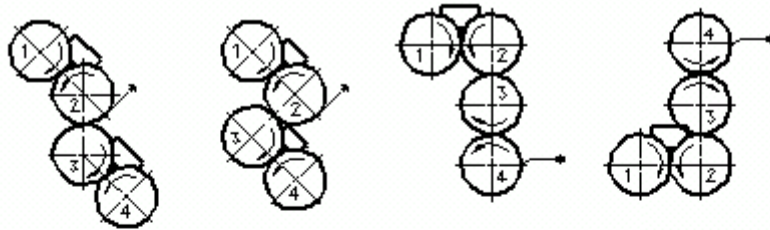


Chart A.4 Four-roll calender

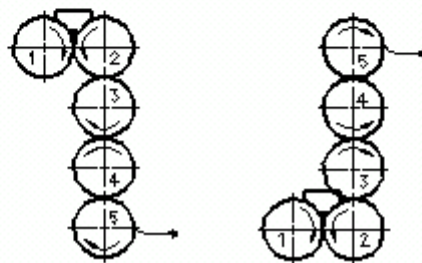


Chart A.5 Five-roll calender

Annex B (Informative annex) Examples of calendaring technologies

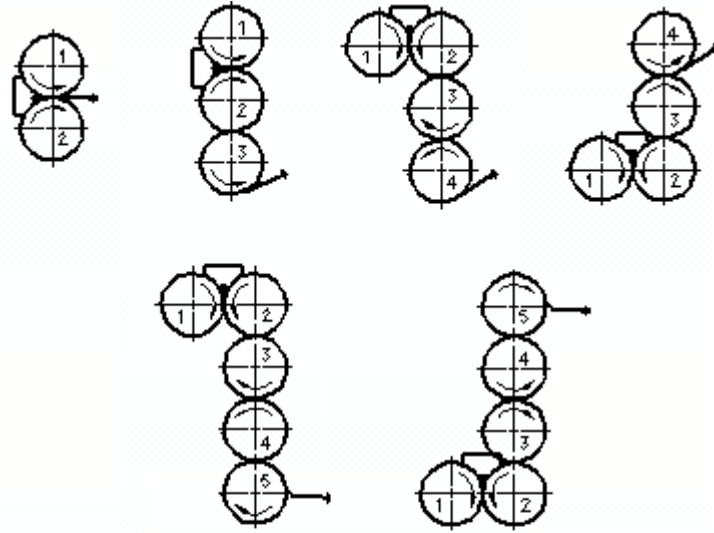


Chart B.1 Tableting

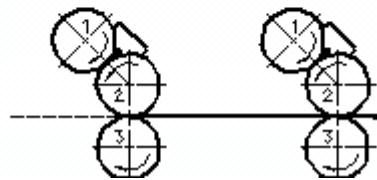


Chart B.2 Two-layer tableting

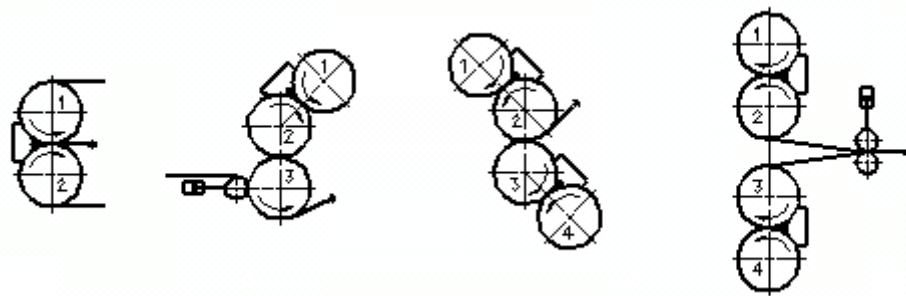


Chart B.3 Single-surface double-layer

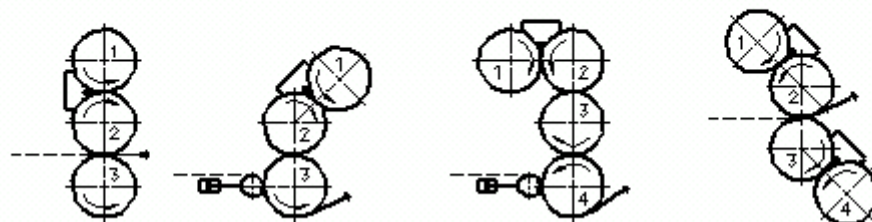


Chart B.4 Single-surface rubberising

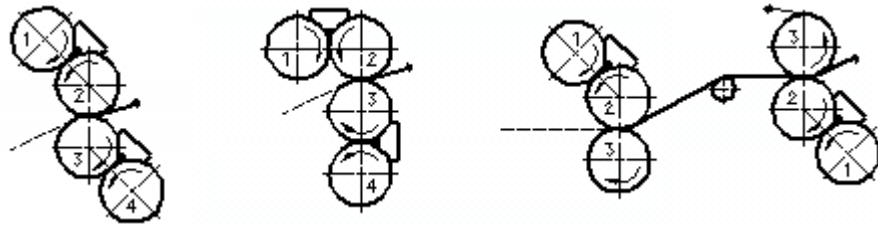


Chart B.5 Double-surface rubberising

Annex C(Informative annex)The risk caused by processing materials

C.1 Introduction of risk

Touching and/or soaking in poisonous gas, vapour, smoke or dirt in processing the materials.

C.2 Protection of material risk

In designing the machine, on the basis of not influencing the original mechanical structure, an air-exhaust device shall be installed and fixed; the poisonous gas can be released in time.

