INTERNATIONAL STANDARD

ISO 12649

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Graphic technology — Safety requirements for binding and finishing systems and equipment

Technologie graphique — Exigences de sécurité pour les systèmes et les équipements de reliure et de finition

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Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12649 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

Introduction

During the development of this International Standard, existing relevant standards of other countries were taken into consideration. An effort has been made to harmonize the requirements of all countries, recognizing that national standards or laws may dictate national requirements. In cases where it was known that there is a national requirement that differs from this International Standard, that has been noted.

This International Standard was developed to harmonize three U.S. safety standards:

— ANSI B65.2, Safety standard — Binding and finishing systems,

— ANSI B65.3 Safety standard — Guillotine cutters, mill trimmers, and integral handling equipment,

— ANSI B65.4, Safety standard — Three-knife trimmers, including rotary, and single- and multiple-knife trimmers;

and three European standards:

— prEN 1010-1, *Safety of machinery — Safety requirements for the design and construction of printing and paper converting machinery — Part 1: Common requirements*,

— EN 1010-3, *Safety of machinery — Safety requirements for the design and construction of printing and paper converting machinery — Part 3: Cutting machines*,

— EN 1010-4, *Safety of machinery — Safety requirements for the design and construction of printing and paper converting machinery — Part 4: Bookbinding, paper converting and paper finishing machines*.

Graphic technology — Safety requirements for binding and finishing systems and equipment

1 Scope

This International Standard provides safety specifications for the design and construction of binding and finishing equipment operated in a system configuration or in stand-alone mode.

This International Standard provides safety requirements for the design and construction of equipment used to convert printed or blank substrates into cut, folded, collated, assembled, bound, or otherwise finished product. It may also be applied to processes for preparing substrate for the printing process.

It addresses recognized hazards specific to binding and finishing equipment and systems in the following areas:

— mechanical;

— electrical;

— slipping, tripping, falling;

— ergonomics;

— noise;

— radiation;

— fire and explosion;

— thermal;

— emissions.

This International Standard applies to new machines manufactured after December 31 of the year following the year of issue of this International Standard.

Equipment covered by this International Standard may be used in a stand-alone configuration, or in combination with other machines affected by an integrated control system. These may include but are not limited to, the combinations of the machines noted in Clause 4.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8031, *Rubber and plastic hoses and hose assemblies — Determination of electrical resistance*

ISO 11553, *Safety of machinery — Laser processing machines — Safety requirements*

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

ISO 12100-1, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 12648:2003, *Graphic technology — Safety requirements for printing press systems*

ISO 13849-1:1999, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

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

ISO 13851, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

ISO 13852:1996, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs*

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

ISO 13855, *Safety of machinery — Positioning of protective equipment with respect to the approach speeds of parts of the human body*

ISO 13856-1, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for the design and testing of pressure-sensitive mats and pressure-sensitive floors*

ISO 14119:1998, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

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

ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and gangways*

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

ISO 14123-1, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

ISO 14123-2, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 2: Methodology leading to verification procedures*

ISO 15847:—[1)], *Graphic technology — Graphical symbols for printing press systems and finishing systems, including related auxiliary equipment*

1) To be published.

IEC 60079-1, *Electrical apparatus for explosive gas atmospheres — Part 1: Flameproof enclosures "d"*

IEC 60079-2, *Electrical apparatus for explosive gas atmospheres — Part 2: Pressurized enclosures "p"*

IEC 60079-5, *Electrical apparatus for explosive gas atmospheres — Part 5: Powder filling "q"*

IEC 60079-6, *Electrical apparatus for explosive gas atmospheres — Part 6: Oil-immersion "o"*

IEC 60079-7, *Electrical apparatus for explosive gas atmospheres — Part 7: Increased safety "e"*

IEC 60079-11, *Electrical apparatus for explosive gas atmospheres — Part 11: Intrinsic safety "I"*

IEC 60079-14, *Electrical apparatus for explosive gas atmospheres — Part 14: Electrical installations in hazardous areas (other than mines)*

IEC 60079-18, *Electrical apparatus for explosive gas atmospheres — Part 18: Encapsulation "m"*

IEC 60204-1:2000, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60825-1, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide*

IEC 60947-5-1, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements*

IEC 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals*

IEC 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking*

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

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

EN 563, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces*

EN 1127-1, *Explosive atmosphere — Explosion prevention and protection — Part 1: Basic concepts and methodology*

EN 1539, *Dryers and ovens, in which flammable substances are released — Safety requirements*

EN 1760-2, *Safety of machinery — Pressure sensitive protective devices — Part 2: General principles for the design and testing of pressure sensitive edges and pressure sensitive bars*

EN 12198-1:2000, *Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles*

EN 13023, *Noise measurement methods for printing, paper converting, paper making machines and auxiliary equipment —Accuracy grades 2 and 3*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 13849-1:1999 and the following apply.

