
**Graphic technology — Safety
requirements for graphic technology
equipment and systems —**

**Part 4:
Converting equipment and systems**

*Technologie graphique — Exigences de sécurité pour les systèmes et
l'équipement de technologie graphique —*

Partie 4: Systèmes et équipement de façonnage

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 130, *Graphic technology*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 198, *Printing and paper machinery — Safety*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 12643-4:2010), which has been technically revised.

The main changes are as follows:

- in [Clause 3](#), terms and definitions, in particular concerning corrugated board machinery, have been added;
- a new [Clause 4](#) has been added and subsequent clauses have been renumbered;
- throughout the document, requirements related to hazards dealt with in ISO 12643-1:2023 have been deleted (e.g. Safeguarding automatic reel loading in [6.2](#));
- in [Clause 6](#), the requirements for machinery for the production of corrugated board, e.g. terminological amendments, has been revised;
- [Figure 14](#) has been updated;
- in [6.3.3](#), the description of measures to safeguard the movable splicer module have been revised;
- in [6.8.2](#), an exception to the continued running of glue rollers in the gluing unit in case of an emergency stop has been added;
- in [6.16.1](#), limitation of the speed of the conveyor belt to 45 m/min, if access is required for production reasons, has been specified;

- [Clause 7](#) has been revised;
- in [Clause 8](#), the requirement to safeguard entry into the pile carrier plate with ESPDs has been amended;
- in [9.2.4](#), requirement for residual pile monitoring as safety device set to PL d / SIL 2, and a figure showing the safeguarding of hazard points outside the sidelays on feeders has been added;
- in [Clause 10](#), requirements on safeguarding the delivery on automatic flatbed die-cutting machines (sheet gripper system, analog ISO 12643-2:2023) have been added;
- in [Clause 13](#), a subclause on requirements for interlocks has been added;
- [Clause 14](#), which is also applicable to machinery for the production of interfolded facial tissues, has been added (taken and adapted from EN 1010-5);
- a new [Clause 15](#) has been added;
- in [Clause 16](#), a table on the verification of the safety requirements and/or protective/risk reduction measures has been added;
- a new [Annex A](#) with a list of significant hazards has been added;
- in [Annex B](#), an example of noise declaration for paper converting machines has been added.

This document is intended to be used in conjunction with ISO 12643-1:2023.

A list of all parts in the ISO 12643 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type-C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e. g. trade unions, organizations for people with special needs);
- service providers, e. g. for maintenance (small, medium and large enterprises);
- consumers (in the case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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

The purpose of this document is to reduce the risk of injury to operating personnel working on converting equipment.

During the development of this document, existing relevant standards of other countries were taken into consideration. In cases where it was known that there is a national requirement that differs from this document, that has been noted.

This document was developed to harmonize the following US and European safety standards:

- ANSI/PMMI B155.1^[8]
- EN 1010 4^[9]
- EN 1010-5^[10]

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

The full set of requirements for graphic technology equipment and systems are those given in the part of ISO 12643 applicable to that type, together with the relevant requirements from ISO 12643-1:2023, to the extent specified in the Scope of the applicable part of ISO 12643.

This document supplements and modifies the general requirements of ISO 12643-1:2023. Where a requirement of this document conflicts with a requirement of ISO 12643-1:2023 the requirement of this document will take precedence.

Graphic technology — Safety requirements for graphic technology equipment and systems —

Part 4: Converting equipment and systems

1 Scope

This document deals with all significant hazards, hazardous situations or hazardous events relevant to converting equipment and systems used in the corrugated board, package printing, converting and graphic technology industries (see [Clause 5](#)), when it is used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

This document is applicable to converting equipment not covered by other parts of ISO 12643.

This document is not applicable to the machinery or machinery components manufactured before the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 12643-1:2023, *Graphic technology — Safety requirements for graphic technology equipment and systems — Part 1: General requirements*

ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13854:2017, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

IEC 60529:1989+AMD1:1999, *Degrees of protection provided by enclosures (IP code)*

IEC 61496-1:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

IEC 61496-2:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 62061:2021, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 12643-1:2023 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 access height

<automatic flatbed die-cutting machine delivery zone> dimension of the maximum opening into the area below the sheet gripper, measured between the access level and the lower edge of fixed machine parts

Note 1 to entry: Examples for the access level are floor, fixed platform or footboard.

Note 2 to entry: Examples for fixed machine parts are fixed guard, fixed cover or fixed parts such as a sheet stop.

Note 3 to entry: See [Figure 27](#).

3.2 bridge

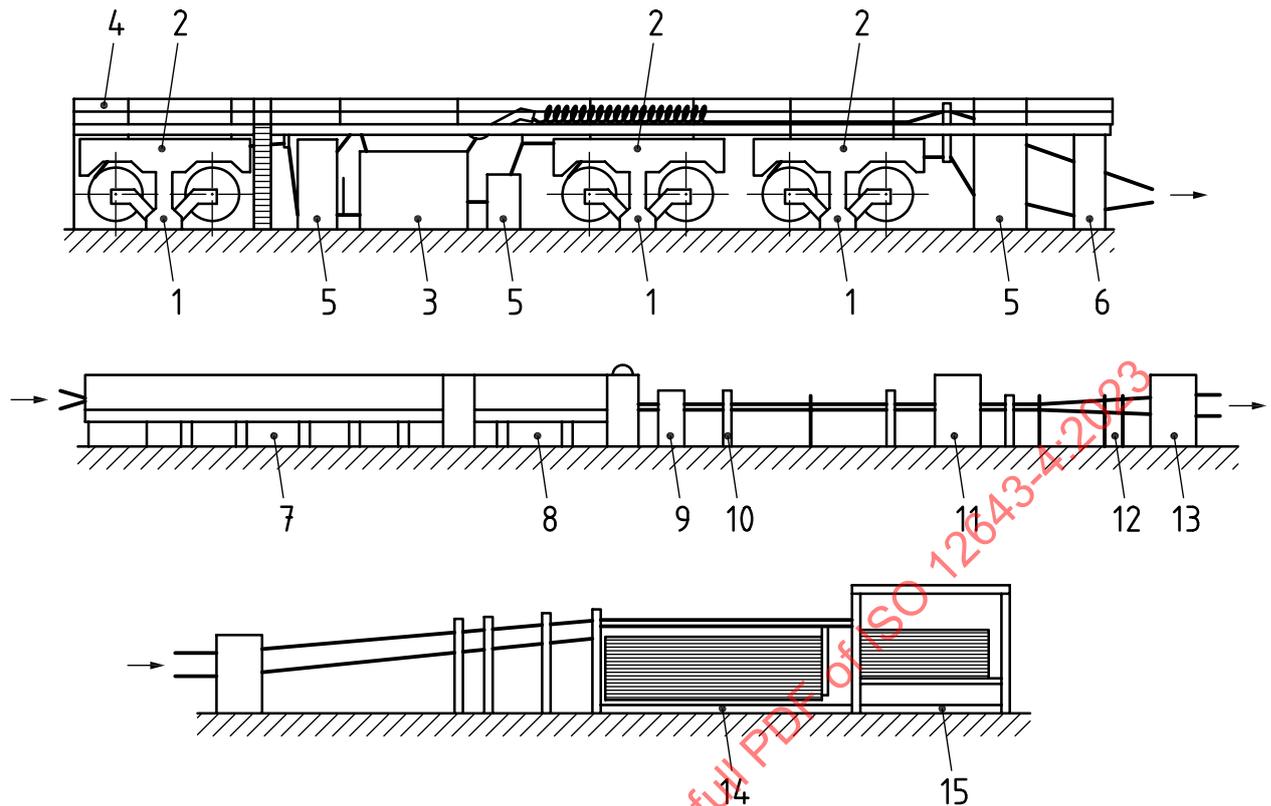
transport system positioned in an upper level (e.g. above the single facer, splicer or gluing unit) serving as storage facility

Note 1 to entry: The inclined belt conveyor feeds the single faced corrugated board to the bridge where it is deposited in loops and subsequently fed to the following machines

3.3 corrugating machine corrugated board machinery

machinery which produces board consisting of one or more layers of fluted paper glued to one or more layers of flat paper or board and which produces the fluted web to be glued in-line by means of two corrugating rollers

Note 1 to entry: An example of a corrugating machine is shown in [Figure 1](#).



Key

- | | | | |
|---|-----------------|----|---------------------|
| 1 | unwind | 9 | rotary shear |
| 2 | splicer | 10 | pulling unit |
| 3 | single facer | 11 | slitter-scorer unit |
| 4 | bridge | 12 | web diverter |
| 5 | preheater | 13 | cut-off |
| 6 | gluing machine | 14 | upstacker |
| 7 | heating section | 15 | downstacker |
| 8 | pulling section | | |

Figure 1 — Example of a machine for the production of corrugated board

3.4

cut-off

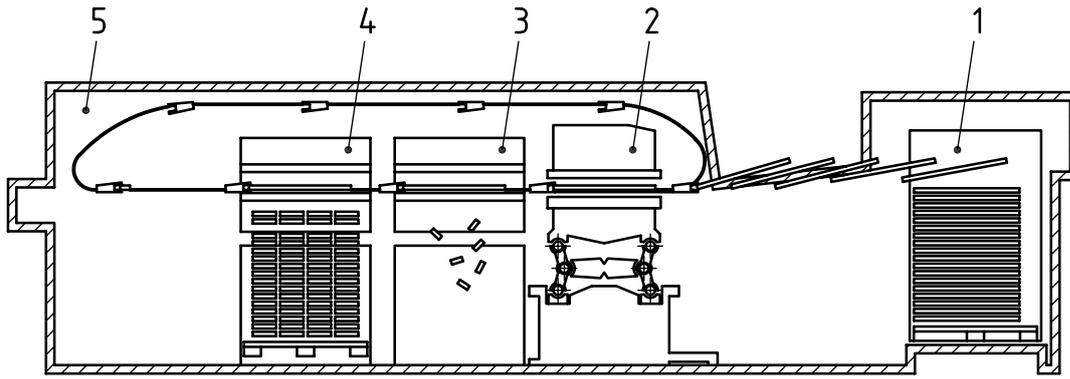
machine which cuts the material to a pre-determined length

3.5

die-cutter

flatbed die-cutting machine

machine which cuts and/or creases the material and/or strips the waste from the material



Key

- 1 feeder
- 2 punching section
- 3 breaking section
- 4 blank separating section, delivery
- 5 trimming of gripper edge, delivery

Figure 2 — Example of an automatic flatbed die-cutting machine

**3.6
downstacker
auto-piler**

stacking device on corrugated board machines where the position of the feeding conveyor remains unchanged and the pile is created by the lowering movement of the pile carrier

**3.7
folding section**

part of a folder gluer which folds the substrate to its required position

**3.8
gluing machine**

separate machine for applying an even layer of glue onto the top of the corrugations of one or more single faced board webs

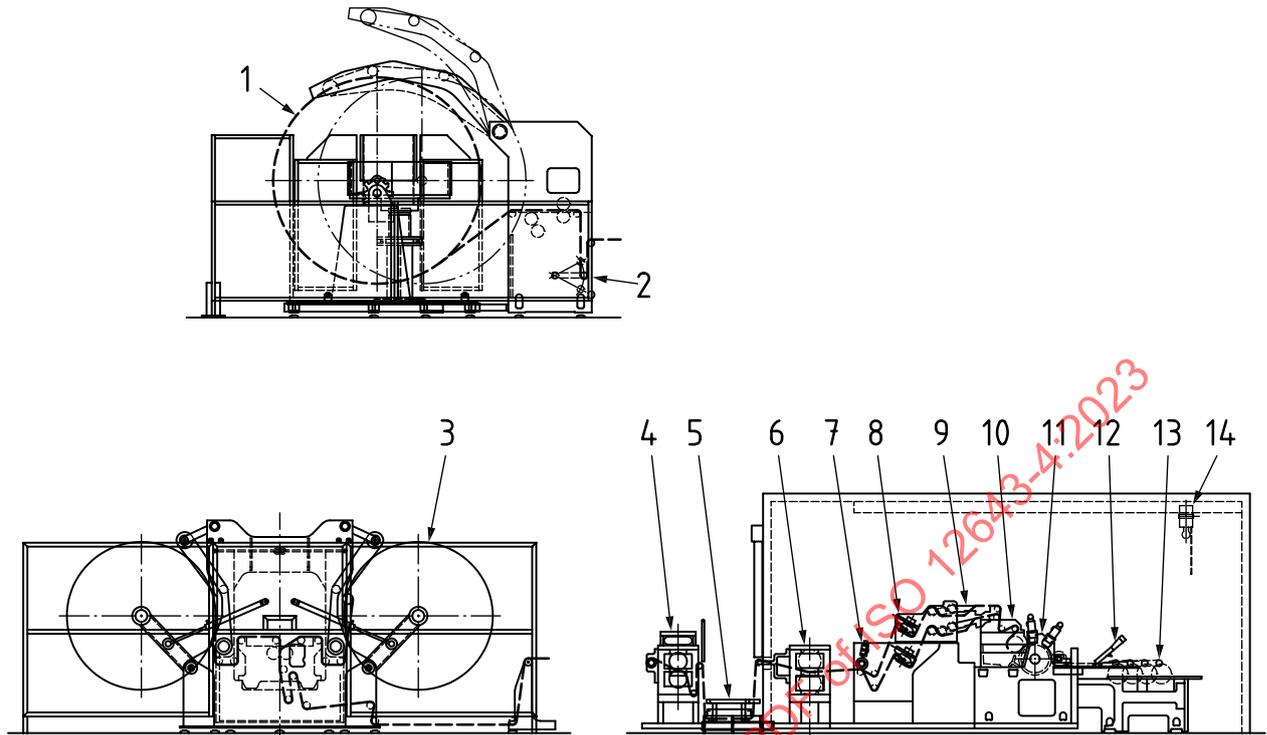
**3.9
gluing unit**

part of a *single facer* (3.19) or *gluing machine* (3.8) which applies a layer of adhesive to the fluted board peaks

**3.10
handkerchief machine**

machine for the in-line production of tissue-based handkerchiefs, which includes calendaring, embossing, folding and cutting

Note 1 to entry: An example of a handkerchief machine is shown in [Figure 3](#).

**Key**

- | | | | |
|---|------------------------------|----|-------------------------------|
| 1 | star-type unwinding | 8 | aligning section |
| 2 | dancer roller | 9 | longitudinal folding section |
| 3 | unwinding device | 10 | sheeter cylinder |
| 4 | smoothing section | 11 | cross folding cylinder |
| 5 | web guide control | 12 | waste suction device |
| 6 | embossing section | 13 | counting and transfer section |
| 7 | longitudinal cutting section | 14 | noise hood |

Figure 3 — Machine for the production of handkerchiefs**3.11****inclined belt conveyor**

transport system for feeding the single-faced corrugated board onto the *bridge* (3.2)

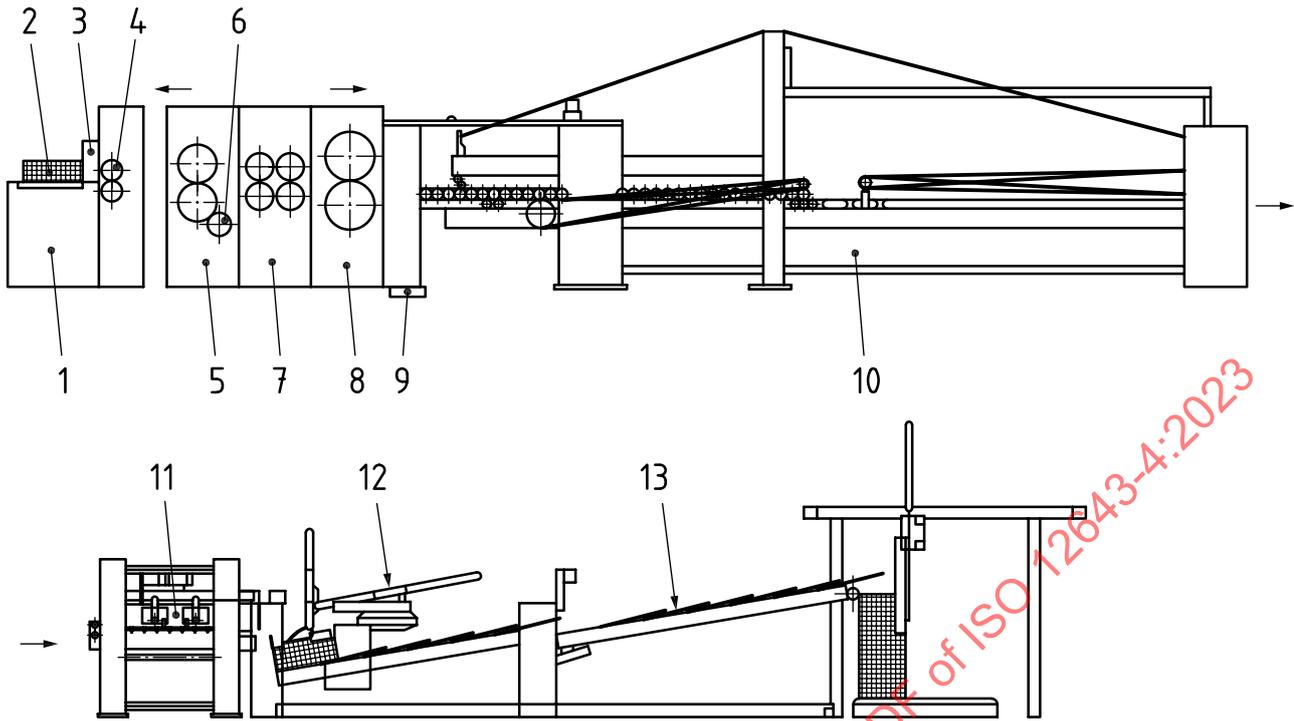
3.12**inclined belt conveyor side**

that side of a *single facer* (3.19) where the corrugated board is delivered and fed onto the *bridge* (3.2) by the inclined *belt conveyor* (3.11)

3.13**in-line machine**

machine for processing board and corrugated board, consisting of a number of units such as a feeding unit, one or more printing units, slitter-scoring unit, rotary die-cutter, gluing unit, folding unit, stitching unit, taping unit

Note 1 to entry: Depending on the type of machine, one or more of the units listed may be missing.



Key

- | | | | |
|---|---------------------------|----|-----------------------------------|
| 1 | feeding unit | 8 | rotary die-cutter |
| 2 | blank pile | 9 | waste discharge conveyor belt |
| 3 | side alignment | 10 | folding unit |
| 4 | feed rollers | 11 | stitching unit |
| 5 | printing unit | 12 | counter-ejector and squaring unit |
| 6 | ink roller | 13 | delivery |
| 7 | slitting and scoring unit | | |

Figure 4 — In-line machine

3.14

pile turner

machine that is used to turn over/rotate material

Note 1 to entry: Can be part of a *pre-feeder* (3.15).

3.15

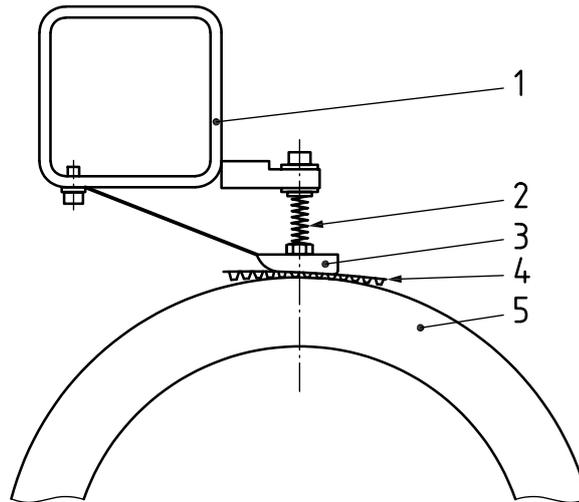
pre-feeder

system that provides material to the feed of the machine

3.16

pressing device

part of a gluing machine of a corrugating machine, that ensures that the single faced web is evenly immersed into the glue film

**Key**

- 1 cross beam/support
- 2 load spring
- 3 single faced web
- 4 pressing shoe
- 5 applicator roll

Figure 5 — Pressing device with spring-loaded design

3.17**rotary shear**

rotary cutter for cutting the traveling corrugated cardboard web across the working width in the event of format change and for removing waste material

Note 1 to entry: Rotary shears are necessary for the cross-cutting of the corrugated board web, when the format is changed, or waste are removed.

3.18**separator**

part of machine which separates the die cut material

3.19**single facer**

equipment where corrugations are embossed into a paper web by using two corrugating rollers and where a liner is glued onto one side

3.20**slitter-scorer**

machine which slits and scores material to a pre-determined depth

3.21**upstacker**

stacking device on corrugated board machines where the position of the pile carrier remains unchanged and the pile is created by the upward movement of the conveyor belt

3.22**web diverter**

system of movable elements for diverting and feeding the slit webs delivered from the slitting and scoring unit into the sheeter

3.23

weighting device

assembly of a corrugating machine which controls the degree of drying in the heating and pulling section

Note 1 to entry: The more heating plates are in contact with the web and thus with the heating plate the higher is the degree of drying.

4 Significant hazards

The list of significant hazards covered by this document is given in [Annex A](#).

5 Equipment and interrelation between this document and ISO 12643-1:2023

5.1 General

This document covers a variety of equipment used in printing plants and converting operations. Those used primarily in a converting operation are listed in [5.2](#), while those that may be used in a printing operation covered in other parts of ISO 12643 are listed in [5.3](#).

Converting equipment and systems used in the corrugated board, package printing, converting and graphic technology industries complies with the requirements of ISO 12643-1:2023, as far as not modified or replaced by the requirements of this document.