See requirements in 5.4 of GB/ T 15706.2-2007.

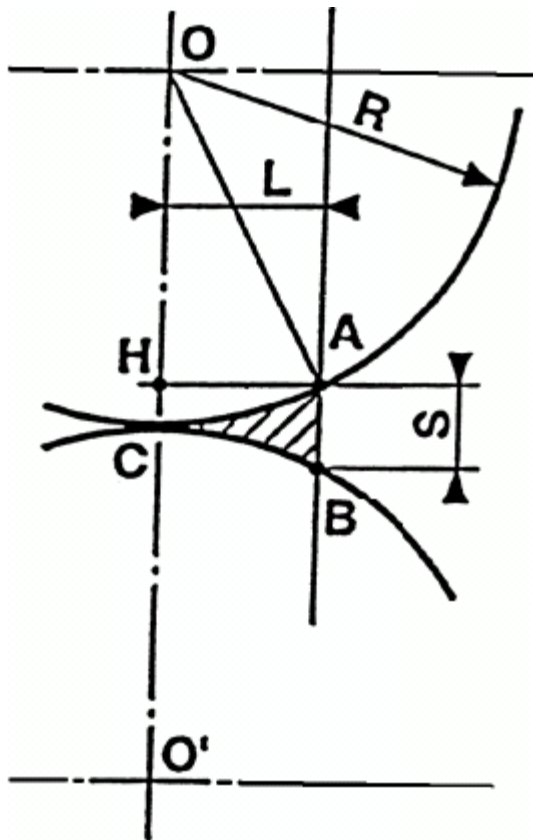
C.3 User guidance

If the release of poisonous substances is likely while processing certain materials, guidance books about installing and locating the exhaust system shall be provided to the users to instruct them. The installation of the exhaust system shall be convenient to the installation and the disassembly of the calender rolls.

When eyes and/or skin are likely to touch poisonous materials or substances, the users shall provide personal protective devices to the operators.

Annex D (Informative annex) Calculation of the Suction Area Size (to rollers with the same diameter)

- OO• •• Axis of the roller;
- C •• Theoretical roller contact point;
- OA •• Radius of the roller• OA• R••
- AB •• The entry of the suction zone• A B• S• 12mm••
- H •• Projection of A on the OO' axis;
- AH •• Depth of the suction zone• AH• L••