3.1
actuator
part of the actuating system to which an external actuating force is applied

[IEV 441-15-22][39]

NOTE 1 The actuator may take the form of a handle, knob, pushbutton, roller, plunger, etc.

NOTE 2 There are some actuating means that do not require an external actuating force, but only an action.

NOTE 3 See also **machine actuator** (**3.48**)

3.2
anti-repeat device
mechanical or electromechanical mechanism to ensure that only one cutting cycle occurs for each manual activation or automatic cut if the primary stopping system or **single-cycle device** (**3.83**) fails

3.3
armed condition
machine status in which machine motion can be automatically initiated

NOTE **Zero speed** (**3.92**) can be considered to be an armed condition.

3.4
audible alarm
horn, bell or other distinctive audible warning device which sounds to indicate impending machine motion

3.5
authorized person
person identified by plant management as having special training or designated to act in specified situations

NOTE The specified situations can include special tasks to be performed; the function of the adjustments in the work zone; proper operation of adjustments and controls; all types of hazards in the area where the task is to be performed; the application of equivalent, alternative protection to perform the task; improper actions that can cause injury; and the consequences of those improper actions.

3.6
automatic cutting sequence
programmed succession of clamping operations and/or cutting movements that is initiated by the operator and proceeds to a specified point without further intervention by the operator

3.7
back rounding and pressing machine
apparatus for processing book signatures, i.e. for rounding the spine and the trimmed front edge of book signatures and compressing the resulting signatures

3.8
backgauge
movable device (automatic or manual) on a guillotine cutter, positioned square to the cutting table, and which is used to stop the stack of material to be cut when the material is pushed into the opening under the cutting blade by the operator, and to determine the dimensions of the cut

3.9
backgauge drive
mechanism to position the **backgauge** (**3.8**) prior to the initiation of the cut

3.10
backlining and head banding machines
equipment for the automatic production of hard cover books where the binding together of the signatures is rounded or flat, with glue, gauze, or paper

3.11
barrier guard
distance guard
guard (**3.35**) that reduces or prevents physical access to a hazard zone by closing off access to an area containing one or more hazards

EXAMPLE A perimeter fence or tunnel guard.

3.12
binding and finishing system
combination of machines functioning in an integrated configuration to turn an incomplete printed product into a finished product by means of one or more processes, such as cutting, folding, binding, stitching, gluing, wrapping, etc.

3.13
book cover crease forming machine
⟨hard-cover bookbinding⟩ apparatus for creating, under heat and pressure, a permanent bend in the cover of a hard-cover book, then pressing the entire cover surface

3.14
book press
press used for flattening books after binding

3.15
book signature press
power-operated press used for flattening book signatures, which are fed and aligned manually

3.16
casing-in machine
⟨hard-cover bookbinding⟩ apparatus for gluing the end papers of the book signatures to the interior surfaces of the book cover

3.17
category 0 stop
uncontrolled stop
stopping by immediate removal of power to the **machine actuators** (**3.48**)

[IEC 60204-1:2000]

3.18
category 1 stop
controlled stop with power available to the **machine actuators** (**3.48**) to achieve the stop and then removal of power when the stop is achieved

[IEC 60204-1:2000]

3.19
category 2 stop
controlled stop with power left available to the **machine actuators** (**3.48**)

[IEC 60204-1:2000]

3.20
clamp
device using pressure to secure product so that it does not move during an operation

3.21
clamp drive
mechanism by which the **clamp**(s) (**3.20**) of the paper cutter is/are forced against the material to be cut

3.22
coater
finishing machine that applies a predetermined thickness of a liquid substance (for example glue, varnish, ink) on substrates made of paper or a similar material

3.23
counter-stacker
machine for stacking of piles of leaflets, books, magazines or newspapers such that the successive layers are at 180°

3.24
cutting cycle
⟨for machines with (a) manually driven **clamp**(s) (**3.20**)⟩ programmed succession of operations that begins when the knife drive is activated and ends when the knife returns to its retracted position

3.25
cutting cycle
⟨for machines with (a) power-driven **clamp**(s) (**3.20**)⟩ programmed succession of operations that begins when high-pressure clamping is initiated and ends when the knife(s) and clamp(s) return to their retracted positions after a single clamp/knife stroke

3.26
cutting zone
three-dimensional space through which any part of the knife(s) and/or **clamp**(s) (**3.20**) travel(s) during the entire **cutting cycle** (**3.24**, **3.25**)

3.27
drive
mechanism, divided into the following two general categories, which causes a machine or any of its elements to move:

— drives with no stored energy, which include, but are not limited to, direct-motor drives;

— drives having stored energy, which include, but are not limited to, motor-flywheel-clutch drives and hydraulic-pneumatic drives

3.28
electrical hazard
source of potential injury or death from electric shock or burn

[adapted from ISO 12100-1:2003]

3.29
electro-sensitive protective device
ESPD
apparatus that detects the presence of a person or part of a person or object in a defined area, using any detection means including, but not limited to, photoelectric, light screen, ultrasonic, etc.