5.2 Machines used primarily in a converting operation

Machines used primarily in a converting operation include the following:

- machinery for the production of envelopes;
- handkerchief machines;
- machinery for the production of interfolded facial tissues;
- machinery for the production of corrugated board;
- folding-box gluer machines;
- in-line machines;
- automatic flatbed punching machines;
- tube-winding machines;
- box-making machines;
- finishing/window equipment;
- hole punching machines;
- laminating machines/laminators;
- pre-feeding/stack-turning machines.

5.3 Machines used in both printing and converting processes

Examples of machines used in both printing and converting processes include the following:

- label printing machines (see also ISO 12643-1:2023 and ISO 12643-2:2023);

- coating machines (see also ISO 12643-3:2023);
- curing and drying machines (see also ISO 12643-2:2023);
- cutters, creasers and die-cutters (see also ISO 12643-3:2023);
- breakers (separators, stripping station) (see also ISO 12643-1:2023);
- embossing equipment (see also ISO 12643-2:2023);
- tension control equipment (see also ISO 12643-1:2023);
- rewinding/roll equipment/slitting and rewinding equipment (see also ISO 12643-1:2023);
- foil unwinders (see EN 13418:2013);
- extruders (see EN 1114-1:2011).

NOTE This document is not applicable to winder-slitters and sheeters in paper finishing (sheeters with unwinders).

6 Machinery for the production of corrugated board

6.1 All machines

6.1.1 Emergency stop

Emergency stop devices shall be provided in accordance with ISO 13850:2015 and, as a minimum, on each control station that initiates the start of the entire machine. Emergency stop devices shall be no more than 15 m apart.

Emergency stop devices shall stop the motion of the entire machine unless control zones are being used (see [6.1.2](#)).

As an exception, the glue rollers of the gluing unit may continue running if the hazard points on the gluing unit are safeguarded by guards.

As an exception, the ink and print rollers of the printing unit may continue running if the hazard points on the printing unit are safeguarded by guards.

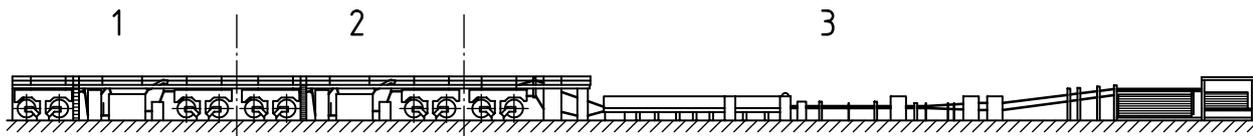
6.1.2 Control zones with stop/safe pushbuttons

Where the machine is configured into control zones, they shall be as follows (see [Figure 6](#)):

- one control zone for each single facer group (unwind of liner with preheater, single facer, unwind of medium);
- one control zone for the liner unwind before heating up to stacker device.

At minimum, one stop/safe pushbutton in accordance with ISO 12643-1:2023, 5.7.2.5.2 shall be provided in each control zone.

NOTE Control zones can overlap.



Key

- 1 first control zone for first single facer group
- 2 second control zone for second single facer group
- 3 third control zone for liner unwind up to stacker device

Figure 6 — Example of control zones

6.1.3 Steam pipes

Steam pipes that can be accessed from any working level shall be insulated up to a height of 2,70 m from the working level for protection against contact with hot parts.

6.2 Unwinding stations

6.2.1 General

Means shall be provided to ensure that reel cores, which might be stuck to a chucking cone, can be safely removed, e.g. using an automatic reel core ejector that pushes the core away from the chucking cone.

6.2.2 Chucking cones and lifting arms

Inserting chucking cones and moving lifting arms shall be accomplished with hold-to-run control. Hold-to-run speeds for inserting the chucking cones and moving the lifting arms may be increased to 15 m/min maximum if the hold-to-run buttons are located at a minimum distance of 850 mm from the lifting arms.

6.2.3 Braking systems

The blowers for the braking systems on unwinding stations shall have at least the degree of protection IP 23, as specified in IEC 60529:1989+AMD1:1999+AMD2:2013. Accumulation of flammable dust in the brakes shall be prevented.

NOTE The accumulation of flammable dust in the brakes can be reduced if the louvres provided in the ventilator housing open to the bottom while the lifting arms are in operating position.

6.3 Splicers

6.3.1 Guarding hazard points

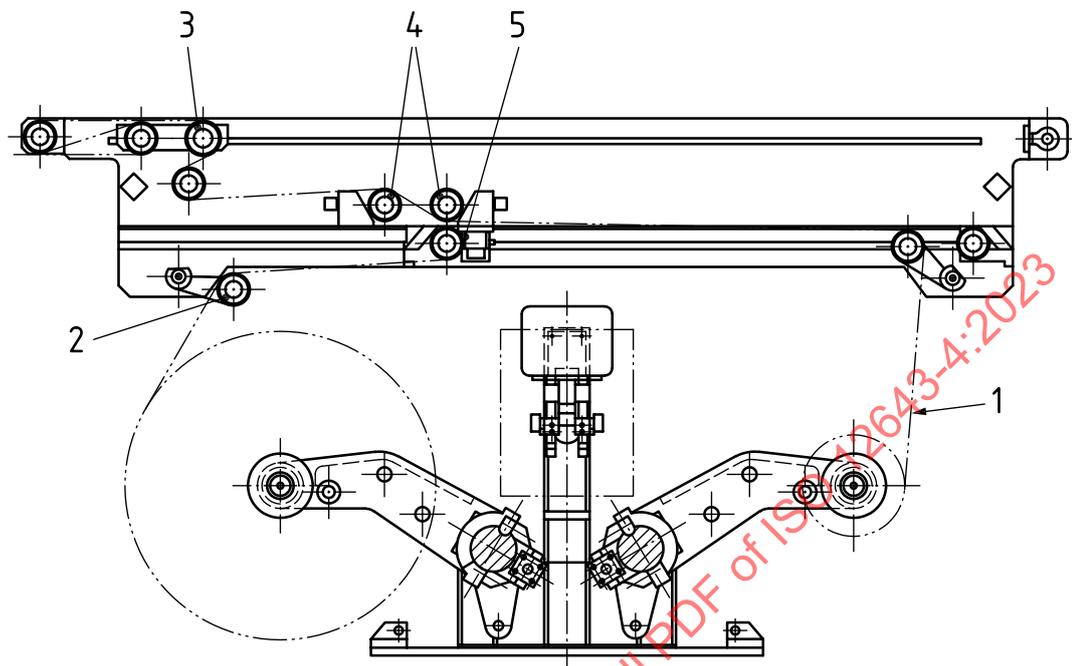
On splicers, any hazard points between the dancer roller carriage and guide rollers, and between the dancer roller and fixed parts of the machine shall be avoided by design measures or be safeguarded (see [Figure 7](#)).

If safeguarding by distance, the following requirements apply:

- a minimum distance of 25 mm if the hazard points are at a height greater than 2,20 m;
- a minimum distance of 120 mm if the hazard points are at a height less than or equal to 2,20 m.

6.3.2 Dancer roller

Where hold-to-run control is used for safeguarding, the hold-to-run speed shall not exceed 15 m/min.



Key

- 1 paper web
- 2 guide rollers
- 3 dancer roller
- 4 splice knife
- 5 splice carriage

Figure 7 — Splicer

6.3.3 Splicers

On splicers, hazard points between the movable splicing carriage and fixed machine parts shall be prevented by safety measures or be safeguarded (see [Figure 7](#)). Safeguarding is possible by one or more of the following measures:

- providing minimum distances of 25 mm for hazard points above 2,20 m and of 120 mm at heights less than or equal to 2,20 m;
- a hold-to-run control meeting the requirements of ISO 12643-1:2023, 5.3.6, if it is possible to observe the hazard points and hazard zones from the point of operation of the hold-to-run control;
- a moving speed of the splicing unit of max. 15 m/min and a force reduction to 300 N when moving out into the working areas, if it is ensured that a reel/reel core is clamped on both sides as access restriction.

NOTE This can be done, for example, by the paper break sensor, which releases a machine stop after a missed splice as a result of a missing new paper reel and thus also stops the movement of the splicing units.

If these measures cannot be observed, the hazard zone shall be protected by fixed guards, movable guards or protective devices with an approach reaction (safety edges, safety mats, ESPDs). The distance to the maximum reel geometry shall be at least 500 mm. ISO 13855:2010 does not have to be considered

(unintentional access to the area is not to be expected, access to the working area is focused, the hazard is only present for a short period after the splice).

6.3.4 Knife

The cutting edge of the knife shall be safeguarded in the rest position. Safeguards shall also be in place to prevent a person accessing the blade when it is cutting. The control system which controls the cutting cycle of the knife shall meet at least ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.

NOTE These safeguards can be different than those in the rest position.

6.3.5 Pneumatic and hydraulic control systems

Where pneumatic or hydraulic control systems are used for starting the cutting cycle, a well-vented check valve shall be supplied to ensure that the knife remains in the safe position in case of leakage or hose breakage. The control system shall meet at least ISO 13849-1:2023, PL d.

6.3.6 Frame edges

Where the machine frame of the splicer is lower than 2 m at the sides (as measured from the floor), frame edges shall be provided with black-yellow padding for protection against impacts.

6.3.7 Splicers in elevated positions

If adjustment or setup of the movable splicing carriage cannot be accomplished from floor level, safe access shall be provided.

6.3.8 Warning lights

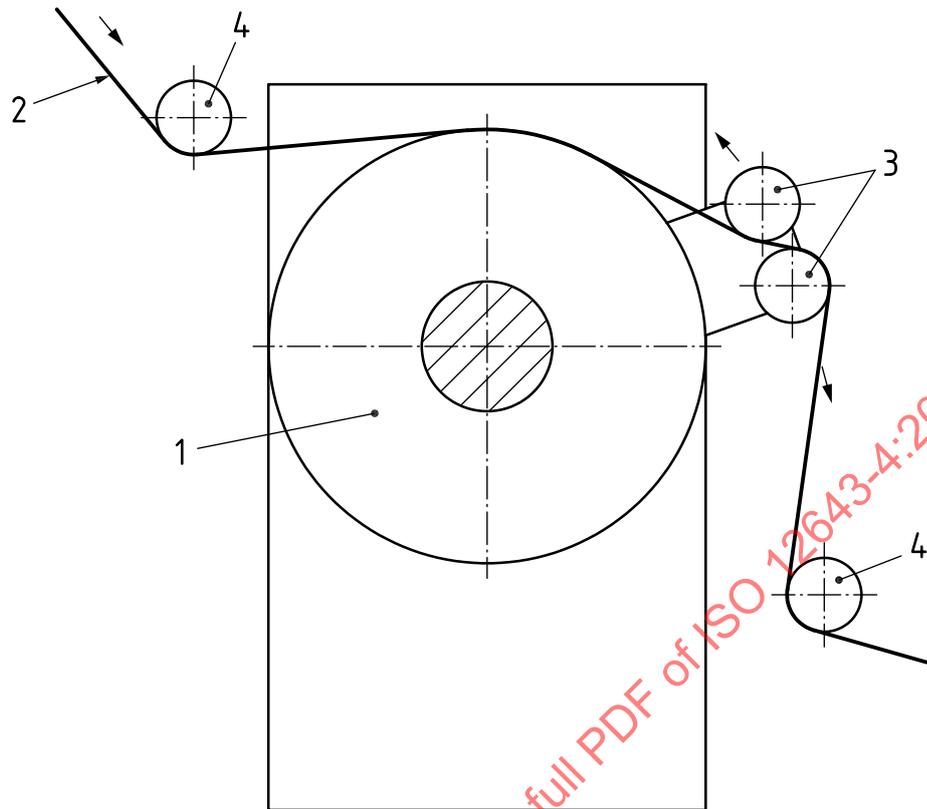
A yellow warning light shall flash for 2 s prior to the initiation of the automatic splicing operation and during the entire period of automatic motion. The integration of the warning lights into the control system may be single-channel, e.g. via an electronic control system.

6.4 Preheater

6.4.1 In-running nips

The in-running nips between the wrap roller and the preheating cylinder, and between the wrap roller and fixed machine parts or guide rollers (see [Figure 8](#)), shall be safeguarded by one or more of the following measures:

- using a minimum distance of 120 mm;
- guarding in accordance with ISO 12643-1:2023, 5.3.4.

**Key**

- 1 preheating cylinder
- 2 paper web
- 3 wrap roller
- 4 guide roller

Figure 8 — Preheater, side view**6.4.2 In-running nips between preheating cylinder and cross beams**

The in-running nips between the preheating cylinder and any cross beam shall be safeguarded by maintaining a minimum distance of 300 mm between these parts.

6.4.3 Wrap roller and rotating arms

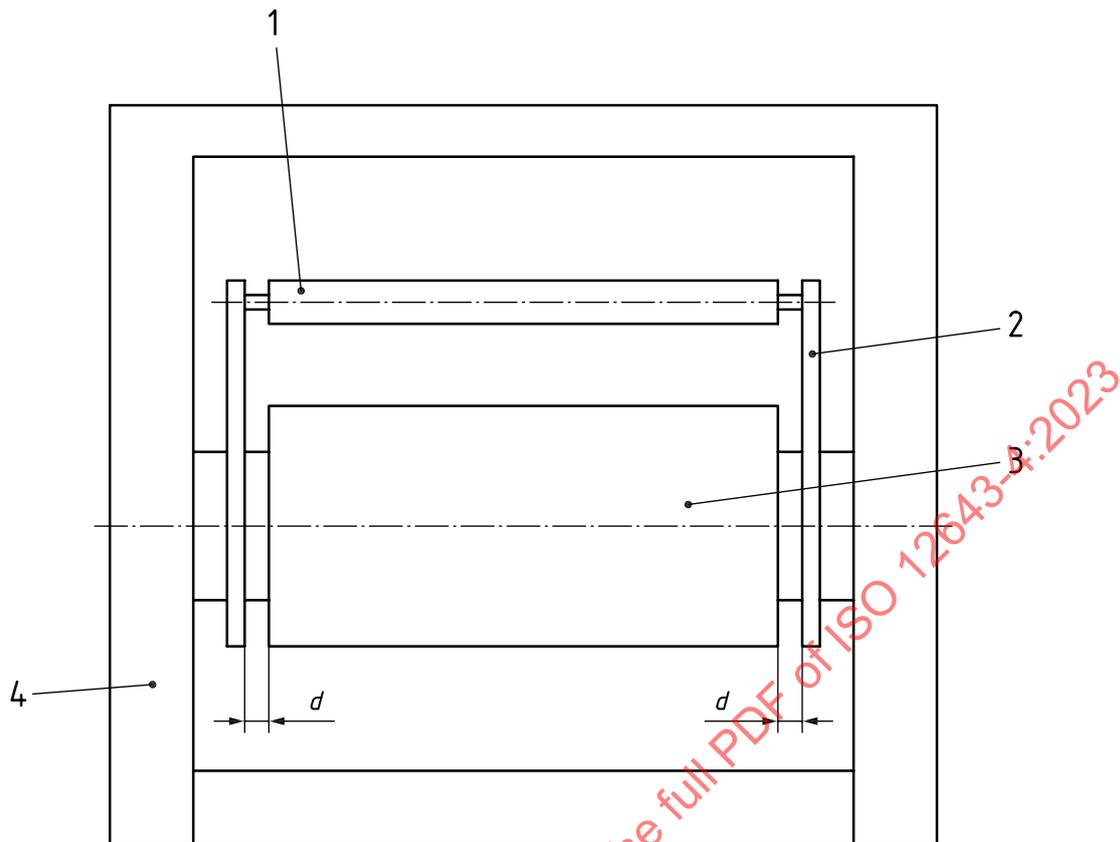
The rotating arms shall be safeguarded by interlocking guards or ESPDs which are interlocked with the drive system of the rotating arms.

If hold-to-run mode is provided inside of the guarded area it shall fulfil the requirements of ISO 12643-1:2023, 5.3.6.

The drives for the wrap roller shall be safeguarded by fixed guards completely enclosing the drives.

Rotating arms (see [Figure 9](#), item 2) shall be designed such that any openings in the rotating arms do not create a shearing hazard. Rotating arm or machine side shall be designed in such a way that parts of the body are deflected by the arm when rotating at its maximum circumferential speed of 5 m/min.

The distance (see [Figure 9](#), *d*) between the preheating cylinder and the rotating arm shall be 6 mm or less or 30 mm or more.



Key

- 1 wrap roller
- 2 rotating arm
- 3 preheating cylinder
- 4 machine frame
- d distance between preheating cylinder and rotating arm

Figure 9 — Preheater, feeding side

6.4.4 Hot surfaces

Where the temperature of any surface is higher than 65 °C, warning signs indicating the hot surfaces shall be fitted to both sides of the preheater.

6.4.5 Walkways

If walkways with fall-off protection are located near preheaters, the distance between the fall-off protection and movable parts of the preheater shall be at least 120 mm.

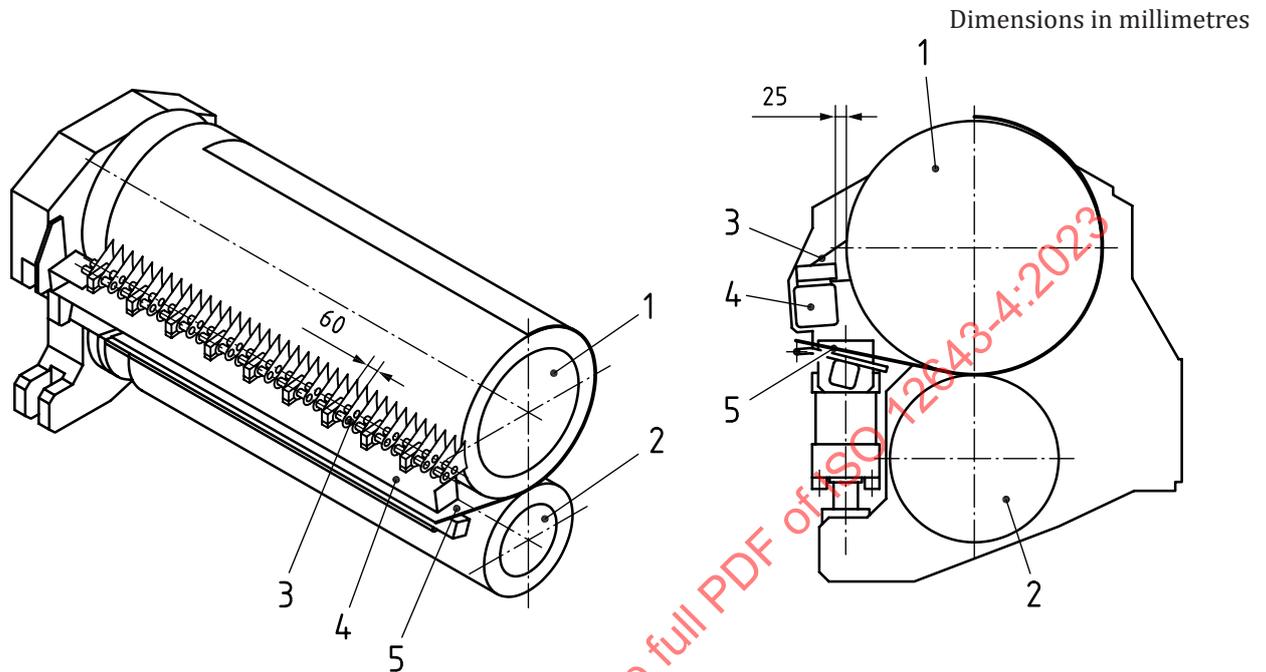
For fall-off protection and walkways, see ISO 12643-1:2023, 5.4.4.

6.5 Single facer

6.5.1 In-running nips

On single facers where the web is fed through a webbing slot the safety distances specified in ISO 13857:2019 (as required by ISO 12643-1:2023) shall be met.

The in-running nips between the corrugating rollers and fixed machine parts shall be safeguarded by fixed guards. The hazard point between the corrugating roller and the cross beam with scrapers is considered to be safeguarded if the clearance between the corrugating roller and the cross beam is at least 25 mm and the clearance between the scrapers is no more than 60 mm (see [Figure 10](#)).



Key

- 1 upper corrugating roller
- 2 lower corrugating roller
- 3 scraper
- 4 cross beam
- 5 feeding of paper web

Figure 10 — Corrugating rollers with scraper (front and side views)

6.5.2 Corrugating rollers

Where corrugating rollers are removed for changing, lifting devices and means of transport shall be provided that allow easy and safe changing of rollers.

6.5.3 Hazard points during roller change

Any hazard points that can be accessed after removal of, or during changing of, corrugating rollers shall be safeguarded in accordance with ISO 12643-1:2023.

Where corrugating rollers are mounted on an indexing turret, any movement of the turret shall be under hold-to-run control with displacement limited to a maximum of 75 mm or with a maximum operating speed of 5 m/min.