$$OA^2 = OH^2 + AH^2$$

$$AH^2 = OA^2 - OH^2$$

$$AH = \sqrt{OA^2 - OH^2} \text{ where } OA = R$$

$$\text{and } OH = R - \frac{S}{2}, \text{ and } AH = L$$

$$L = \sqrt{R^2 - \left(R - \frac{S}{2}\right)^2}$$

$$L = \sqrt{\left(R + R - \frac{S}{2}\right)\left(R - R + \frac{S}{2}\right)}$$

$$L = \sqrt{\left(2R - \frac{S}{2}\right)\frac{S}{2}}$$

$$L = \sqrt{RS - \frac{S^2}{4}} \text{ where } S = 12$$

$$L = \sqrt{12R - \frac{144}{4}}$$

Chart D.1 Calculation of the dimension

$$L = \sqrt{12(R - 3)} \text{ can be simplified to}$$

$$L = \sqrt{6D}$$

For example: if R=300 mm • diameter of roller D• 600 mm•

$$L = \sqrt{6 \times 600} = 60\text{mm}$$

Annex E (Informative annex) Fixed protective device of the suction zone

The unit is mm

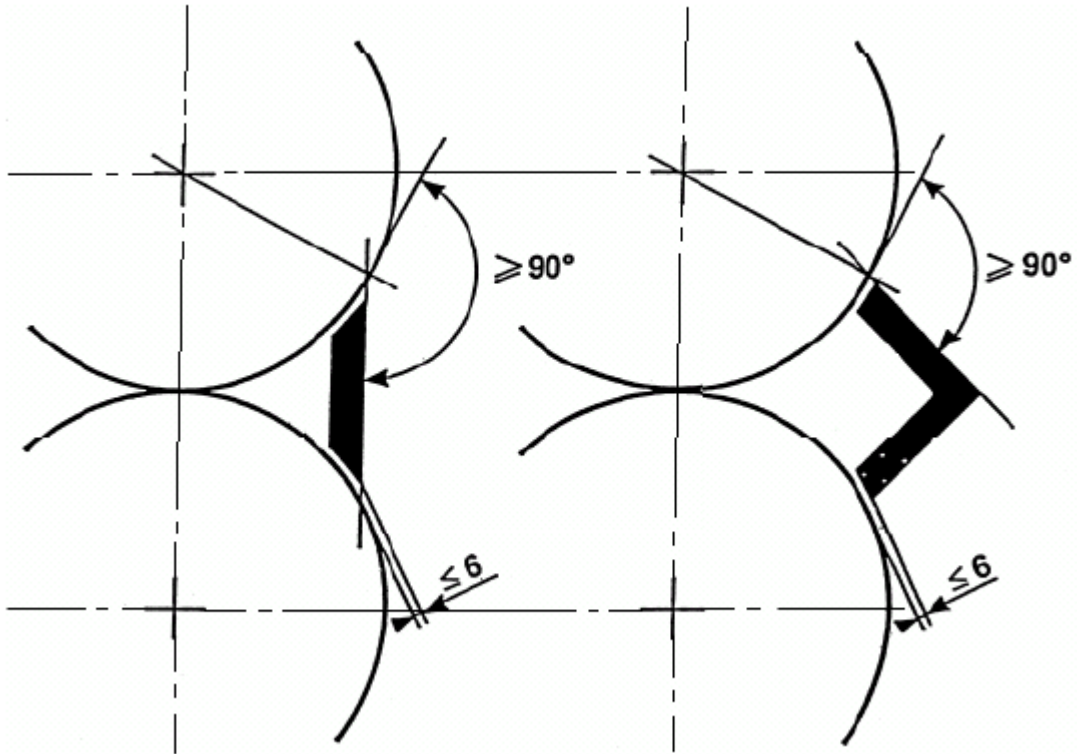


Chart E.1 Legends of fixed protections of the suction zone

Annex F(Informative annex) Example of Special Protection by Restricting Movement to Prevent Entering into the Suction Area

F.1 Introduction

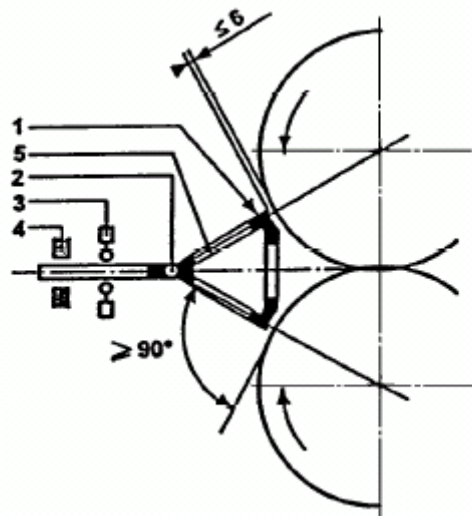
The protective device that extends to the length of the whole roller, used to prevent the operator's fingertips from entering into the suction zone. It is required that in the installation, the operator is able to see the roll gap clearly. This kind of protective device is particularly applicable to the processing protection of fibre hangings.