6.5.4 In-running nip between pressure roller or pressing belt and corrugating roller

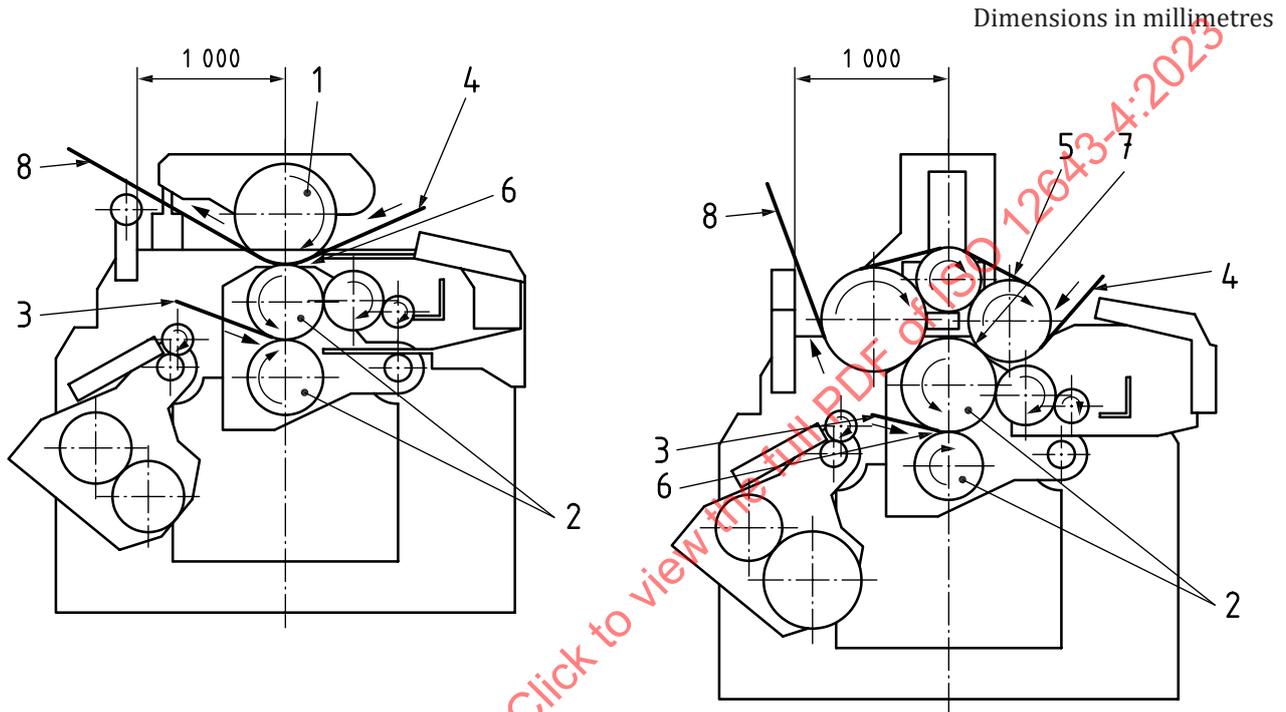
The in-running nip between the pressure roller or pressing belt and the corrugating roller (see [Figure 11](#)) shall be safeguarded by fixed guards.

The crushing point created by the lowering of the pressure roller contacting the corrugating roller shall be safeguarded by a guard in accordance with ISO 12643-1:2023 or by using a horizontal safety distance of 1 000 mm from the hazard point (see [Figure 11](#)).

In-running nips on the pressing belt shall be safeguarded by fixed guards.

6.5.5 Pressing belt breakage

On the delivery side of the single faced web (inclined belt conveyor side), a containment device shall be provided to eliminate the risk of injury in the case of pressing belt breakage.



a) Design using pressure roller

b) Design using pressing belt

Key

- | | | | |
|---|---------------------|---|---------------------------------|
| 1 | pressure roller | 5 | pressing belt |
| 2 | corrugating rollers | 6 | in-running nip |
| 3 | medium | 7 | in-running nip on pressing belt |
| 4 | liner | 8 | single-faced web |

Figure 11 — Corrugating unit

6.5.6 Walkway

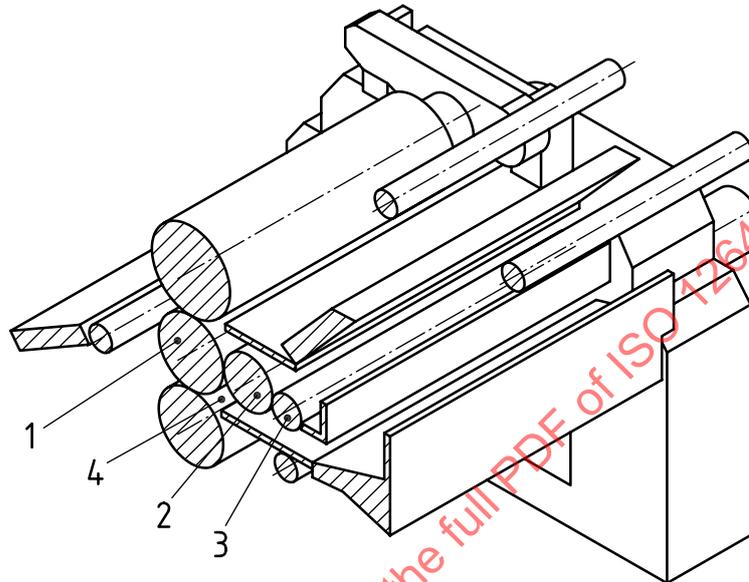
The walkway on the inclined belt conveyor side (see [Figure 13](#), item 7) shall have fall-off protection towards the corrugating rollers. Where cross beams in the form of handrails are provided for fall-off protection they shall be at a height of 1,10 m (see [Figure 13](#), item 6).

6.5.7 In-running nips between glue rollers

In-running nips between glue rollers or between glue rollers and corrugating rollers that are accessible when the gluing unit is disengaged shall be safeguarded by fixed guards in accordance with ISO 12643-1:2023.

Where disengaging and engaging the gluing unit is an automatic operation, the gluing unit shall not create any hazard points; otherwise, this movement shall only be carried out under hold to run control at a maximum speed of 5 m/min.

Where maintenance or cleaning operations are carried out with the interlocking guard covering the gluing unit in an open position (see [Figure 12](#)), the glue rollers (applicator, scraper roll) shall only be allowed to rotate at a maximum circumferential speed of 6 m/min. Glue rollers shall rotate in the same direction with no possibility of access to an in-running nip between corrugating roller and glue roller.



Key

- 1 corrugating roller
- 2 glue applicator
- 3 scraper roller
- 4 in-running nip

Figure 12 — Gluing unit

6.5.8 Hazard points between movable gluing unit and fixed machine parts

The hazard points between the movable gluing unit and fixed machine parts (machine frame) shall be safeguarded by one of the following measures:

- a hold-to-run control as defined in ISO 12643-1:2023, 5.3.6;
- interlocking guards;
- a minimum distance of 25 mm.

6.5.9 Moveable glue units

If the in-running nips are accessible it shall only be possible to open and close the moveable glue units when the corrugator roller and pressure roller/belt, glue roller and doctor roller is stopped.

Prior to opening/closing moveable glue units a request shall be generated to stop movement of the rolls. The safety related control systems shall meet the requirements of ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.

6.5.10 Inclined belt conveyor

The in-running nips on belts shall be safeguarded by fixed guards.

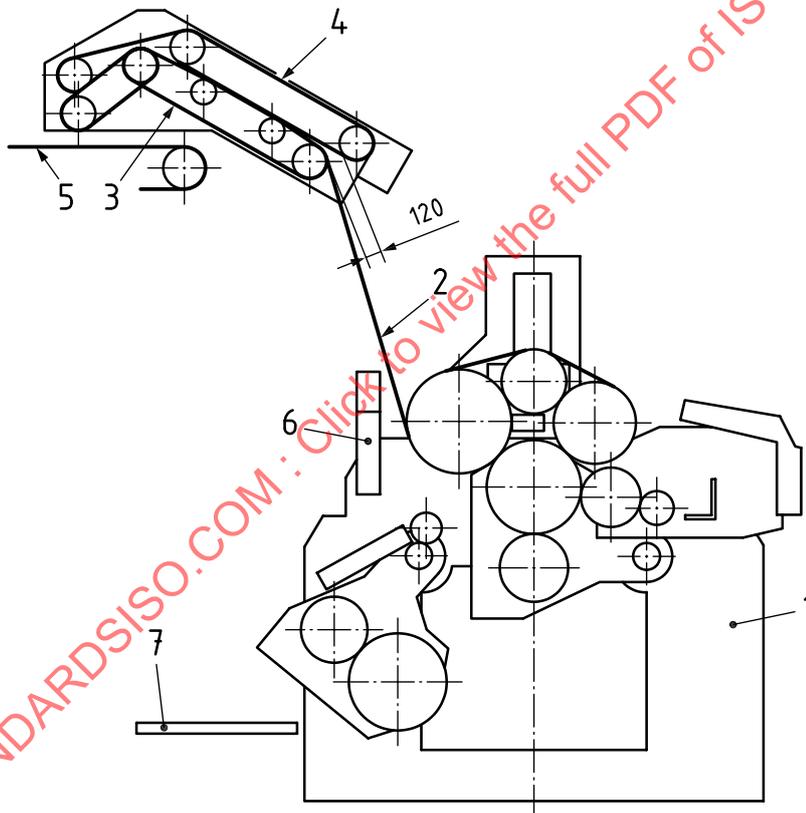
The in-running nip between the upper belt and the lower belt shall be safeguarded by off-setting the two pulleys in such a way that the minimum clearance between the two rollers is 120 mm (see Figure 13). The inlet height shall be at least 2 100 mm measured from the walkway.

There shall be no fixed parts in the in-running nip area and the risk of drawing in shall be reduced sufficiently low.

This is given if the following requirements are met:

- the nip point shall be at least 200 mm away from the inlet point;
- a maximum wrap angle in the in-running nip point of 15°;
- the pressure belt shall allow a deflection distance of at least 25 mm at the nip point, whereby a pressure force of 280 N shall not be exceeded.

Dimensions in millimetres



Key

- | | | | |
|---|------------------|---|---------------------|
| 1 | single facer | 5 | bridge |
| 2 | single-faced web | 6 | fall-off protection |
| 3 | lower belt | 7 | walkway |
| 4 | upper belt | | |

Figure 13 — Single facer with inclined belt conveyor

Danger points on the inclined belt conveyor that can be accessed from the bridge shall be safeguarded by fixed guards in accordance with ISO 12643-1:2023, 5.3.4.

6.5.11 In-running nips between pulleys and fixed machine parts

The in-running nips between pulleys and fixed machine parts shall be safeguarded by one or both of the following measures:

- fixed nip bars designed in suitable sections and extending across the entire working width of the pulleys;
- a minimum distance of 120 mm between pulleys and fixed machine parts.

If fixed nip bars are used, the clearance between the bar and the pulley shall not exceed 6 mm.

6.5.12 Steam pipes

When disengaging the steam couplings, the hazardous escape of pressurized steam shall be safeguarded by the following measures:

- coupling systems with relief valves on the ingoing and outgoing sides of the coupling; or
- devices that ensure that the steam supply is cut off and steam is allowed to escape into the work area safely.

Protection shall be provided to ensure that steam escaping unexpectedly during set-up is directed away from personnel.

6.5.13 Warning signs

Single facers shall be provided with signs warning of a burn risk from steam or hot parts with exposed surface above 65 °C.

6.5.14 Noise enclosures

Single facers shall be positioned inside noise enclosures. The doors of the enclosure shall close automatically. When power-driven doors are used, no hazardous movements shall be created during opening or closing (see ISO 12643-1:2023, 5.4.16.1). The enclosure shall be provided with signs pointing out the need to wear ear protection while inside the enclosure. The web feed and take-off openings provided in the noise enclosure shall be designed to minimize the escape of noise into the workroom.

Noise enclosures shall be designed such as to allow easy access for make-ready and inspection.

6.6 Bridge

6.6.1 Slots

The slots provided in the surface of the accessible part of a bridge shall not be wider than 50 mm. This requirement does not apply to the walkways alongside the bridge.

NOTE Slots allow humidity to escape from the single-faced web.

6.6.2 Fall-off protection

Fall-off protection shall be provided on both sides of the bridge in accordance with ISO 12643-1:2023, 5.4.4.

6.6.3 Access stairs

Access stairs shall be provided for each section of the bridge. The maximum pitch angle specified in ISO 14122-3:2016 is 45°. However, the pitch angle may be increased to a maximum of 60° if justified by the results of the risk analysis specified in ISO 12643-1:2023, Annex C. Access stairs shall be designed

in accordance with ISO 12643-1:2023, 5.4.4. Where access stairs connect to a walkway directly (i.e. without a platform), fall-off protection (i.e. a gate) that closes automatically (i.e. spring loaded) shall be provided.

6.6.4 Passage height underneath the bridge

The passage height underneath the bridge shall be a minimum of 2,10 m. Where this height requirement cannot be met for design reasons, the parts below this height shall be provided with black-yellow padding for protection against impacts.

6.7 Braking and web aligning systems

In-running nips and other hazard points shall be safeguarded by the following measures:

- the use of guards in accordance with ISO 12643-1:2023; or
- a minimum distance of 120 mm between rollers or rollers and fixed machine parts.

6.8 Gluing machine

6.8.1 Steps and handles

Steps and handles meeting the requirements of ISO 12643-1:2023, 5.4.4, shall be provided for threading of the web and easy access to the gluing units for cleaning.

6.8.2 Hazard points

The hazard points between the glue rollers (see [Figure 14](#), item 3), glue duct (see [Figure 14](#), item 2) and fixed machine parts that are accessible when the glue rollers are moved in or moved out, or when the glue duct is swung down, shall be safeguarded by one of the following measures:

- a hold-to-run control with at least ISO 13849-1:2023, PL c or IEC 62061:2021, SIL 1;
- the limitation of automatic movements to 0,5 m/min.

An emergency stop pushbutton shall be provided at the position of the operator observing the operation.

As an exception the glue rollers of the gluing unit may continue running when an emergency stop button is pressed if the hazard points on the gluing unit are safeguarded by guards.

6.8.3 Pressing device

The automatic movement of the pressing device (see [Figure 14](#), item 4) applying pressure on the single faced corrugating board towards the glue applicator roller shall be safeguarded by one or both of the following measures:

- guarding in accordance with ISO 12643-1:2023;
- with a spring-loaded design allowing the pressing device to deflect at least 25 mm with a maximum spring force of 150 N.

6.9 Heating and pulling section

6.9.1 In-running nips

The in running nip existing on the in-feed into the heating section between the upper belt (see [Figure 14](#), item 5) or the guide roller (see [Figure 14](#), item 8) and the heating plates (see [Figure 14](#), item 7) shall be safeguarded in accordance with ISO 13857:2019. The safety distance shall be measured from the point at which the distance between the upper belt or guide roller and the heating plate is 50 mm. Trapping

hazards on the guide roller of the upper belt (see [Figure 14](#), item 5) shall be guarded in accordance with ISO 12643-1:2023.

6.9.2 Hazard points

The hazard points between the lower transport rollers or heating plate and the upper weighting device (see [Figure 14](#), item 9) shall be safeguarded by guards that meet the requirements of ISO 12643-1:2023. Guard openings and safety distances shall be in accordance with ISO 13857:2019.

The hazard point (see [Figure 14](#), item 10) between the upper belt (see [Figure 14](#), item 11) and lower belt (see [Figure 14](#), item 12) at the transition point between the heating and pulling section shall be safeguarded by guards.

The hazard points below the heating plate shall be safeguarded by fixed guards in accordance with ISO 12643-1:2023.

6.9.3 Heating plates

Warning signs (safety labels) shall be placed at any position where it is reasonably foreseeable that personnel can come into contact with heating plates or other hot parts above 65 °C when guards are open.

6.9.4 Preventing the weighting device from falling

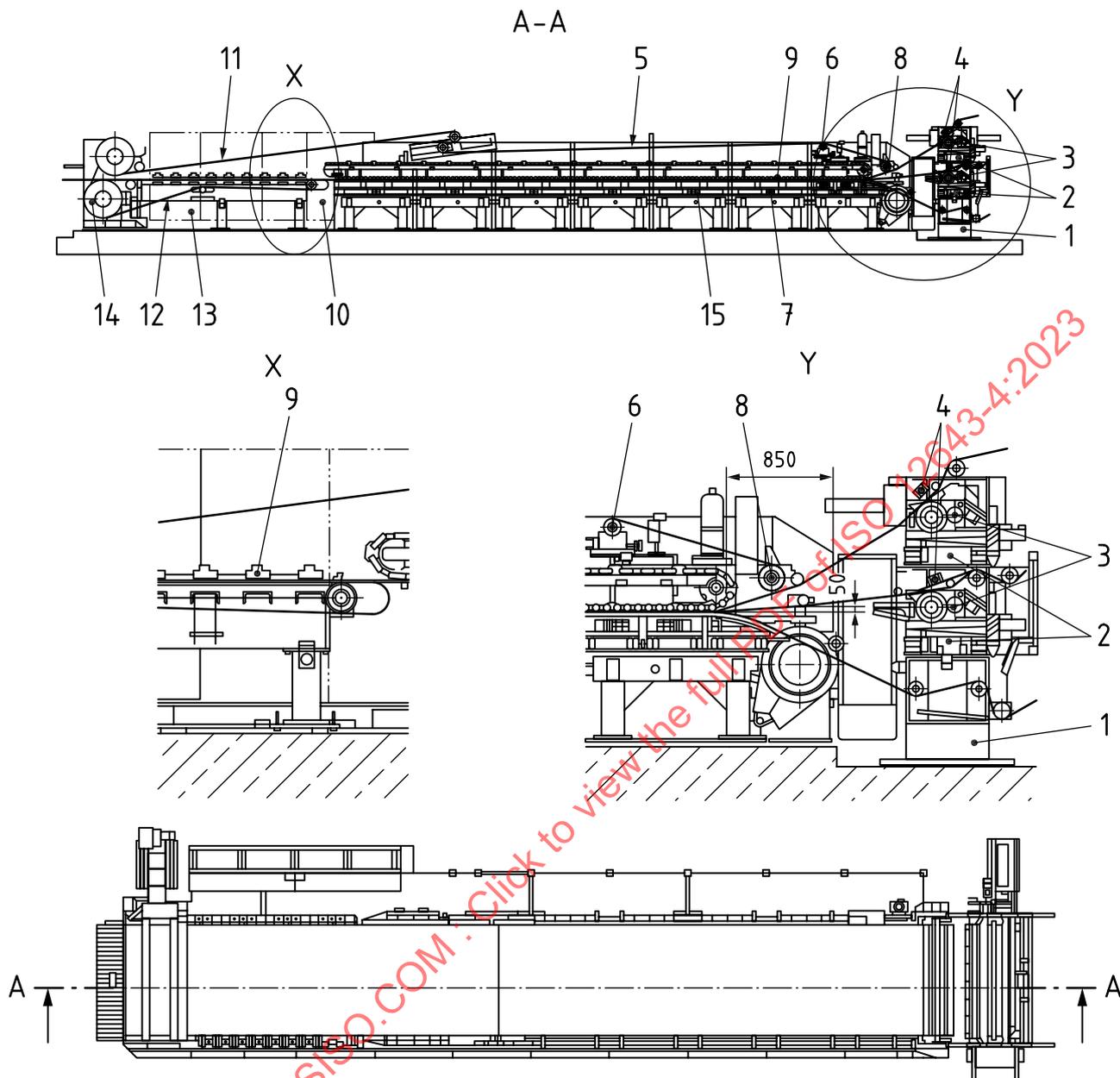
Where access to the area beneath the weighting device is required, measures shall be taken to prevent the weighting device from falling due to gravity. Examples of these measures include:

- self-locking spindles for spindle drives;
- well-ried check valves for hydraulic or pneumatic cylinders;
- other means that ensure an equivalent level of protection.

For inspections, a manually operated mechanical device shall be used to secure the pressure device in a safe position, e.g. locking pins or safety supports.

6.9.5 Web threading in the heating section

In the area of the heating section, a threading device shall be provided for threading the paper web in order to reduce the risk of contact with hot parts.



Key

- | | | | |
|---|-------------------|----|---|
| 1 | gluing machine | 9 | weighting device |
| 2 | glue duct | 10 | hazard point between upper and lower belt |
| 3 | glue rollers | 11 | upper belt |
| 4 | pressing device | 12 | lower belt |
| 5 | upper belt | 13 | pulling section |
| 6 | belt guide roller | 14 | belt guide roller |
| 7 | heating plates | 15 | lift-off device |
| 8 | guide roller | | |

Figure 14 — Gluing machine, heating and pulling section

6.10 Transition point from gluing machine to heating and pulling section

An interlocked access - door guard in accordance with ISO 12643-1:2023 shall be provided on both sides of the machine at the transition point from the gluing machine to the heating and pulling section. The door guard shall be interlocked with the machine control system and incapable of being opened unless the machine speed has fallen to less than or equal to 15 m/min. The in-running nips shall be safeguarded in accordance with [6.9.1](#).

6.11 Rotary shear unit

6.11.1 Rotary shear

The rotary shear shall be guarded in accordance with ISO 12643-1:2023.

NOTE Rotary shears are used for cutting the running corrugated board web when changing the format and removing waste material.

6.11.2 Knife driving shaft

Any knife driving shaft shall be safeguarded on all sides in accordance with ISO 12643-1:2023.

Where there is a risk of personnel being injured by the knife not yet having come to a standstill, guard locking is required. Unlocking of the guard shall only be possible when the knife has come to a standstill.

Guard locking shall meet the requirements specified in ISO 14119:2013.

6.11.3 Guarding a non-powered movement of the rotary shear

On rotary shears where there is a risk of a non-powered movement of the knife, the guard shall also be interlocked with the operation of a braking mechanism to ensure that the knife is held stationary while the guard is open.

NOTE Risk of non-powered movement of the knife can exist, for example, after the clearing of a material blockage.

6.11.4 Waste removal

Provisions shall be made for the safe removal of waste.

NOTE Means to remove waste can include movable collection bins or conveyor belts.

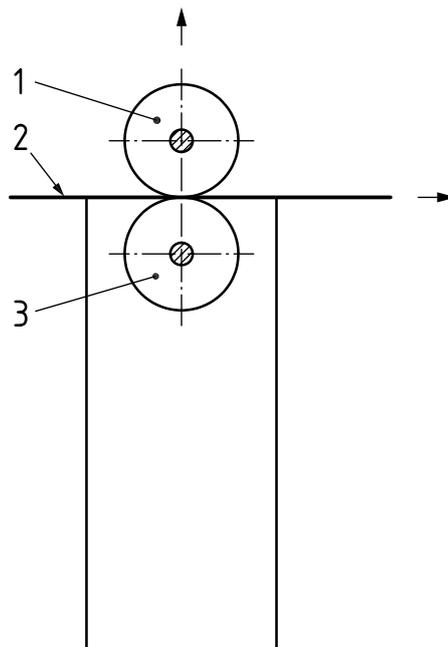
Where collecting bins are also used for guarding purposes, they shall be interlocked with the hazardous movement of the waste separator.

6.12 Pulling unit

The crushing point between the upper and lower pulling rollers when moving the upper discharging roller into position shall be safeguarded (see [Figure 15](#)).

NOTE Safeguarding can be achieved, for example, by one or both of the following measures:

- hold-to-run control of at least ISO 13849-1:2023, PL c or IEC 62061:2021, SIL 1;
- fixed or interlocking guards in accordance with ISO 12643-1:2023.



Key

- 1 upper pulling roller
- 2 corrugated board web
- 3 lower pulling roller

Figure 15 — Pulling unit

6.13 Slitter-scoring units

6.13.1 Automatic positioning

The automatic positioning of the slitter-scoring blade and the extractor hood shall only be permitted with the interlocking guards in the closed position.

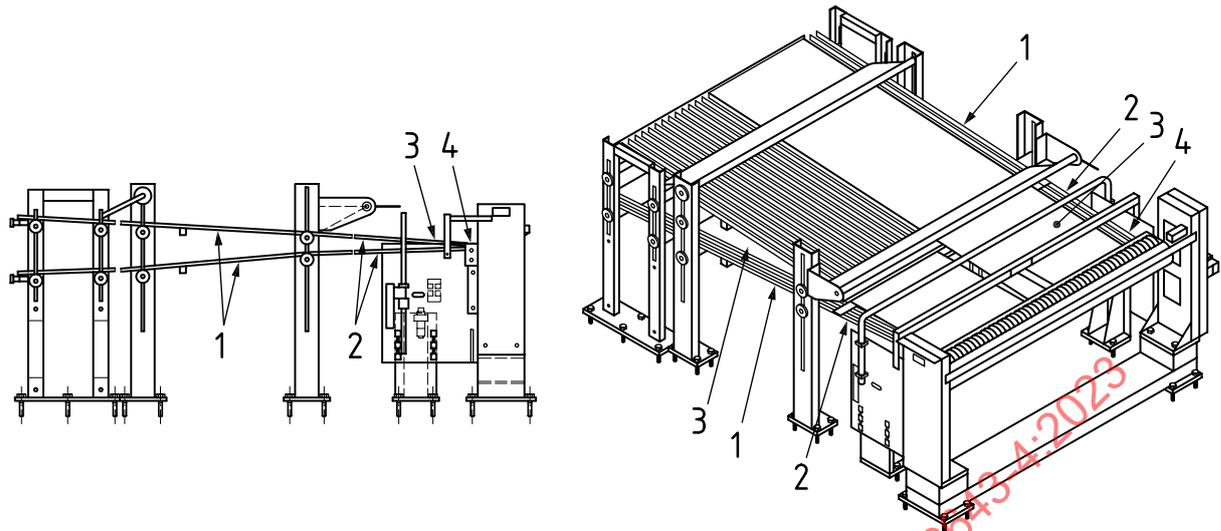
6.13.2 Movement of slitting and scoring units under hold-to-run control

Individual slitting/scoring units shall be allowed to travel under hold-to-run control only at a maximum speed of 5 m/min. Hold-to-run control shall be in accordance with at least ISO 13849-1:2023, PL c or IEC 62061:2021, SIL 1. The distance between fixed guards and rails shall be 15 mm maximum.

With the units moved apart, slitting and scoring tools shall only be allowed to be moved under hold-to-run control in accordance with ISO 12643-1:2023, 5.3.6. Hold-to-run control shall be in accordance with at least ISO 13849-1:2023, PL c or IEC 62061:2021, SIL 1.

6.14 Web diverter

Access from the bottom of the web diverter shall be prevented by fixed guards in accordance with ISO 12643-1:2023 (see [Figure 16](#)).



Key

- 1 fixed web guides
- 2 movable web diverters
- 3 corrugated board web
- 4 swivel point of web diverters

Figure 16 — Web diverter

6.15 Cut-off

The hazard points on the rotary knives shall be safeguarded on all sides by interlocking guards in accordance with ISO 12643-1:2023. Where there is a risk of the operator being endangered during knife shaft stopping, the provision of guard locking is required. The opening of the guard shall only be possible when the knife has come to a standstill.

Guard locking shall meet the requirements specified in ISO 12643-1:2023.

6.16 Stacker devices

6.16.1 Whole-body access

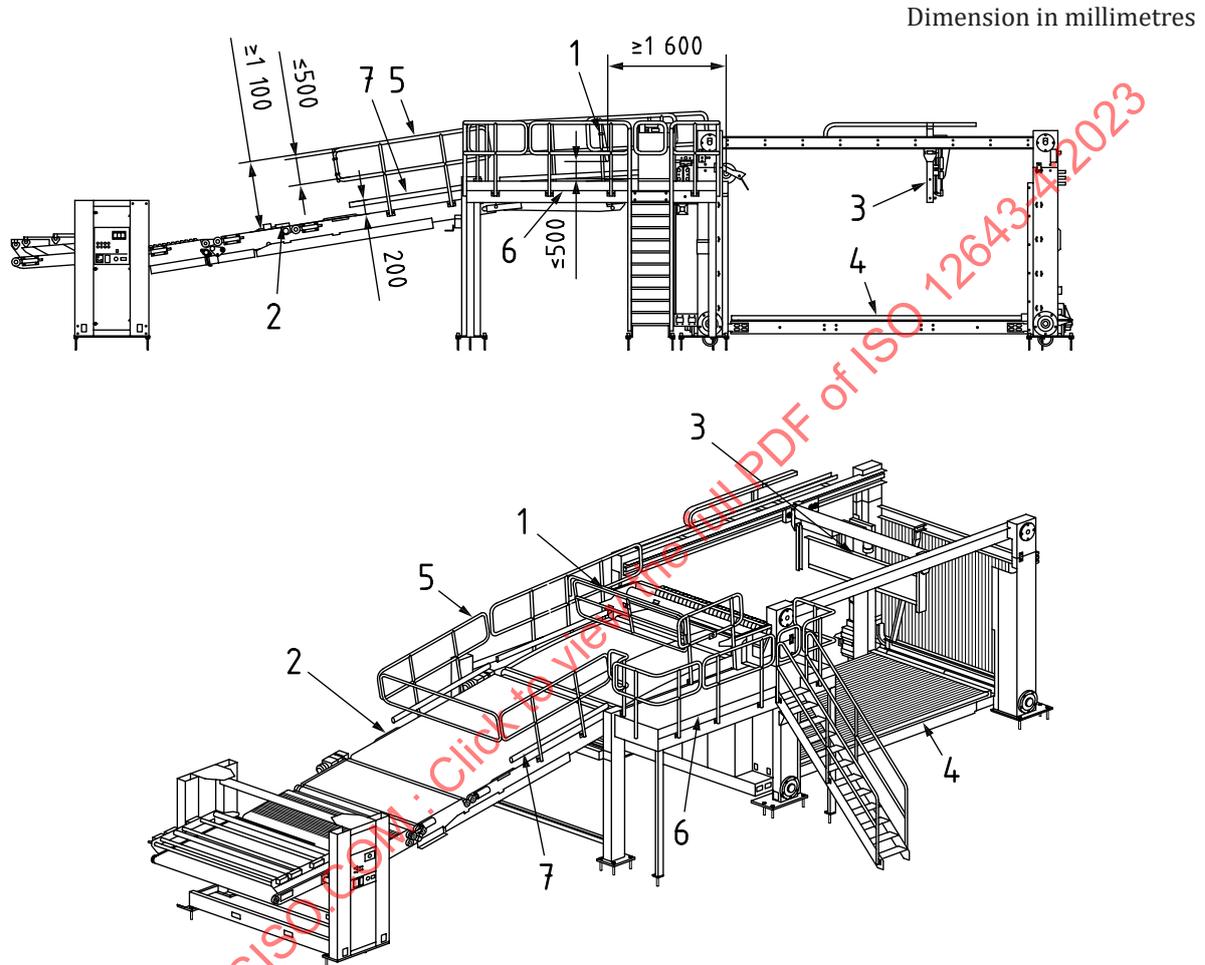
Where whole-body access to conveyor belts feeding the stacker devices is required during production runs, the following measures are required.

- a) Before a person can access the belt, the speed of the belt shall be reduced to 45 m/min maximum. During the period in which a person is located on the conveyor belt, it shall be prevented by control-related measures that the belt speed does not increase unintentionally (e.g. switching to operating speed). After the person has left the belt, the person shall actuate an enabling device that will return the belt to operating speed. The enabling device shall not be within the reach of the person on the belt, and shall be located in a position that ensures the operator of the device has a clear view of the belt.

NOTE Means of reducing the speed and preventing unintended speed increase include, for example, opening a gate interlocked with the speed limit control or use of an ESPD.

- b) A visual warning signal (light) shall flash for at least 5 s before the automatic start of the reduced speed and for the complete duration of the reduced-speed state.

- c) On both sides of the conveyor belt, railings in accordance with ISO 12643-1:2023, 5.4.4, shall be provided. There shall also be an intermediate rail 200 mm above conveying level to prevent a person falling off the conveyor belt. A toe board is not required.
- d) Movable fall-off protection shall be provided across the conveyor belt at a maximum height of 500 mm and at a distance of at least 1 600 mm from the stacker front. The fall-off protection shall be interlocked with the movement of the conveyor belt and of the stacking device and shall have a black/yellow marking (see [Figure 17](#)).



Key

- | | | | |
|---|-----------------------------|---|-------------------|
| 1 | movable fall-off protection | 5 | handrail |
| 2 | conveyor belt | 6 | catwalk |
| 3 | movable backstop | 7 | intermediate rail |
| 4 | side transport | | |

Figure 17 — Conveyor belt with fall-off protection

6.16.2 Guarding of downstackers

Stacking devices shall meet the requirements specified in ISO 12643-1:2023.

On automatic downstackers (auto-pilers), additional measures shall be taken to ensure that the ascending movement of the pile carrier may only be started if there is no person present on the carrier (see [Figure 18](#)).

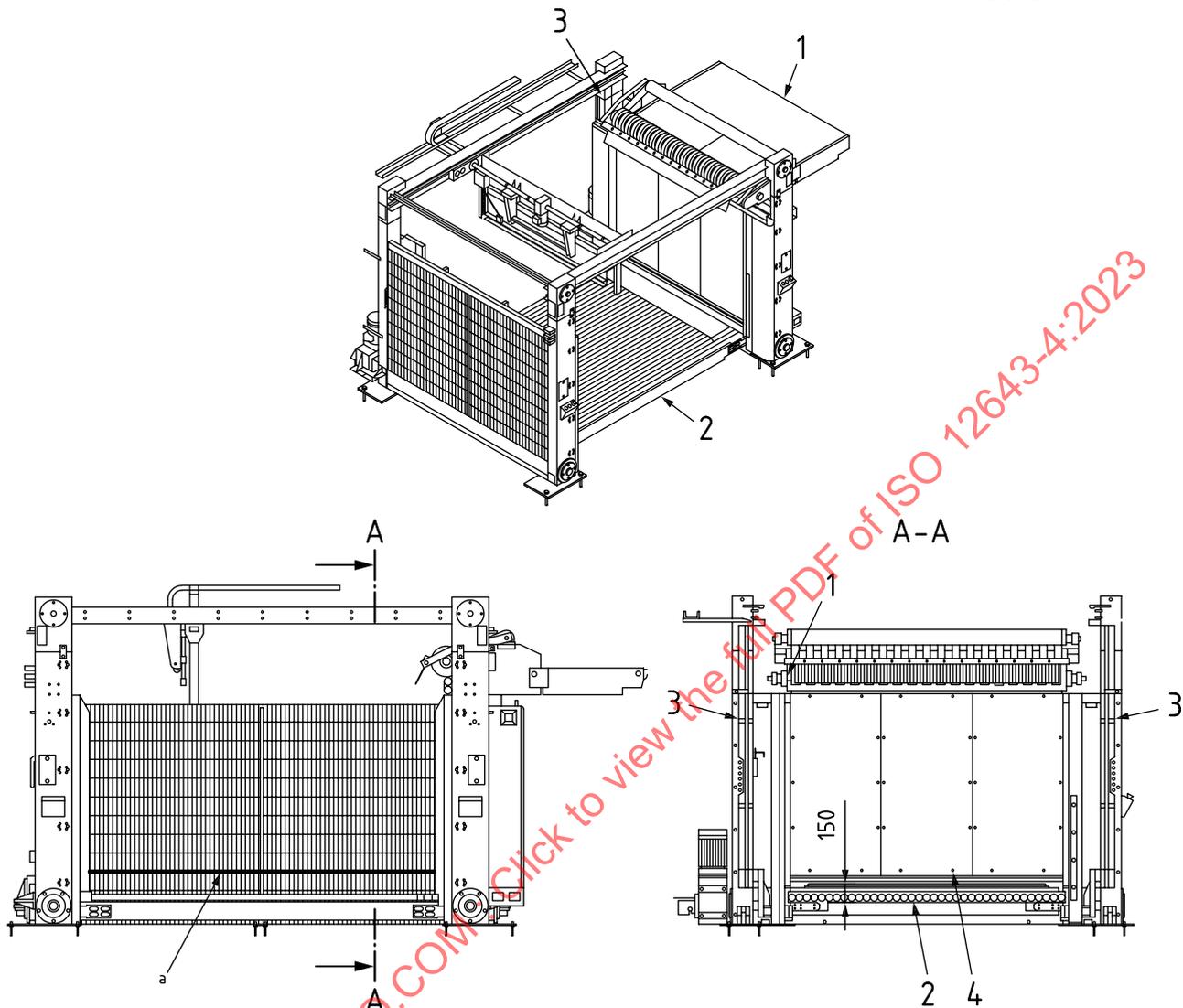
This requirement shall be met by one or more of the following measures:

- providing parallel safety light beams in accordance with ISO 13855:2010 and horizontally at a height of $150 \text{ mm} \pm 50 \text{ mm}$ above the pile carrier plate with the carrier plate in its lowest position; or
- a laser scanner in accordance with IEC 61496-1:2020 and IEC 61496-2:2020 and arranged in accordance with ISO 13855:2010

Safeguarding of the hazard zone beneath the pile carrier plate shall meet the requirements of ISO 12643-1:2023.

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Dimensions in millimetres



Key

- 1 conveyor belt
- 2 pile carrier (roller conveyor)
- 3 chain
- 4 photoelectric beam
- a Path of photoelectric beam.

Figure 18 — Downstacker

6.16.3 Maintenance and inspection

For maintenance and inspection operations, downstackers and upstackers shall each be provided with an adequately rated mechanical device to prevent lowering, on downstackers, of the carrier plate or, on upstackers, of the final conveyor belt. Application of that mechanical device shall occur if the pile carrier plate has been lowered down to a maximum distance of 100 mm above the mechanical device.

If access is provided to a hazard zone by a door or gate, it shall be interlocked.

The position of the mechanical holding device shall be monitored to ensure that the interlocking gate can be opened only when the holding device is in the correct position. The machine can be restarted only when the interlocking gate is closed, and the mechanical holding devices are in the home position. The monitoring system shall meet the requirements of ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2. Movement of the pile carrier plate shall be prevented in the event of any mechanical failure.

Instructions for securing the pile carrier plate with mechanical devices to prevent falls due to gravity shall be provided in the instruction handbook. For reference on instructions to be given in the instruction handbook, see [17.2.8](#).

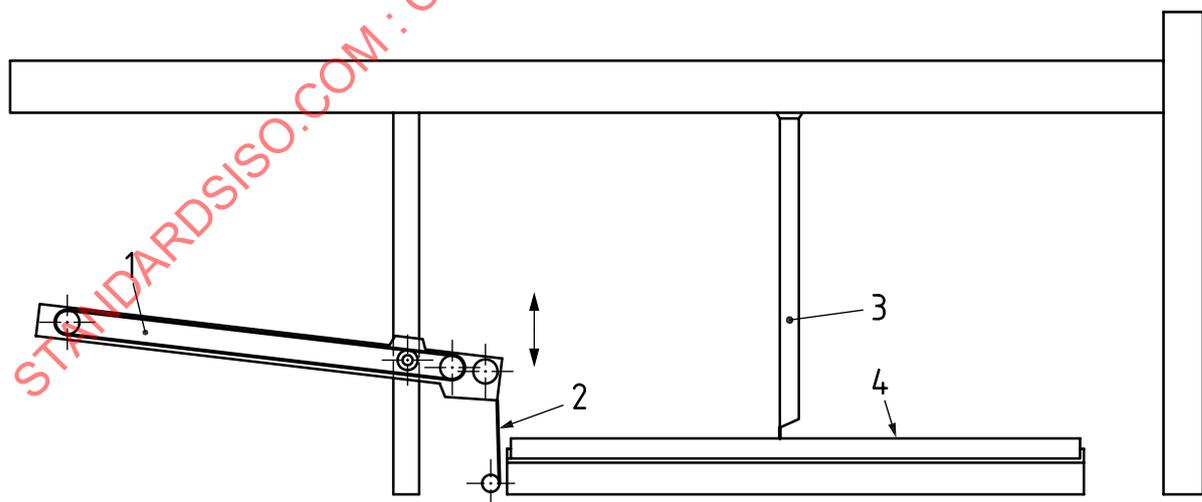
6.16.4 Guarding of upstackers

On stackers adjusting to varying pile heights (upstackers), the hazard point between the descending conveyor belt and roller conveyor or floor shall be safeguarded (see [Figure 19](#)). Access to the conveyor belt in motion shall be prevented, for example, by fence-type enclosures on the sides and, on the front, by blinds of sufficient strength and durability to prevent access to the hazardous area.

Where there is a requirement for corrugated sheets to be taken from the conveyor belt feeding the upstacker, the fixed guards provided alongside the conveyor belt may be replaced by the following measures:

- ensuring that the minimum height between the lower edge of the feeding conveyor belt and the floor is always 500 mm;
- providing a warning on the free sides that passage is not permitted (see ISO 12643-1:2023 for information on warning signs);
- providing a chain curtain below the feeding conveyor belt to prevent passage below;
- preventing access to both sides of the area below the feeding belt by providing blinds at the beginning and at the end of the free area on the feeding conveyor belt across the entire width of the feeding belt.

Fence-type enclosures shall meet the requirements specified in ISO 12643-1:2023.



Key

- 1 feeding conveyor belt
- 2 blinds
- 3 movable backstop
- 4 roller conveyor

Figure 19 — Upstacker

6.16.5 Roller conveyors

On accessible roller conveyors of stacking devices, the hazard points created by the automatic movement of backstop and fixed machine parts shall be safeguarded by applying the minimum distance of 500 mm. Where the minimum distance cannot be applied, adequate guards in accordance with ISO 12643-1:2023 shall be provided.

7 Folder gluer machines

7.1 Entire machine

7.1.1 Emergency stop

An emergency stop device in accordance with ISO 12643-1:2023, 5.7.2.5.1.2 shall be provided on or at each control station that can initiate the start of the entire machine. In addition, the maximum clearance between the emergency stop device shall be dependent on the product format width and shall not exceed the following values:

- 5 m for product format widths smaller than 1 500 mm
- 10 m for product format widths greater than or equal to 1 500 mm

7.1.2 Power-driven shafts

The area between machine frame and the respective format-limiting parts, such as the roller stringers or roller tracks, which are arranged as the outermost, towards to the machine frame, can be entered. There are trapping points which can be reached with the legs. Trapping points on power-driven shafts shall be safeguarded by one or more of the following measures:

- telescopic fixed guards which automatically adapt themselves to the size of the format and are not allowed to rotate with the shaft;
- other means that ensure an equivalent of protection.

The area between the respective format-limiting parts, for example the roller stringers or roller tracks which are arranged as the outermost, facing the machine frame, cannot be accessed. Trapping points shall not be located in an area that is accessible by the operator's legs. Trapping points that are accessible to the operator's arms cannot be safeguarded by guards as this can cause detrimental effects on the functions of the machine. Information about existing residual risks shall be provided.

7.1.3 Power-driven format setting

Where format setting of the roller tracks, is power-driven, hazard points shall be safeguarded by one of the following measures:

- Hold-to-run control in accordance with ISO 12643-1:2023, 5.3.6. The control system of the hold-to-run device shall at least be in accordance with ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2. During safeguarding with hold-to-run operation, the speed shall not exceed 5 m/min.
- Manual actuation of the movement followed by automatic self-locking if a minimum gap of 180 mm according to ISO 13854:2017 is maintained over the total setting area, since it is expected that persons will climb over the lateral machine frames at the stations. As with the hold-to-run mode, the speed shall not exceed 5 m/min. The control system shall be in accordance with ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2. Where the minimum gap is ensured by means of a control system, this control system shall be in accordance with ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.
- Automatic format setting during make-ready operations are permitted up to a speed of 0,5 m/min without additional protective measures if crushing hazards for the head or body are not to be expected.