F.2 Structure and performance

F.2.1 The protective device is composed of bars or rings with small intervals, with numerous holes along it. The intervals and holes are determined according to Table 3 or Table 4 in GB 12265.1-1997. The design of the protective shape must ensure that the protection and the angle and interval of the roller are no more than the size mentioned in Chart 1.

F.2.2 If the hands or materials are entangled between the protection and roller, the protection will rotate around the horizontal axis. The rotation will touch the position sensor to stop the calender roller. The protection will be turned back by a block and keep an interval of 6mm with the roller. When evacuating the hands or materials, the protection will return to the static position to avoid restart.

The unit is mm



1 • • Protection; 2 • • pivot; 3 • • position sensor; 4 • • block; 5 • • Intervals and holes on the protective device.

Chart F.1 Examples of special protections

Annex G
(Informative annex)

Table G.1 Check List for Relevant Standards Quoted by the Standard

National standards quoted in the standard	Corresponding standards quoted in the International Standard EN12301 • 2000
GB 1251.1.1• 2008	ISO 7731• 2003 EN 457• 1992
GB/T 3767.2• 1996	ISO 3744• 1994 EN ISO 3744• 1995
GB/T 3768.2• 1996	ISO 3746• 1995 EN ISO 3746• 1995
GB 4208.1• 2008	IEC 60529• 2001 EN 60529• 1991
GB 5226.1.1• 2002	IEC 60204-1• 2000 EN 60204-1• 1997
GB/T 6881.2.2• 2002	ISO 3743-1• 1994 EN ISO 3743-1• 1995
GB/T 6881.3.2• 2002	ISO 3743-2• 1994 EN ISO 3743-2• 1996
GB/T 8196.2• 2003	ISO 14120• 2002 EN 953• 1992
GB 12265.1• 1997	— EN 294• 1992
GB 12265.3.1• 1997	— EN 349• 1993
GB/T 14574.2• 2000	ISO 4871• 1996 EN ISO 4871• 1996
GB/T 15706.1.2• 2007	ISO 12100-1• 2003
GB/T 15706.2• 2007	ISO 12100-2• 2003 EN 292-2• 1991/A1• 1995
GB/T 16404.2• 1996	ISO 9614-1• 1993 EN ISO 9614-1• 1995
GB/T 16404.2.2• 1999	ISO 9614-2• 1996 EN ISO 9614-2• 1996
GB/T 16538.2• 2008	ISO 3747• 2000 ISO /DIS 3747• 2000
GB 16754.1• 2008	ISO 13850• 2006 EN 418• 1992
GB/T 16855.1.2• 2005	ISO 13848-1• 1999 EN 954-1• 1994
GB/T17248.2• 1999	ISO 11201• 1995 EN ISO 11201• 1995
GB/T 17248.3.2• 1999	ISO 11202• 1995 EN ISO 11202• 1995

Table G.1 (Continued)

National standards quoted by the standard	Corresponding standards quoted by the International Standard EN12301 • 2000
GB/T 17248.4.2• 1998	ISO 11203• 1995 EN ISO 11203• 1995
GB/T17248.5• 1999	ISO 11204• 1995 EN ISO 11204• 1995
GB/T 17454.1.2• 1998	— EN 1760-1• 1994
GB/T 17888.1.2• 2008	ISO• DIS 14122-1• 2001 Pr EN 12437-1• 1996
GB/T 17888.2.2• 2008	ISO• DIS 14122-2• 2001 Pr EN 12437-2• 1996
GB/T 17888.3.2• 2008	ISO / DIS 14122-3• 2001 Pr EN 12437-3• 1996
GB/T 17888.4.2• 2008	ISO / DIS 14122-4• 2004 Pr EN 12437-4• 1996
GB/T 18153.2• 2000	• EN 563• 1994
GB/T 18209.1.2• 2000	IEC 61310-1• 1995 IEC 61310-1• 1995
GB/T 18831.2• 2002	ISO 14119• 1998 EN 1088• 1995
GB/T 19436.1.2• 2004	ICE 61496-1• 1997 EN 61496-1• 1998
GB/T 19670.2• 2005	ISO 14118• 2000 EN 1037• 1995
GB/T 19876.2• 2005	ISO 13855• 2002 EN 999• 1998