7.1.4 Reaching of hazard points between format-limiting parts

Hazard points above the production level can only be reached with the upper limbs due to various fixtures and extensions required for the technical production process so that leaning towards them with the upper part of the body need not be considered in the determination of safety distances according to ISO 13857:2019.

During the production run, access to the hazard points between the format-limiting parts below the production level is prevented by the passing folding box blanks.

7.2 Feeder

The trapping points at the driven shafts for the feeder belts shall be safeguarded between the machine frame and the respective outer feeder belt.

The trapping points at the areas of the driven shafts for the feeder belts positioned between the individual feeder belts are covered by the stack of material in the feeder hopper during the production run. Warning signs shall be provided where hazards exist when the feeder hopper is empty. As an alternative, the shaft may have a clearly visible yellow marking indicating the rotational movement.

The risk assessment shall take into consideration any trapping points that can be created where driven shafts are exposed, for example, as the result of not all belts being used for small format runs. Consideration of reduced risk may be given due to inaccessibility as the result of, for example, protective devices, guarding, feeder belts and/or material in the hopper.

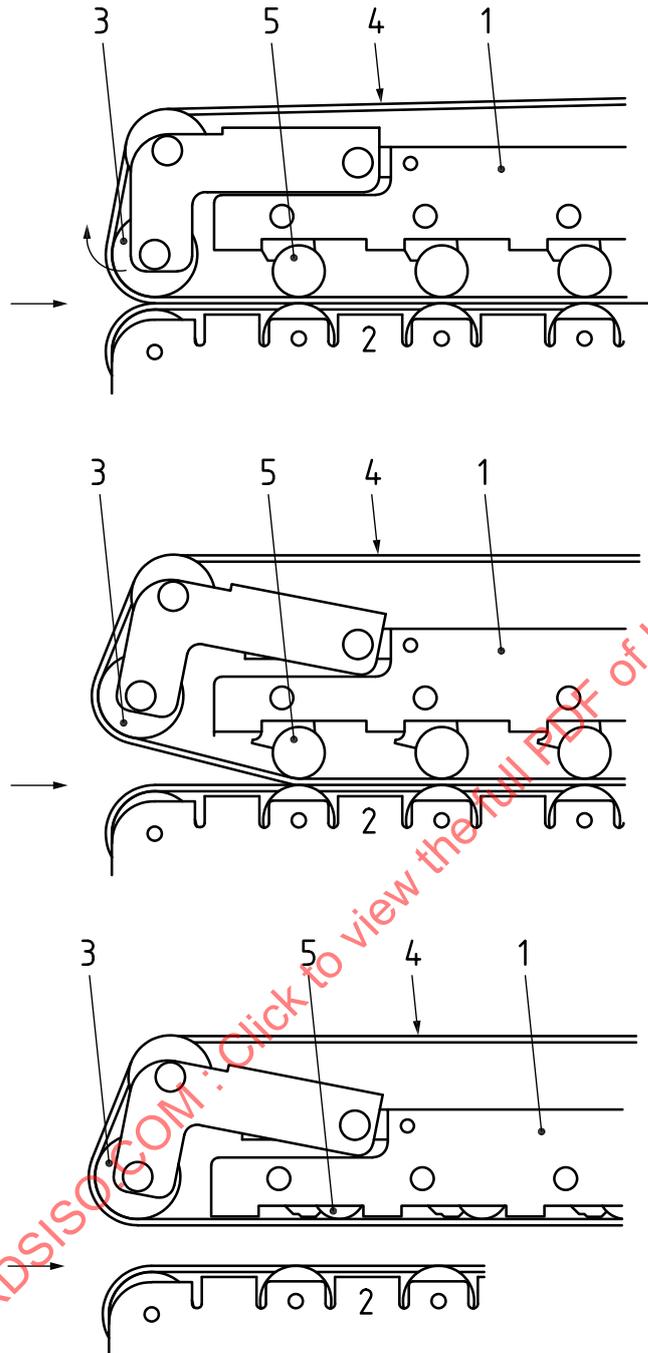
7.3 Folding section

7.3.1 Roller tracks

The in-running nips between upper and lower roller tracks or folding belt (see [Figure 20](#)) shall be safeguarded, for example by all of the following measures:

- a deflection of the first roller in the roller track (see [Figure 20](#), item 3) of at least 25 mm under a maximum contact force of 70 N;
- a deflection of all following rollers in the roller track (see [Figure 20](#), item 5) of at least 25 mm under a maximum contact force of 70 N. For machines having belt widths of up to 25 mm, a deflection of all following rollers in the roller track (see [Figure 20](#), item 5) of at least 15 mm under a maximum contact force of 70 N with roller widths limited to 25 mm (see ISO 12643-1:2023, 6.10.7) can be provided as an alternative.

The hazard points created by the movement of the roller track shall be safeguarded by hold to run control in accordance with ISO 12643-1:2023, 5.3.6, or by other means that ensures an equivalent level of protection.



Key

- 1 upper roller track
- 2 lower roller track
- 3 first roller
- 4 folding belt
- 5 following rollers

Figure 20 — Roller tracks

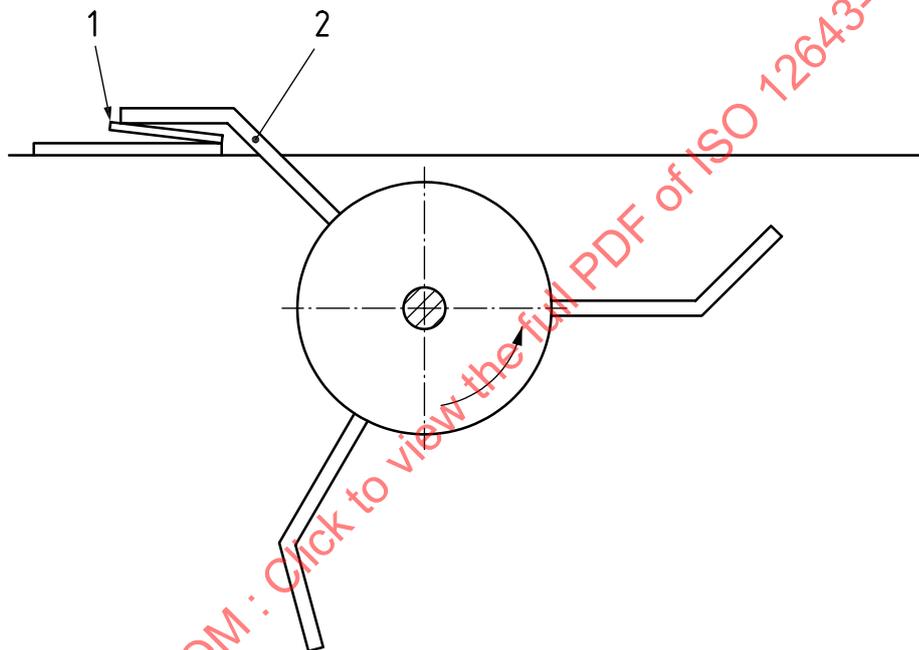
7.3.2 Folding hooks

The hazard points caused by folding hooks (see [Figure 21](#)) shall be safeguarded by interlocking guards, or the use of ESPDs that are placed in accordance with ISO 13855:2010. In the determination of the

necessary safety distances, it may be determined that, as a rule, body parts do not approach the hazard points in the shortest possible way between the ESPD and the hazard point or that such access is exclusively with the upper body parts without whole body approach. Furthermore, a production run at maximum production speed with maximum format setting is, as a rule, not possible.

For set-up operations, the folding hook may only be started or be kept in operation after an interlocking guard has been opened or the ESPD has been interrupted by one of the following measures.

- Hold-to-run operation according to ISO 12643-1:2023, 5.3.6. The control of the hold-to-run device shall at least be in accordance with ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2. During safeguarding by hold-to-run operation, the production speed shall not exceed 20 m/min.
- Two-hand control according to ISO 12643-1:2023, 5.3.6 and 5.7.5. The control of the two-hand device shall at least be in accordance with ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2. During safeguarding by two-hand control operation, the main drive may run at production speed.



Key

- 1 folded blank
- 2 folding hook

Figure 21 — Folding hook

7.4 Gluing section

Where hotmelt glue is used, a temperature control device and a separate temperature monitoring device are required.

The glue reservoir shall be thermally insulated.

Safeguards to protect personnel from splashing glue shall be provided.

7.5 Folding belts

The in-running nips between folding belts and hold-down rolls shall be safeguarded, for example, by one or more of the following measures:

- hold-down rolls that allow a minimum deflection of 25 mm under a maximum contact force of 70 N;

- fixed or interlocking guards in accordance with ISO 12643-1:2023;
- ESPDs at a distance in accordance with ISO 13855:2010.

7.6 Pressure rollers

7.6.1 In-running nips between pressure rollers in the area between machine frame and format-limiting parts

The in-running nips between the upper and the lower pressure rollers in the area between machine frame and format-limiting parts where no folding box needs to be conveyed through the folding box gluer machine shall be safeguarded by guards which automatically adapt themselves to the format size used.

7.6.2 In-running nips between pressure rollers in the area between format-limiting parts

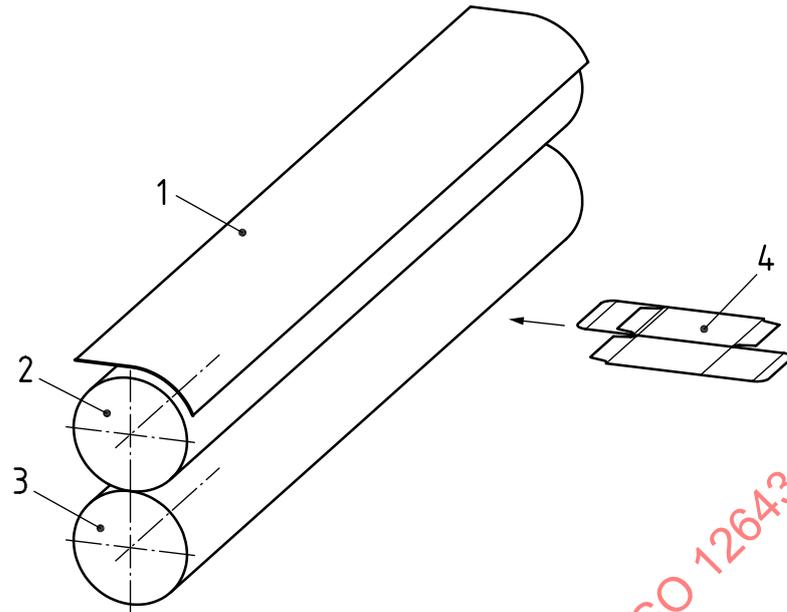
Due to the thick and rigid materials at folding box gluing machines, technical reasons during production can make it impossible to observe ISO 13857:2019 in the area of the material infeed. The opening width of the in-running nip shall then be as small as possible and shall not be more than 20 mm.

At machines for product format widths larger than or equal to 1 500 mm, which are mainly designed for the processing of multi-wall corrugated board, the in-running nip shall not be larger than 30 mm due to the material thickness and rigidity.

Safety signs/symbols shall warn of the residual risks that still exist when the pressure rollers are rotating. In addition, a yellow marking shall be given so that the rotational movement is clearly visible.

The in-running nips between the upper and the lower pressure rollers in the area between the format-limiting parts where the folding box is conveyed through the pressure rollers cannot be safeguarded by guards due to technical reasons during production. Any direct access to the hazard points shall be prevented, for example, by a fixed guard (see [Figure 22](#)). Information about existing residual risks shall be provided in the instruction handbook.

With product format widths greater than or equal to 1 500 mm and continuous pressure rollers, in addition an emergency stop device within easy reach of the pressure rollers shall be provided.

**Key**

- 1 fixed guard
- 2 upper pressure roller
- 3 lower pressure roller
- 4 folding box blank

Figure 22 — Fixed guard at pressure rollers to prevent direct access by reflex action

7.7 Ejection module

In the area of the ejection module, unintended access to the hazard point from above and parallel to the production direction shall be prevented by fixed or interlocking guards. These protective devices shall at least reach to the lower edge of the ejector. For technical reasons, protection during production from the lower side is not possible due to the blanks to be ejected. Safety signs/symbols shall warn of the residual risks due to the possibility of gaining access under the guards.

7.8 Pressing and gathering device (pressing band)

7.8.1 Pulleys

The hazard point between upper and lower pulleys of the pressing belt on the feeding side shall be safeguarded, for example, by both of the following measures:

- limiting the pressing force of the pulleys on the feeding side to 500 N;
- a deflection of the pulleys of at least 120 mm.

NOTE This can be done, for example, by arranging the pulleys for the upper and lower pressing belts such that one is not directly below the other and the clearance between the pulleys is at least 120 mm. See [Figure 23](#).

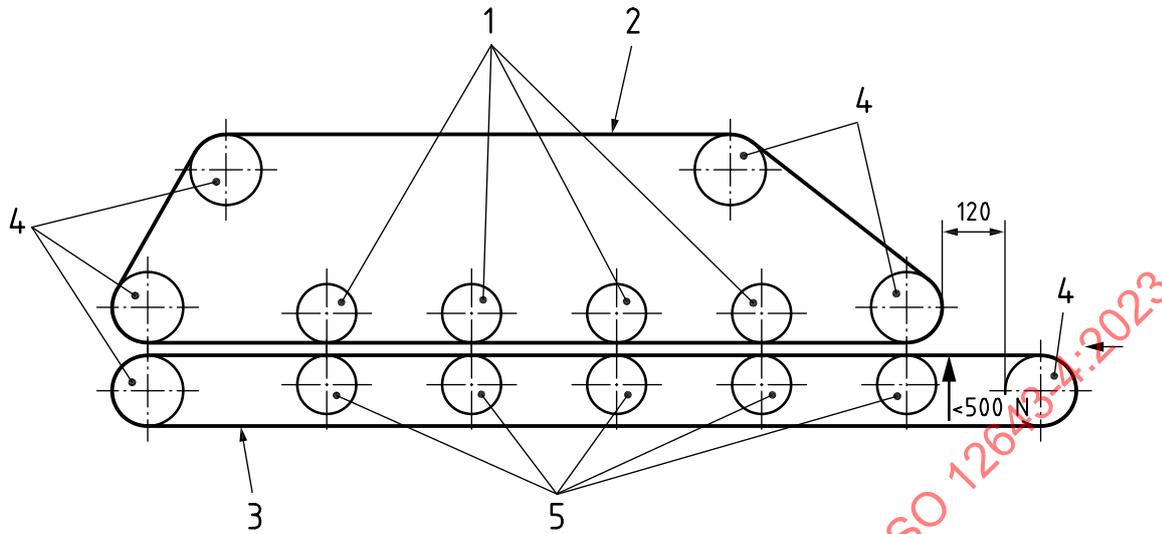
7.8.2 Pressure rollers

In-running nips between pressure rollers and pressing belt shall be safeguarded, for example, by one or both of the following measures:

- fixed guards in accordance with ISO 12643-1:2023;

- a deflection of the pressure rollers of at least 120 mm under a maximum contact force of 100 N.

Dimensions in millimetres



Key

- 1 pressure rollers
- 2 upper pressing belt
- 3 lower pressing belt
- 4 pulleys
- 5 guide rollers

Figure 23 — Pressing section

8 Pre-feeders

8.1 Feeding and transfer bridge

To ensure safe access/egress platforms and railings shall be provided on the pre-feeder/extend.

NOTE 1 There is frequent work on the pre-feeder/extend including, but not limited to, the following:

- unblocking a machine
- changing conveyor belts

NOTE 2 For specific information, see ISO 12643-1:2023, 5.4.4.

8.2 All pre-feeders with pile carrier plate

8.2.1 Opening for pallet movement

The aperture for ejection of empty pallets shall be in accordance with ISO 13857:2019.

The entrance into the pile carrier plate shall be guarded in accordance ISO 13857:2019 with ESPDs positioned in accordance with ISO 13855:2010. The safety-related control system shall be in accordance with at least ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.

8.2.2 Guarding on feeding and transfer bridges

The hazardous movements on the feeding and transfer bridge shall be safeguarded, for example, by one or both of the following measures:

- hold-to-run control with 5 m/min maximum in accordance with ISO 12643-1:2023, 5.3.6;
- fixed side guards in accordance with ISO 13857:2019.

NOTE Hazardous movements can be lifting, lowering and telescoping movements.

The hazard points between the pushers at the end of the feeding and transfer bridge shall be safeguarded, for example, by guards or by a minimum distance of 120 mm.

The hazard points between the pushers and the stack in the hopper of the subsequent in-line machine shall be safeguarded, e.g. by limiting the force to 300 N.

8.2.3 Rotating shafts

All rotating shafts shall be protected by mechanical guarding.

8.2.4 Guarding hazards created by automatic format setting

Where a hazard exists, automatic format setting operations may be performed at speeds up to and including 0,5 m/min without additional safety measures. However, if there is a crushing hazard for the head or trunk of the body, format setting shall be permitted only with a hold-to-run control. The location of the hold-to-run control shall allow the operator to clearly see the hazard points.

EXAMPLE Automatic format setting devices include side lays.

If additional safety measures are needed in the area of the format setting device, personnel shall be protected from motion of the device(s) by one or more of the following measures:

- the provision of trip devices;
- separate stop device that is not included in the emergency stop function of the printing press;
- control zone using the emergency stop function.

8.2.5 Guarding hazards when moving pre-feeder

Hazard points created when moving the pre-feeder into or out of the in-line machinery shall be guarded. These hazard points are considered to be adequately safeguarded if one of the following conditions exists:

- the machine travel is possible only under hold-to-run control with a maximum speed of 5 m/min;
- there is a continuous audible and/or visual warning signal for the duration of machine travel;
- and hazard points and hazard zones can be observed from the location of the hold-to-run button;
- the hazard zone is safeguarded by fixed guards and ESPDs.

8.3 Pre-feeder with pile turner

8.3.1 Opening for pallet movement

The aperture for ejection of empty pallets shall be in accordance with ISO 13857:2019.

The entrance into the pile carrier plate shall be guarded in accordance ISO 13857:2019 with ESPDs positioned in accordance with ISO 13855:2010. The safety-related control system shall be in accordance with at least ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.

8.3.2 Guarding on feeding and transfer bridge

The hazardous movements on the feeding and transfer bridge shall be safeguarded, for example, by one of the following measures:

- hold-to-run control with a maximum speed of 5 m/min in accordance with ISO 12643-1:2023, 5.3.6;
- fixed side guards in accordance with ISO 13857:2019.

NOTE Examples of hazardous movements include lifting, lowering and telescoping movements.

8.3.3 Guarding transport belts

Where in-running nips on transport belts can be accessed, nips shall be guarded in accordance with ISO 12643-1:2023.

The hazard points between the pushers at the end of the feeding and transfer bridge shall be guarded or provided with a minimum clearance of 120 mm.

The hazard points between the pushers and the stack in the hopper of the subsequent in-line machine shall be safeguarded, for example by limiting the force to 300 N.

8.3.4 Guarding hazards created by automatic format setting

Where a hazard exists, automatic format setting operations may be performed at speeds up to and including 0,5 m/min without additional safety measures. However, if there is a crushing hazard for the head or trunk of the body, format setting shall be permitted only with a hold to run control. The location of the hold-to-run control shall allow the operator to clearly see the hazard points.

If additional safety measures are needed in the area of the format setting device, personnel shall be protected from motion of the device(s) by one or more of the following measures:

- the provision of trip devices;
- a separate stop device that is not included in the emergency stop function of the downstream (following) machine;
- a control zone using the emergency stop function.

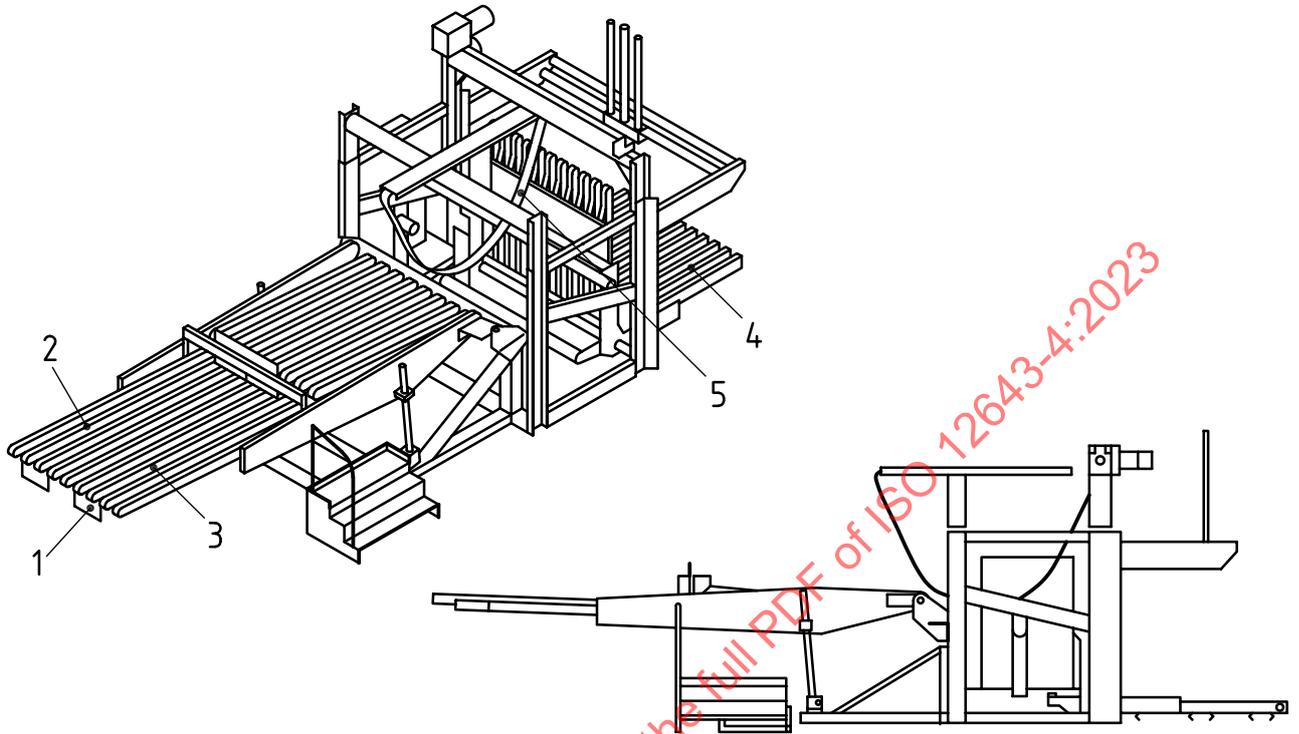
8.3.5 Guarding hazards when moving pre-feeder

Hazard points created when moving the pre-feeder into or out of the in-line machinery shall be guarded. These hazard points are considered to be adequately safeguarded if one of the following conditions exists:

- the machine travel is possible only under hold-to-run control with a maximum speed of 5 m/min;
- there is a continuous audible and/or visual warning signal for the duration of machine travel;
- and hazard points and hazard zones can be observed from the location of the hold-to-run button;
- the hazard zone is safeguarded by fixed guards and ESPDs.

Typical examples of moving pre-feeders are given in [Figures 24](#) and [25](#).

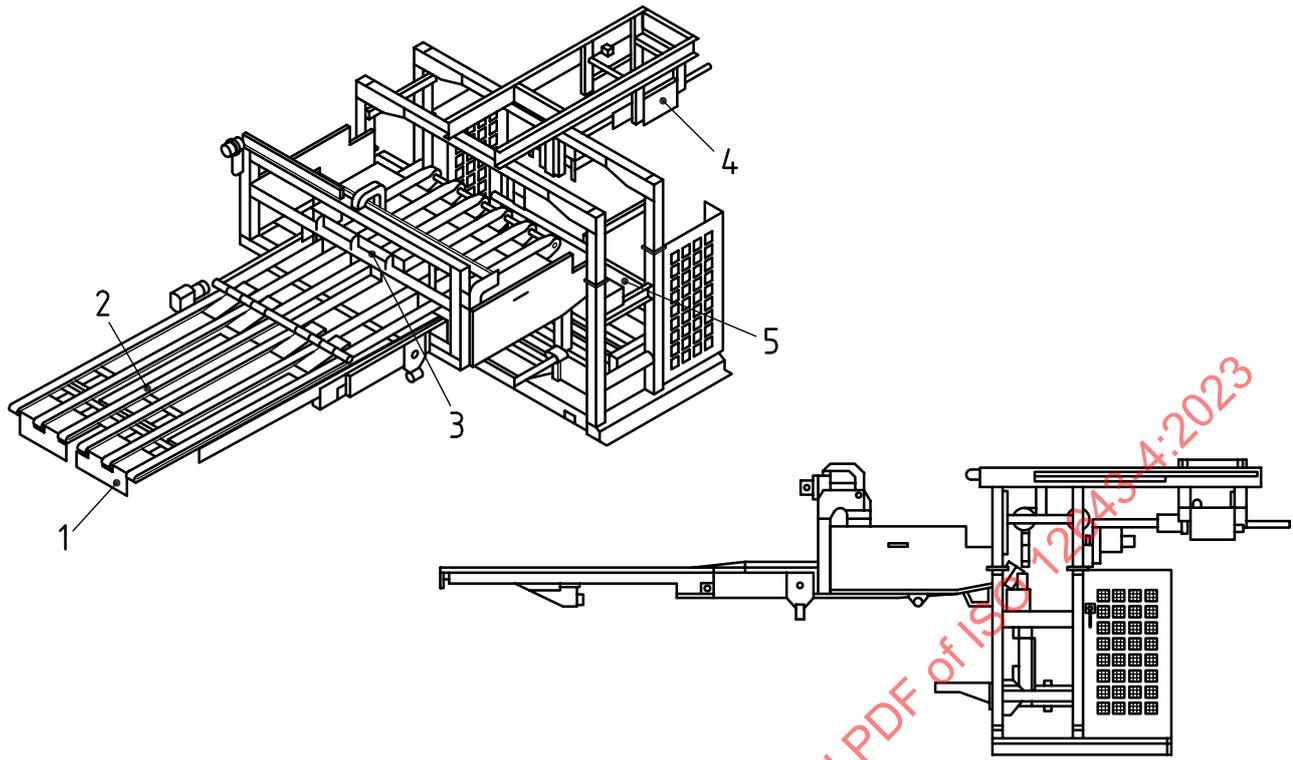
To prevent the table falling as a result of gravity during maintenance and other interventions below the raised table, measures shall be in place to prevent this, for example well-tries check valve, mechanical pins or safety support.



Key

- 1 pushers
- 2 feeding and transfer bridge
- 3 transport belt
- 4 brake belt
- 5 pile turner/ tipping unit

Figure 24 — Pre-feeder with pile turner



Key

- 1 pushers
- 2 feeding and transfer bridge
- 3 shingling barrier
- 4 separating head
- 5 pile carrier plate

Figure 25 — Pre-feeder with pile carrier plate

9 In-line machines

9.1 Entire machine

9.1.1 Moving units together

When moving units together hazard points created between machine side frames are deemed to be safeguarded if all of the following conditions shall be met.

- Movement of units is possible only under hold-to-run control with a maximum speed of 5 m/min.
- The hold-to-run control is located in such a position that the hazard point cannot be reached by hand, even with fingers spread apart.
- A warning device gives a continuous audible and/or visual warning signal for the duration of the closing travel of the machine units.
- In the passageways between the individual units, stop/safe pushbuttons are provided if the passageways cannot be observed from the location from which the actuator starts the travel movement. All travel movements shall be stopped when the stop/safe pushbutton is actuated. The necessity for and distance between stop/safe pushbuttons shall be determined as a result of the risk assessment.

When in the open position, crushing hazard points caused by inadvertent closing of the machine units these units shall be safeguarded by mechanical means (i.e. safety bolts, pins).

For reference on instructions relating to residual risk to be given in the instruction handbook, see [17.2.9](#).

9.1.2 Separating units

Separation of the units shall be possible only after all hazardous movement has stopped.

9.1.3 Rotary tools on separated units

After separating the units, continuous operation of the rotary tools shall not be possible.

NOTE Examples of such rotary tools include knives, blades, dies, etc.

9.1.4 Travel wheels

The in-running nips between the travel wheels and floor or runway shall be safeguarded, e.g. by providing foot guards fixed such that there is a distance of no more than 15 mm between the runway and the lower edge of the guard.

9.2 Feeding unit

9.2.1 Slide-in rollers

The in-running nips between slide-in rollers (feeder shafts, friction rollers) and fixed machine parts shall be safeguarded by deflecting guarding sections designed in such a way that the deflecting plane is at right angles to the surface of the rotating parts and the distance is as small as possible and does not exceed 4 mm.

9.2.2 Side aligning devices

The hazard points between side aligning devices (side pushers) (see [Figure 4](#), item 3) and fixed machine parts shall be safeguarded by guards or by a minimum distance of 120 mm.

The hazard points between side aligning devices (side pushers) ([Figure 4](#), item 3) and the blank pile (see [Figure 4](#), item 2) in the hopper shall be safeguarded. Safeguarding can be achieved by limiting the force to 300 N.

9.2.3 Hopper side lays

The side lays of the hopper create danger points when travelling against fixed machine parts.

Safeguarding shall be provided by one or more of the following measures:

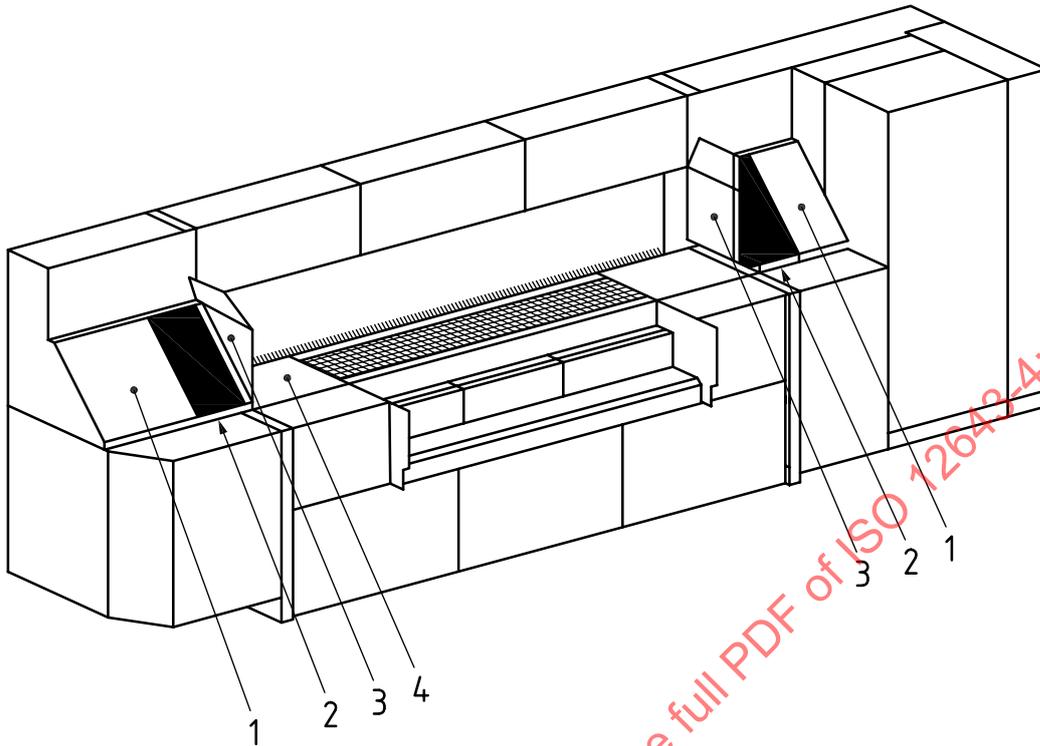
- manual operation of the movement;
- a hold-to-run control with a maximum speed of 5 m/min;
- limiting the travel speed to a maximum of 0,5 m/min, and an emergency stop device located on the delivery side.

9.2.4 Feed rollers

The hazard points outside the side lays on feeders shall be safeguarded for every format size used.

NOTE This safeguarding can be achieved, for example, by using accordion-type bellows or by the use of additional guards. See [Figure 26](#).

For hazard points within side lays, residual pile monitoring that is also used as a safety device shall be in accordance with at least ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.



Key

- 1 fixed guards
- 2 accordion-type bellows or additional guards
- 3 side lays
- 4 magazine

Figure 26 — Safeguarding of hazard points outside the sidelays on feeders

9.3 Printing unit

9.3.1 Rotating rollers and drive elements

All hazardous movement shall stop before it is possible to separate the units.

9.3.2 Separated units

When printing units are separated, they shall only be allowed to be moved under hold-to-run control with a maximum speed of 5 m/min.

A foot pedal can be used for the hold-to-run operation to allow the operator to use both hands when mounting printing plates.

9.3.2.1 Changing of printing plates

9.3.2.2 General

The changing of printing plates shall be done with the help of appropriate means for lifting or handling the plates to ensure easy and safe loading and unloading.

9.3.2.3 Automatic printing plate changes

If the changing of printing plates is done by automatic operation, the changing of printing plates may be done without printing units being separated during the plate change.

If the cylinder is rotated by automatic means when mounting the plate to the cylinder, hazard points between the cylinder and fixed machine parts (machine frame) shall be safeguarded by one or more of the following measures:

- the use of guards in accordance with ISO 12643-1:2023;
- the use of ESPDs in accordance with ISO 12643-1:2023, 5.7.6;
- safety devices with approach reaction (e.g. trip devices, pressure-sensitive mats).

9.3.2.4 Semi-automatic printing plate changes

If the changing of printing plates is done by semi-automatic operation (i.e. an operator shall assist when mounting the plate to the cylinder, and the cylinder is not rotated by automatic means), the hazard points between the cylinder and fixed machine parts (machine frame) shall be safeguarded by one or more of the following measures:

- the use of guards in accordance with ISO 12643-1:2023;
- the use of hold-to-run control with at least ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2;
- the use of a foot pedal (designed as a hold-to-run control with at least ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2), if the operator needs to use both hands when mounting printing plates. Movement shall be limited to a maximum speed of 5 m/min or maximum distance of 75 mm

9.3.3 Guarding of rollers

Actuation of an emergency stop device need not cause stopping of the ink roller if continuing movement is required for operational reasons and if all in-running nips on the ink roller are safeguarded by interlocking guards, possibly in combination with fixed guards, in accordance with ISO 12643-1:2023.

When the printing units are in the open position and where rollers such as ink rollers (see [Figure 4](#), item 6) need to continue to be driven for operational reasons, the hazard points shall be safeguarded by interlocking guards.

Where ink rollers need to keep running, there shall be a clearance between the ink roller and the printing cylinder (with printing plate attached) that is sufficient to avoid frictional contact between ink roller and printing cylinder.

9.4 Slitter-scorer unit, rotary die-cutter

9.4.1 Automatic format setting

When units are in the open position, tool setting shall be possible only under hold-to-run control in accordance with ISO 12643-1:2023, 5.3.6, with a maximum speed limitation of 5 m/min.

9.4.2 Waste removal

The hazard points on the tools provided for breaking out trimmings shall be safeguarded, e.g. by providing a tunnel-type guard that complies with ISO 13857:2019 that allows the removal of the waste while preventing access.

9.4.3 Waste discharge conveyor belts

Hazard points on waste discharge conveyor belts (see [Figure 4](#), item 9) shall be safeguarded.

9.5 Separators

Access to the separator shall be prevented by using one or more of the following methods:

- fixed or interlocking guards (see ISO 12643-1:2023 for requirements);
- laser scanners;
- light curtains.

The control system of the ESPDs and interlocking guard with guard locking shall be in accordance with at least ISO 13849-1:2023, PL d and IEC 62061:2021, SIL 2.

9.6 Folding unit (folding box gluer)

When interlocking doors are in an open position, folding arms shall be allowed to move only under hold-to-run control in accordance with ISO 12643-1:2023, 5.3.6, if all hazard points and hazard zones can be observed.

9.7 Taping unit

The machine shall be designed such that changing, and threading of the adhesive tape shall take place outside hazard zones.

9.8 Stitching unit

The machine shall be designed such that changing, and threading of the stitching material shall take place outside hazard zones.

10 Automatic flatbed die-cutting machines

10.1 Entire machine

10.1.1 Tool

The movable part of the tool (for example lower part of the die-cutting unit or breaking tool) shall not be allowed to change its position while a guard is open for example, by a non-powered movement or gravity falling. This is achieved on pneumatic and hydraulic cylinders by controlled well-ried check valves.

10.1.2 Automatic die-cutting devices

Automatic die-cutting devices, in which the form locking between drive worm and flywheel drive is disconnected in case of material jams, shall be provided with adequate safety provisions.

NOTE 1 Adequate safety provisions include:

- brakes;
- mechanical, pneumatic or hydraulic safety bolts.

Failure of the flywheel coupling shall not result in hazardous movements. This can be avoided by automatic mechanical locking of the gripper bars in accordance with at least ISO 13849-1:2023, PL c or IEC 62061:2021, SIL 1.

NOTE 2 An example of this is the use of a gripper chain lock to prevent movement of the gripper chain due to a mechanical failure of a flywheel or other component within the drive system that can result in unexpected movement of the gripper chain.

10.2 Punching section

10.2.1 Hazard points between sheet feeding grippers and feeding table

The safety distance in relation to the width of the feeding aperture shall be in accordance with ISO 13857:2019.

10.2.2 Die-cutting tools

To ensure safety when working on the die cutting tools (e.g. during make-ready), one or both of the following provisions are required:

- a device on the supporting arms for turning the upper and the lower tool;
- a separate preparation table outside the automatic die-cutting machine

10.3 Breaking section

Where whole-body access is possible interlocking guards or ESPDs shall be provided with a reset control system in accordance with ISO 12643-1:2023, 5.3.7.

10.4 Blank separating section, blank delivery

10.4.1 Guarding sheet gripper from unintentional hand access

In the area of the blank delivery, any unintentional access to movable parts of the sheet gripper system from above and from the side shall be prevented by fixed or interlocked protective devices. At the sides these protective devices shall reach down at least to the bottom edge of the sheet gripper system.

Any residual risk caused by reaching underneath protective devices shall be indicated in the instruction handbook (see ISO 12643-1:2023, 8.3).

10.4.2 Area below blank separating section, blank delivery

10.4.2.1 Guarding rotating sheet gripper systems from full body access

In the area of rotating sheet gripper systems on blank deliveries, measures for safeguarding the full body access of persons shall be in place on all access sides if the access height, h , is 800 mm or more [see [Figure 27 a\)](#) or [27 b\)](#)], or if an electric/electronic control system is used for safeguarding the full body access of persons, this control system shall satisfy the requirements of ISO 12643-1:2023, 5.10.1.2.

If the safeguarding is done via ESPDs see additional requirements in ISO 12643-1:2023, 5.7.6.

10.4.2.2 Safeguarding full body access by electro-sensitive protective devices (ESPDs)

10.4.2.2.1 Arrangement of light beams of ESPDs for machines having a single access level

The light beams of the ESPD on machines having a single access level shall be arranged as specified in [Table 1](#) and shown in [Figure 27 a\)](#) or [27 b\)](#). For the arrangement of light beams of the ESPD on multi-level machines, see [10.4.2.2.3](#). The requirements of ISO 13855:2010 relating to the horizontal distance between the light beams and the rotating gripper systems do not have to be met.

NOTE The primary protective action lies in the prevention of unexpected start-up of the flatbed die-cutting machine. In addition, the basic shape of the machine, the delivery pile carrier and the pile itself prevent or impede unhindered access to the hazard zone, making consideration of access time to the hazard unnecessary.

For information to be provided in instruction handbooks on the residual risks when using ESPDs, see [10.4.2.2.4](#) and ISO 12643-1:2023, 8.3.6.

Table 1 — Arrangement of the ESPD in relation to the access height

Dimensions in millimetres

Access height h	Arrangement of the ESPD in relation to the access level(s)		
	Light beam 1 ^a	Light beam 2 ^b	Light beam 3 ^c
$h \leq 1\,200$	300	not required ^d	400 below h ($h - 400$)
$1\,200 < h \leq 1\,500$	300	in the centre between light beams 1 and 3	400 below h ($h - 400$)
$h > 1\,500$	300	700	1 100

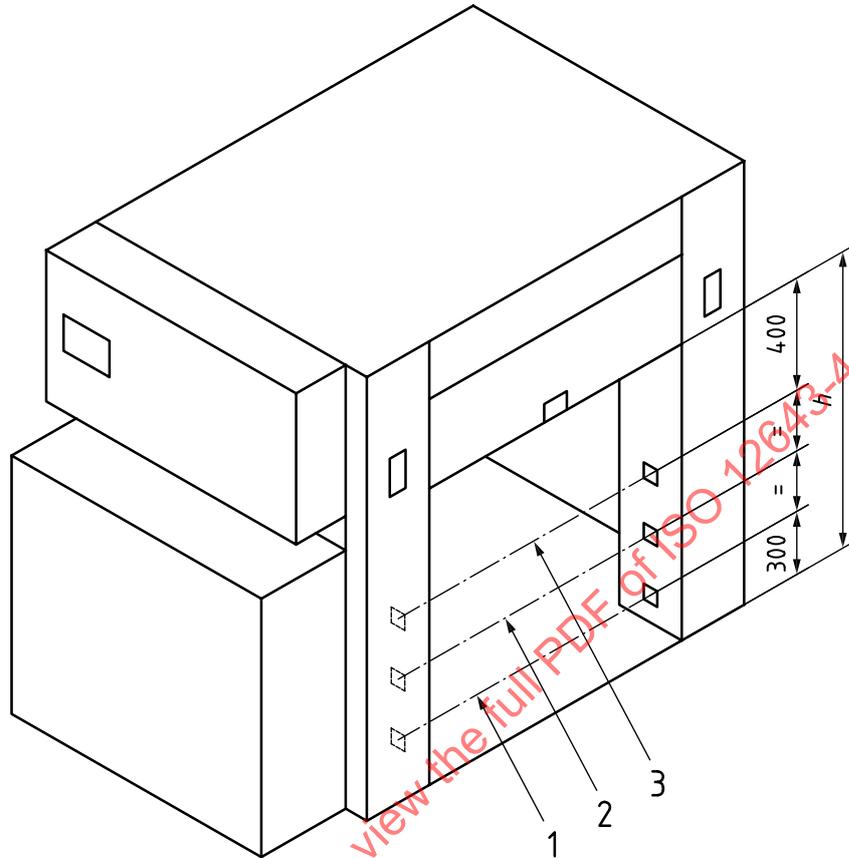
^a Arrangement measured from the access level or from a fixed or swinging platform; due to the structural tolerances at the location of installation, the permissible tolerance for the arrangement is ± 35 mm.

^b Light beam between light beams 1 and 3, if the distance between light beam 1 and light beam 3 is greater than 500 mm.

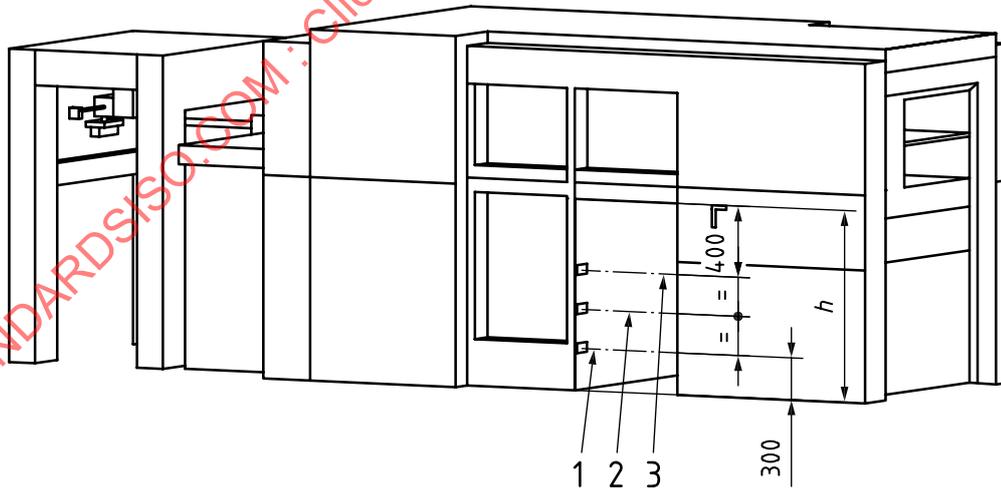
^c A maximum of 1 100 mm in height.

^d Some of the bypassing functions described under [10.4.2.2.2](#) require 3 light beams for safeguarding the access side. Where these bypassing functions are to be used, a third light beam shall be provided in the centre between the upper and the lower light beam also for access heights below 1 200 mm. See [Figure 27](#) a) and b).

Dimensions in millimetres



a) Unloading at frontside



b) Unloading sideways

Key

- 1 light beam 1
- 2 light beam 2
- 3 light beam 3
- h* access height

Figure 27 — Arrangement of the light beams at the blank delivery

10.4.2.2.2 Bypassing light beams

10.4.2.2.2.1 General

For the functions of exit of the pile and complete pile removal (including insertion of empty pallets and moving in equipment, such as a hand forklift truck), a time-limited bypass of individual or several light beams is permissible only if the respective requirements for the individual functions are met under the conditions defined in [10.4.2.2.2.2](#) to [10.4.2.2.2.5](#).

The duration of the individual bypass sequences shall not exceed 20 s. After that time, the bypassed light beams shall be reactivated automatically.

The bypass function may be actuated by either a manual control or an automated sequence.

The bypass functions as defined in the following clauses also include safeguarding of the area beneath the pile support systems.

10.4.2.2.2.2 Bypass function for inserting empty pallets and moving in equipment

Bypassing the light beam 1 [see [Figure 27](#) a) and b)] on the side being accessed shall be possible only if all the following conditions are met:

- the bypass control is a pushbutton positioned on the side being accessed;
- three light beams are installed to safeguard the access side;
- the auxiliary pile support (e.g. forks/rake, roller blind) or an equivalent device prevents access to the hazard zone;
- all top and middle light beams on all access sides and all bottom light beams on all other access sides are active;
- the pile support plate is raised no more than 120 mm.

With regard to the above-mentioned light beams, requirements for electrical interlocking are fulfilled if the auxiliary pile support, or similar device, is interlocked such that the auxiliary device, when inserted, will automatically actuate the safety switch. The control system of the switch shall be in accordance with ISO 13849-1:2023, PL d or IEC 62061:2021, SIL 2.

NOTE Since metal rods, which need to be removed from the machine and can be used for several machines, are used as auxiliary pile supports, it is not possible to use encoded safety position switches with separate actuators.

10.4.2.2.2.3 Manual bypass function for pile removal, including inserting empty pallets

Bypassing the light beams on the side where the pile is exiting shall be possible only if all the following conditions are met:

- the pile removal control is located on the side from which the pile exits the delivery zone;
- the machine is in run mode;
- the pile support plate is no more than 120 mm above the floor;
- three light beams are arranged to safeguard the access side;
- all top, middle and bottom light beams on all other access sides are active during the entire process.

The bypass sequence shall meet all of the following requirements:

- bypass only the light beam 1 [see [Figure 27](#) a) and b)] on the removal side for not more than 20 s;

- during this time, a sensor (e.g. ultrasonic sensor, laser sensor) is to be triggered, which detects the exit of the pile and switches off the light beams on the exit side for a maximum of 20 s;
- light beams 2 and 3 [see [Figure 27 a\)](#) and b)] shall be reactivated automatically after this time (maximum of 20 s) has elapsed;
- light beam 1 [see [Figure 27 a\)](#) and b)] remains switched off for a further duration of maximum 20 s while inserting the empty pallet;
- during this period (maximum 20 s), it is possible to bypass the light beam 1 [see [Figure 27 a\)](#) and b)] for only one additional period of 20 s by actuating the remove pile control again;
- the light beam 1 [see [Figure 27 a\)](#) and b)] is automatically activated again after the expiration of its bypass time.

10.4.2.2.2.4 Automatic bypass function for pile removal

Bypassing the light beams at the side where the pile is moved out shall be possible only if there is a means of detecting the direction of the pile movement from the safeguarded area to a position outside the safeguarded area.

NOTE The machine is in an automatic mode and needs to sense when the pile is full so that it can be removed. So that the pile can move outside the safeguarded area, the light beams require disabling to allow the machine to continue running while the pile movement is occurring. Once the pile has moved past the plane of the light beams, the light beams are reactivated.

Pile removal may be detected by the use of one or more sensors (e.g. ultrasound, light beam, etc.), arranged inside the delivery zone, behind the ESPD.

As an exception to the requirements of ISO 12643-1:2023, the sensor and the related control system shall meet the requirements of at least ISO 13849-1:2023, PL b or IEC 62061:2021, SIL 1.

10.4.2.2.2.5 Status lights

A yellow status light shall be used to indicate that the bypass function is actuated (released automatically or at the push of a button). The end of the bypass duration may be indicated by the yellow status light flashing.

The status lights shall be placed on all access sides that are protected by light beams. The integration of the status lights into the control system may be single-channel, for example via an electronic control system.

NOTE A green status light can be used to indicate that all light beams are activated and uninterrupted. The interruption of a light beam can be indicated by a red status light.

If green and red status lights are used, they shall be positioned in such a way as to ensure that they cannot be confused with the optional personnel warning lights defined in ISO 12643-1:2023.

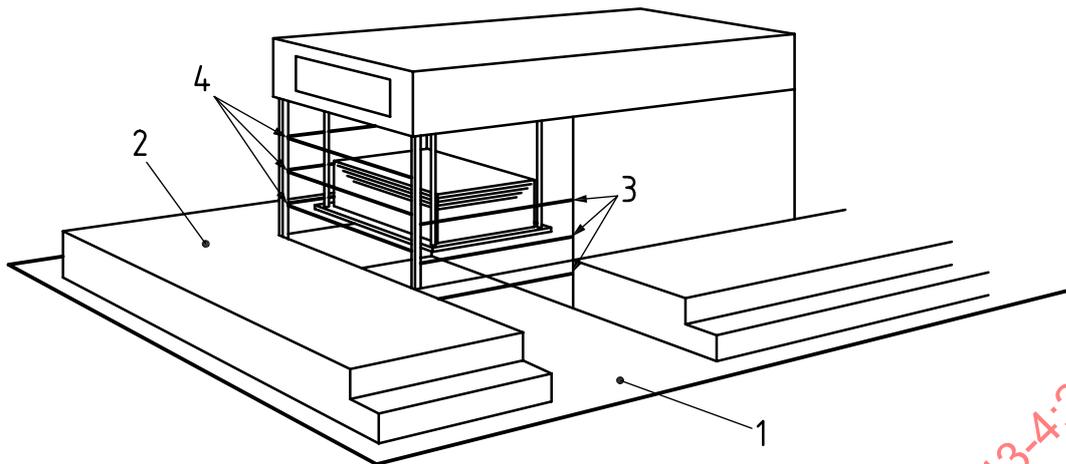
10.4.2.2.3 Machines with multiple access levels

On machines with several access levels (e.g. with movable platforms), the protective measures described in [10.4.2.2.1](#) to [10.4.2.2.2.5](#) shall be provided on every access level (see [Figures 28](#) and [29](#)).

[Figure 28](#) shows two access levels, one for the ground and one for the platform. This requires a set of light beams on each side, positioned at a height appropriate for that access level. [Figure 29](#) shows a situation in which a movable ramp can create an additional access level on that side and necessitates additional light beams to ensure that all access levels are considered.

When the movable platform is raised, the light beams of the exiting side of access level 1 ([Figure 29](#), item 3) shall be activated.

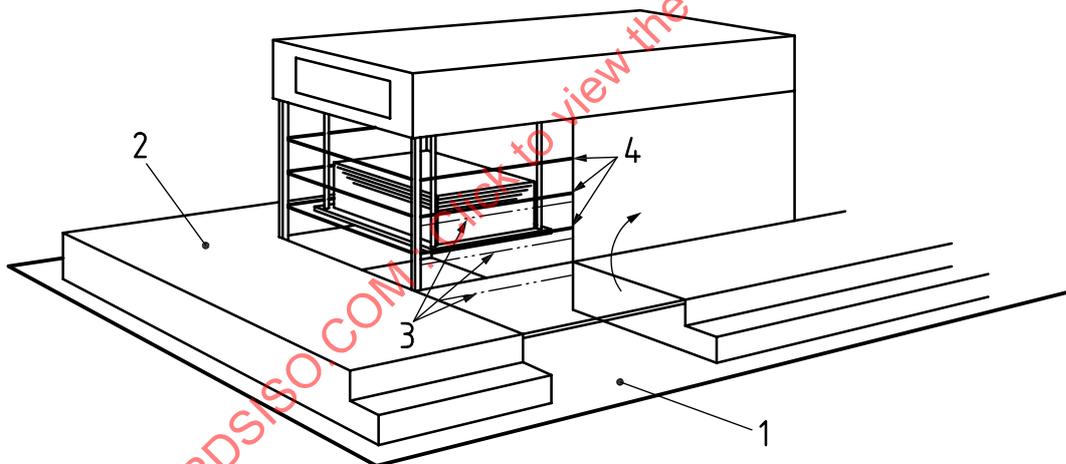
Dimensions in millimetres



Key

- 1 access level 1 (e.g. pile exit)
- 2 access level 2 (e.g. platform, footboard)
- 3 light beams of level 1
- 4 light beams of level 2

Figure 28 — Multiple access levels without movable platform



Key

- 1 access level 1 (e.g. pile exit)
- 2 access level 2 (e.g. platform, footboard)
- 3 light beams of level 1
- 4 additional light beams of level 2

Figure 29 — Multiple access levels with movable platforms

10.4.2.2.4 Information on ESPDs in the instruction handbook

When using ESPDs to safeguard access to the delivery, residual risks, such as unintended contact with sheet gripper bars, shall be indicated in the instruction handbook in accordance with ISO 12643-1:2023.

10.4.2.3 Other methods of full body access safeguarding

As an alternative to safeguarding in accordance with [10.4.2.2](#), full body access safeguarding can be achieved using one or more of the following methods, providing an equivalent level of safety is met:

- fixed or interlocking guards (see ISO 12643-1:2023 for requirements);
- pressure-sensitive mats (see ISO 12643-1:2023 for requirements);
- laser scanners;
- trip bars;
- light curtains.

10.4.2.4 Reset control for delivery units

The reset control shall be placed in a location from which the hazard area can be fully viewed and reaching the reset control from inside the hazard area is prevented. This requirement is met if the reset control is inside the permissible area at least 400 mm away from, but not lower than, the bottom edge of the machine contour (see [Figure 30](#)).

Dimensions in millimetres

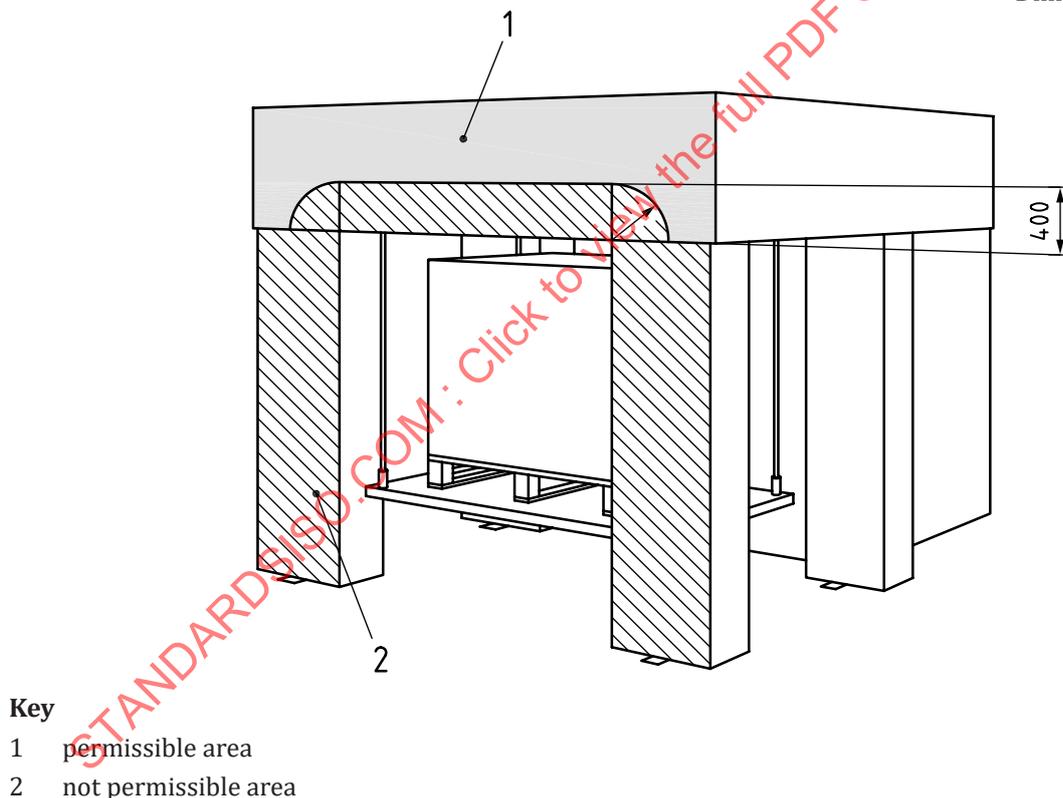


Figure 30 — Permissible area for reset control location

On die-cutting machines having several access areas where all hazard zones cannot be fully viewed from a single location, additional reset controls shall be provided. This is to ensure that the hazardous area affected by each of the reset controls can be viewed from the position of that reset control.

EXAMPLE Examples of machines having several access areas where all hazard zones cannot be fully viewed from a single location include elevated machines or machines with dual deliveries.

In the following circumstances, it is necessary to press the reset control before movement in the delivery area can be initiated using a separate control:

- after switching on the machine at the main switch;
- after actuating the ESPDs;
- when the protective device that safeguards full body access to hazard areas has been tripped.

As an exception, it is not necessary to press the reset control if persons inside the hazard area are safely detected due to the sensing capability of the protective devices (e.g. laser scanners).

Pressing the reset control shall not lead to an automatic start-up of machine motion.

As an exception, pressing a reset control may initiate motion of both the main pile and auxiliary pile system.

NOTE This is to allow the operator to quickly reset the pile system within the time period allowed before the machine stops.

The movements of the main and auxiliary pile carrier systems are allowed to be restarted by the reset button only if the entire hazard zone can be seen from the position of the reset button.

10.4.2.5 Safeguarding the sheet gripper system

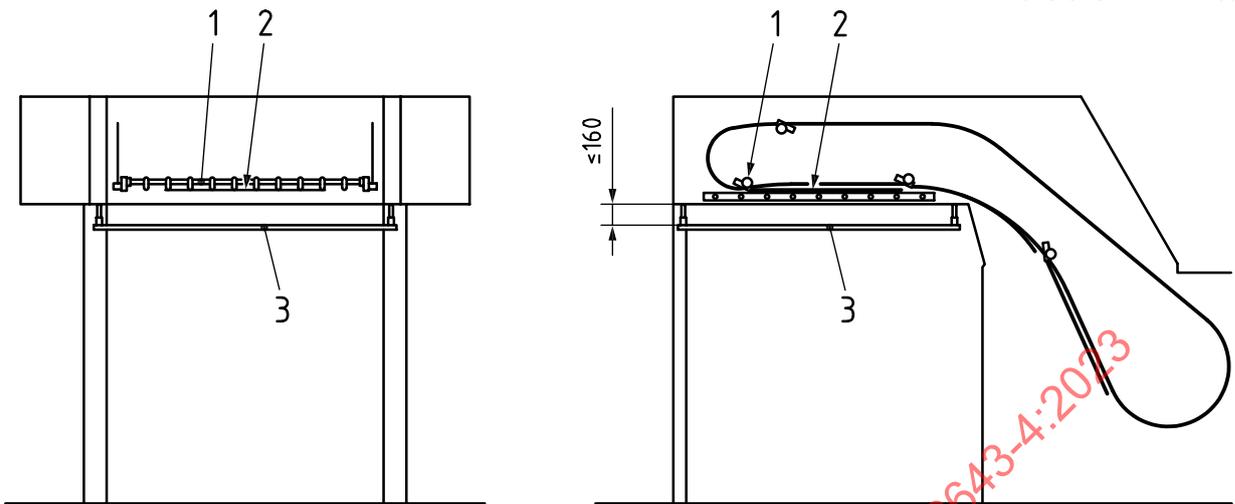
Acceptable risk for full body access to the sheet gripper system is achieved by one of the following risk reduction measures:

- a) While the delivery is separated from the drive train using couplings, the coupling action and restart shall not cause any hazardous movements.
- b) The opening above the pile carrier or the moved-in auxiliary pile support (e.g. forks/rake, roller blind) or equivalent device shall be no greater than 160 mm.
- c) While the machine is delivering material to a raised pile support plate or to an auxiliary pile support (e.g. forks/rake, roller blind) or equivalent device; and the presence of the pile support in use is detected either at insertion or by the time it has reached 160 mm below the access to the hazard; and the opening above the uppermost pile carrier shall be no greater than 300 mm; and no change of state of the main drive has occurred. Restart from the standstill position shall not be possible without additional safety measures.
- d) Horizontal light beams underneath the gripper system if the requirements of ISO 13855:2010 are met.

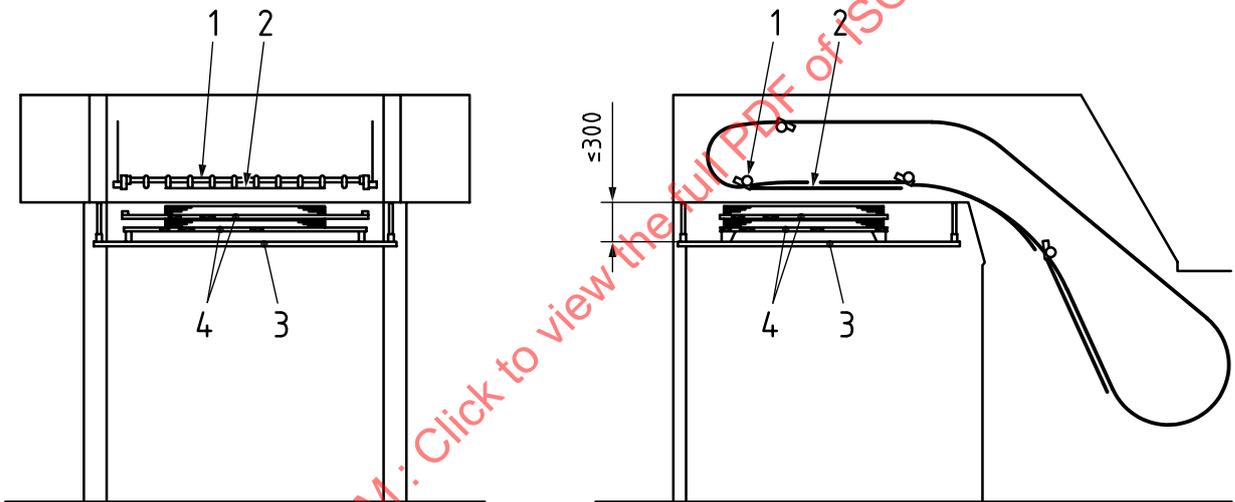
If none of the above conditions exist, the delivery shall not operate without the presence of additional safeguarding against entry into the hazardous area.

For example, if the pile support has not been detected by the time it has descended to a distance of 160 mm below the access to the hazard, the machine shall either shut down or the hazardous area shall be protected by additional safeguarding, such as light beams, guards, etc.

Dimensions in millimetres

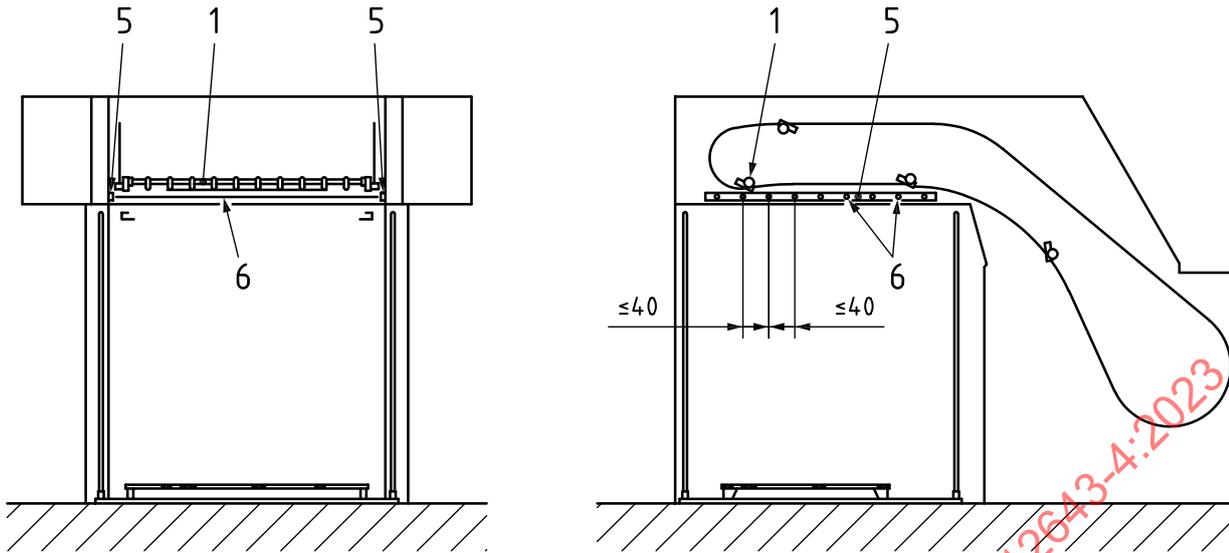


a) Front and side views with pile carrier support in place (≤ 160 mm)



b) Front and side views with pile and pile carrier support in place (≤ 300 mm)

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c) Front and side views with light beams (≤ 40 mm)

Key

- 1 sheet gripper system
- 2 sheet
- 3 pile carrier
- 4 pile support
- 5 sensor parts
- 6 light beams

Figure 31 — Guarding of sheet gripper system

10.5 Trimming and delivery of gripper edge

The hazard points shall be safeguarded by guards interlocked with the hazardous movement. The waste collecting bin can be part of this guarding device. Where the bin is removed for emptying and hazard points can be accessed, the bin shall be interlocked with the hazardous movement.

11 Roller press die-cutters

Roller press die-cutters shall meet the guarding requirements of ISO 12643-1:2023. A trip bar shall be provided at the entrance to and exit from the point of operation to guard against access to the nip created between the roller and the die.

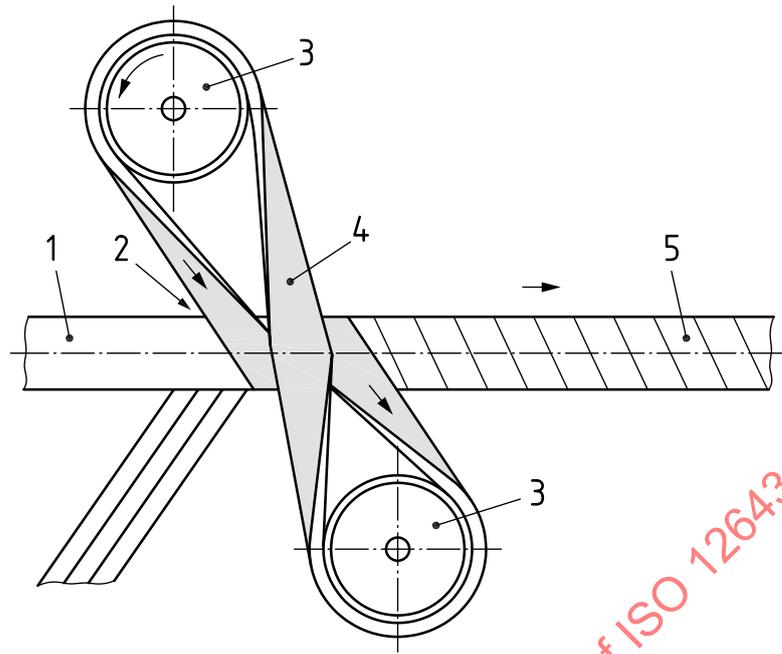
12 Tube winding machines

12.1 Ply reels

Reels of the ply material shall be safely supported for unwinding. For overhung (cantilevered) ply reels, this requirement is met when mechanical devices (e.g. split pins) prevent the reel from falling.

12.2 In-running nip between winding belt and winding mandrel

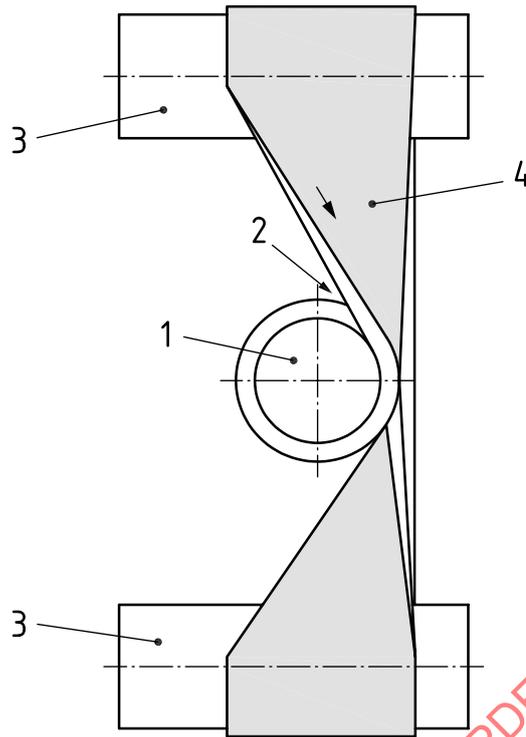
The in-running nip between winding belt and winding mandrel (see [Figure 32](#), item 2, and [Figure 33](#), item 2), shall be safeguarded, for example, by fixed and interlocking guards.

**Key**

- 1 winding mandrel
- 2 in-running nip
- 3 belt drive shaft (drive drum)
- 4 winding belt
- 5 tube

Figure 32 — Winding belt in-running nip on tube winding machine (view of drive drums)

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Key

- 1 winding mandrel
- 2 in-running nip
- 3 belt drive shaft (drive drum)
- 4 winding belt

Figure 33 — Winding belt in-running nip on tube winding machine (view of winding mandrel)

For machines that require that the paper be held and pressed onto the winding mandrel with two hands, while the guard is in the open position for threading the ply, the production speed shall be limited to 5 m/min. If the guard does not close within 60 s, the machine shall stop. An additional emergency stop device shall be provided in the vicinity that can be actuated by some part of the body other than the hand (e.g. knee or abdomen).

Actuation of the emergency stop device shall release the winding belt tension as quickly as possible and thus eliminate the in-running nip.

12.3 In-running nips on shaft bearings

On unwinds using insertable unwinding shafts, the shaft bearings shall be designed so that in-running nips are avoided. Otherwise, safeguarding is required by interlocking guards.

12.4 In-running nips

Guards protecting in-running nips shall be suitable for all winding parameters, including tube diameter, winding diameter, winding angle, ply widths, number of plies, width of winding belt, etc.

NOTE Safeguarding of this type of in-running nip can be achieved by providing adjustable-type guards.

12.5 Tube cutting and sawing section

The hazard points on the tube cutting and sawing section shall be safeguarded by interlocking guards. Such guards may be designed as tunnel-type guards and shall have minimum safety distances of 850 mm on the feeding and the delivery sides.

12.6 Tube transfer

The hazard zone existing during tube transfer between transport elements and fixed machine parts shall be safeguarded.

NOTE Safeguarding of this hazard zone can be achieved by providing tunnel-type guards.

13 Machinery for the production of envelopes

13.1 Emergency stop device

Emergency stop devices shall be provided on each main control panel and be a maximum of 5 m apart.

13.2 Interlocks

13.2.1 Interlocking with guard locking

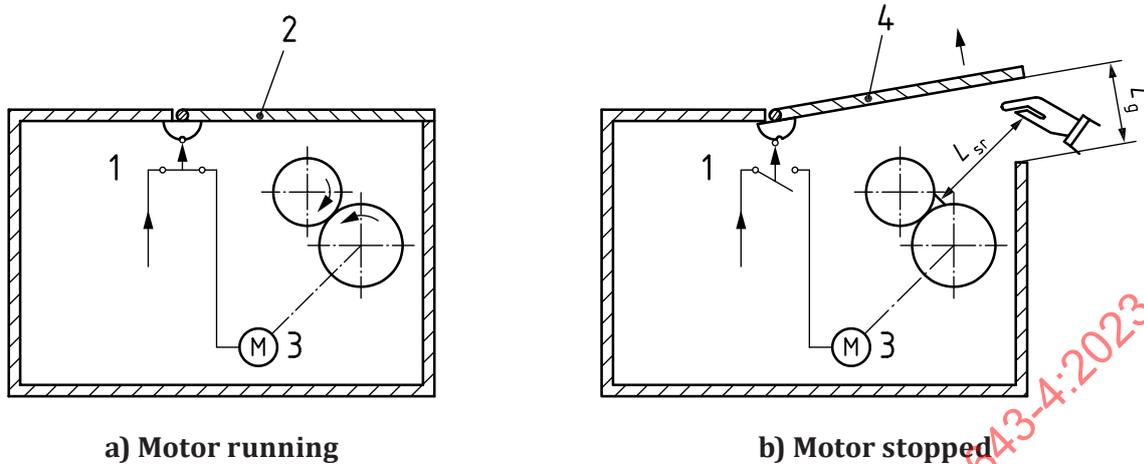
Interlocking with guard locking is required where the hazardous movement cannot be stopped in 3 s or less after actuation of the guard position detector.

Interlocking with guard locking is also required when the guard position detector (interlock/failsafe limit switch) does not be in accordance with the limits specified in [Table 2](#).

Table 2 — Requirements for interlocking guards without guard locking

Safety distance ^a , L_{sp} , between guard opening and hazard point mm	Maximum opening ^a , L_g , of the guard while the detector changes its state mm
< 80	≤ 30
≥ 80 and < 500	≤ 40
≥ 500 and < 850	≤ 80
≥ 850	≤ 160

^a See [Figure 34](#) for location of the measurements.



Key

- 1 failsafe limit switch
- 2 guard closed
- 3 motor
- 4 guard open
- L_{sr} safety distance
- L_g maximum opening

Figure 34 — Distances related to requirements for guard locking

13.2.2 Requirements regarding the unlocking of interlocking guards with guard locking

The requirements on the Performance Level (PL) or the Safety Integrity Level (SIL) during the unlocking of an interlocking guard with guard locking depend on the result of the risk assessment. In most cases, the required PL or SIL of the locking/unlocking function is lower than the required PL or SIL of the interlocking function.

If no immediate hazard occurs as a result of the improper opening of an interlocking guard with guard locking, the corresponding safety functions of the guard locking shall at least satisfy ISO 13849-1:2023, PL b, or IEC 62061:2021, SIL 1.

NOTE An immediate hazard when a guard with interlocking is not opened as intended can, e.g., occur through the spurting out of liquids or the ejection of objects.

13.3 Printing unit guarding

After opening the interlocking guard, the printing cylinder or impression cylinder shall only be allowed to continue running if all the following requirements are met.

- a) The in running nip between the printing cylinder and impression shall be safeguarded by a fixed guard meeting the requirements of ISO 12643-1:2023.
- b) The openings provided on both sides of the guard for introducing the gauge to measure the distance between the impression cylinder and the printing cylinder shall have a maximum width of 33 mm and a maximum height of 20 mm.

NOTE 1 The guard opening is provided when introducing a gauge while the machine is at a standstill in order to set the distance precisely between the printing cylinder and the impression cylinder.

- c) A warning sign shall be provided inside the interlocking guard near the hazard.

d) The speed shall be restricted to 5 m/min.

NOTE 2 Rollers/cylinders continue to run after the interlocking guard has been opened in order to prevent the ink from drying on the rollers.

13.4 Form cutting section

Feed and delivery apertures shall be designed to maintain the safety distances defined in ISO 13857:2019.

13.5 Driven guide rollers

13.5.1 Guarding in-running nips

On guide rollers where the paper guide rails reach from the feeding point to the delivery point, the height of the aperture on the in-running side shall not exceed 10 mm, and the safety distance shall be at least 15 mm.

For troubleshooting, it shall be possible to remove the paper guide rails without dismantling the guard.

13.5.2 Delivery side guards

On the delivery side, the guard shall reach down to at least half the height of the guide roller without creating new in-running nips between the guard and the guide roller.

NOTE This requirement allows for the removal of paper if the format size changes or the web breaks.

13.6 Window cutting section

The hazard zone of the knife in the window cutting section shall be protected, for example, by an interlocking guard meeting the requirements of ISO 12643-1:2023. Apertures on the feeding and the delivery sides shall be designed to be in accordance with the safety distances specified in ISO 13857:2019.

The cutting and crushing zones of the splicer knife shall be safeguarded by fixed or interlocking guards meeting the requirements of ISO 12643-1:2023.

13.7 Scraper gluing unit

Gluing units that can be lifted shall be secured safely in the lifted position by a self-locking device. The lifting means shall be interlocked with the machine drive.

NOTE Examples of locking devices include latches or self-locking spindles.

13.8 Separating cutting section

The feeding aperture shall be designed to be in accordance with the safety distances defined in ISO 13857:2019. Where the delivery aperture on the segment roller cannot be designed to be in accordance with the safety distances specified in ISO 13857:2019 due to the provision of subsequent machine parts required for reliable paper transport, the opening shall be as small as possible and the safety distance shall be as great as technically feasible.

NOTE Direct access is generally prevented by the subsequent machine parts.

13.9 Bottom flap folding section

The feeding aperture shall be designed to be in accordance with the safety distances defined in ISO 13857:2019. Where the feeding aperture cannot be designed to be in accordance with the safety

distances of ISO 13857:2019, the aperture shall be as small as possible and the safety distance shall be as great as technically feasible.

The delivery aperture shall be designed to be in accordance with the safety distances defined in ISO 13857:2019.

13.10 Transport rolls

Where the diameter of the transport rolls is 40 mm or less, the in-running nip is adequately safeguarded if the rolls can be separated at least 25 mm by a force of 70 N.

13.11 Staggering wheel

13.11.1 Guarding staggering wheel hazards

Where gaps are provided between individual staggering wheels, the outer surfaces of the staggering wheels shall be smooth.

NOTE Staggering wheels are used for staggering (separating) the envelopes.

13.11.2 Guarding in-running nips between paper guide supports and staggering wheel

In-running nips between the paper guide supports and the staggering wheel shall be avoided by providing a minimum distance of 25 mm. Where this is not possible, a trip bar as defined in ISO 12643-1:2023 shall be positioned so that the bar is tripped as soon as a finger is drawn in between the paper guide supports and the staggering wheel.

13.12 Roller gluing unit

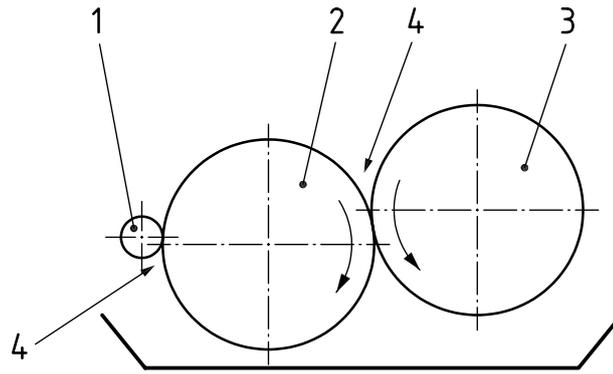
13.12.1 Guarding in-running nips

Where scrapers are used instead of dosing rollers, the drawing-in hazard between the scraper and ductor roller may be eliminated by arranging the scraper so that it is close to 90° to the ductor roller surface and the scraper is never more than 4 mm from the ductor roller, even when the scraper is disengaged (see [Figure 35](#) and [Figure 36](#)).

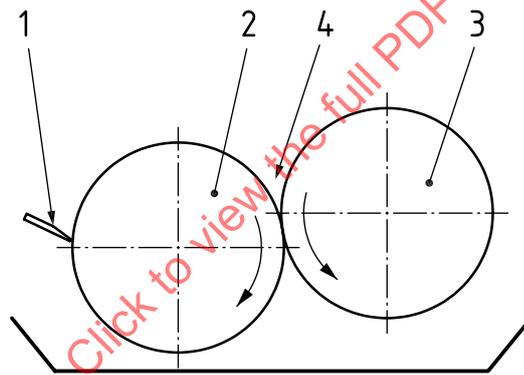
13.12.2 Feeding aperture

The feeding aperture shall be designed to be in accordance with the safety distances specified in ISO 13857:2019. Where the feeding aperture cannot be designed to be in accordance with the safety distances of ISO 13857:2019, the aperture shall be as small as possible and the safety distance shall be as great as technically feasible.

NOTE Direct access to the in-running nip can be prevented by the staggering wheel located directly in front of the unit.

**Key**

- 1 dosing roller
- 2 ductor roller
- 3 applicator
- 4 in-running nip

Figure 35 — Roller gluing unit with dosing roller**Key**

- 1 scraper
- 2 ductor roller
- 3 applicator
- 4 in-running nip

Figure 36 — Roller gluing unit with scraper on the ductor roller**13.12.2.1 Roller movement after actuation of a stop**

Opening an interlocking guard or actuation of an emergency stop device shall not lead to stopping of the dosing roller and the ductor roller if all the hazard zones are safeguarded.

NOTE The continuous running of the dosing roller and ductor roller is necessary to prevent drying out of the glue.

For reference on instructions to be given in the instruction handbook, see [17.4.2](#).

13.13 Separation roller before aligner section

The feeding aperture shall be designed to be in accordance with the safety distances specified in ISO 13857:2019. Where the feeding aperture cannot be designed to be in accordance with the safety

distances of ISO 13857:2019, the aperture shall be as small as possible and the safety distance shall be as great as technically feasible.

NOTE Direct access to the feeding aperture is generally prevented by preceding parts.

13.14 Seal flap folding section

The feeding aperture shall be designed to be in accordance with the safety distances specified in ISO 13857:2019. Where the feeding aperture cannot be designed to be in accordance with the safety distances of ISO 13857:2019, the aperture shall be as small as possible and the safety distance shall be as great as technically feasible.

NOTE Direct access to the feeding aperture is generally prevented by following machine elements (transport rolls).

13.15 Separating disc delivery

Where an in-running nip exists between the separating disc and the roller located in front of the disc, it shall be safeguarded by one of the following measures.

- a) Fixed side guides shall cover the in-running nips so as to prevent access by the fingers. In addition, fixed guards shall be provided on the two outer separating discs in order to prevent unintentional access to the discs from the sides.

NOTE 1 The layout of the separating discs generally prevents any unintentional access to in-running nips.

- b) An interlocking guard meeting the requirements of ISO 12643-1:2023 shall cover the separating disc with a delivery opening of the maximum width required for processing the largest format size. The height of the delivery opening shall not exceed 220 mm. The safety distance between the delivery opening and the separating disc shall be at least 550 mm.

The hazard zone between the separating discs and the delivery table shall be safeguarded.

NOTE 2 Safeguarding can be provided, for example, by

- a minimum safety distance of 25 mm between the two parts, or
- a flap hinged to the table of at least 25 mm in width giving way in a downward direction when forces of more than 50 N are applied.

13.16 Starting the machine with interlocking guards open

Starting the machine with the interlocking guards in the open position for fault-finding and troubleshooting by means of a stroboscope shall only be possible by actuating an enabling device and only if:

- zones with restricted view and mutual interlocking as described under ISO 12643-1:2023, 5.10.5 are provided; and
- a lockable mode selector switch for this kind of operation is provided; and
- time control is provided to limit the time to a maximum of 2 min; and
- the hold-to-run speed is the slowest speed possible under procedural requirements.

For further information in the instruction handbook, see [17.4](#).

14 Handkerchief machines

14.1 Emergency stop devices

Emergency stop devices shall be provided on each main control panel and be a maximum of 5 m apart.

14.2 Starting the machine with interlocking guards open

14.2.1 Rotary knives shall satisfy the requirements of ISO 12643-1:2023, 5.4.10.

If threading requires reaching under the knife, the knife shall also be safeguarded when it is lifted.

14.2.2 Starting the machine with the interlocking guards in the open position for fault-finding and troubleshooting by means of a stroboscope shall only be possible by actuating an enabling device and only if

- zones with restricted view and mutual interlocking as described under ISO 12643-1:2023, 5.10.5 are provided, and
- a lockable mode selector switch for this kind of operation is provided, and
- time control is provided to limit the time to a maximum of 2 min, and
- the hold-to-run speed is the slowest speed possible under procedural requirements.

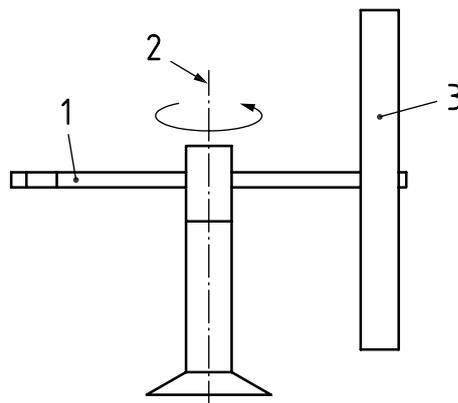
For further information in the instruction handbook, see [17.5](#).

14.3 Star-type unwinding (Turret unwinding)

The drawing-in zone between the belt drive and material reel shall be safeguarded according to ISO 12643-1:2023, 5.3.9.1.

In order to prevent the unwinding drive belt or material reel from lowering unintentionally, well-ried check valves that may be overridden shall be provided on the lifting cylinders of the belt.

The horizontal rotary movement of the star-type unwinding (see [Figure 37](#)) shall be operated only manually or under hold-to-run control with a maximum speed of 5 m/min.



Key

- 1 unwinding axis
- 2 rotating axis
- 3 material reel

Figure 37 — Horizontal turret