3.30
emergency stop device
manually actuated control used to initiate an **emergency stop function** (**3.31**)

[adapted from ISO 13850:1996]

3.31
emergency stop function
mechanism activated by a single human motion and intended to halt machine activity in order to avoid injury to persons, damage to machinery or damage to work in progress

3.32
fixed guard
guard (**3.35**) that is securely affixed by fasteners that require a tool(s) to remove in order to gain access to an area with a significant hazard

3.33
gang stitcher
machine for stitching folded sheets of paper, during the operation of which individual folded sheets are removed by feeding grippers and the open sheets are stacked on top of each other on a transport chain for subsequent back stitching

3.34
gathering machine
apparatus that assembles sheets or folded sheets in a binding line

3.35
guard
physical barrier that restricts access to a significant hazard

3.36
guillotine cutter
power-driven machine having a single knife which is used primarily to cut paper products, stacks of paper, or other substrates as specified by the manufacturer

NOTE This definition includes equipment classified as mill trimmers.

3.37
hazard zone
any area within and/or around machinery in which a person is exposed to risk of injury or damage to health

[adapted from ISO 12100-1:2003]

3.38
high-pressure clamping
operation of **clamps** (**3.20**) with a dynamic force in excess of 300 N for machines up to and including 1,6 m in width, or 500 N for machines greater than 1,6 m in width, when measured at 75 % of the clamp opening (e.g. with the clamp at 25 % of its maximum travel distance measured from the retracted position)

NOTE The 75 % requirement is to ensure the measurement is made at the position that approximates the size of an operator's hand.

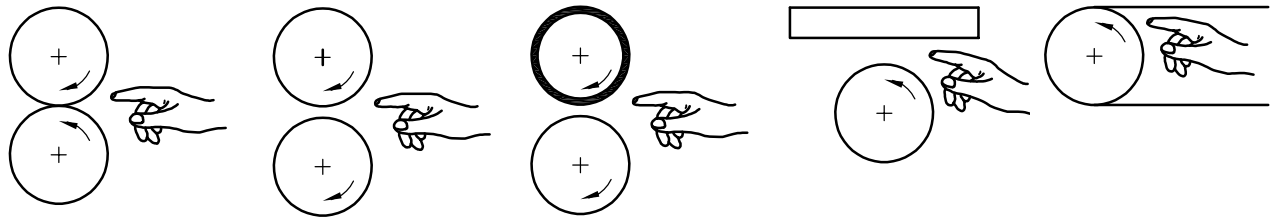
3.39
hold-to-run control
control that starts and maintains machine motion only as long as the control is activated

3.40
inch
jog
⟨operation of machinery⟩ machine motion requiring maintained activation engagement of a hold-to-run control and which will continue until the control is released or until a pre-determined displacement (limited inch) has been reached

3.41
inch speed
how fast the machine is operating while in **inch** (**3.40**) mode

3.42
infrequently used workplace
area in which an activity is carried out, such as observation, make-ready, jam clearing, minor servicing, crossing inserting hoppers or conveyer belts, etc., that is routine, repetitive, integral to (but not necessarily during) production, and done only on an occasional basis

3.43
in-running nip
area created either by two rotating components that are rotating inward, or by one component rotating toward an adjacent surface (see Figure 1)



a) Two counter-rotating rolls

b) Two rolls rotating in the same direction at different speeds

c) Two rolls rotating in the same direction, but with different surface properties (friction)

d) One rotating roll and an adjacent fixed object

e) Belt, chain or web which is driving, or being driven by, a roll

Figure 1 — In-running nips

3.44
inserting machine
apparatus that inserts printed matter such as leaflets and magazines at a predetermined position in other printed products, such as newspapers or magazines

3.45
knife drive
mechanism by which the knife of the guillotine is forced through the material to be cut

3.46
laminator
paper finishing machine that applies a solid material (e.g. foil, paper) on a substrate made of paper or a similar material

3.47
low-pressure clamping
〈for machines with a power-driven clamp(s)〉 operation of **clamps** (**3.20**) at a dynamic force not exceeding 300 N for machines up to and including 1,6 m in width, or 500 N force dynamic for machines greater than 1,6 m in width, when measured at 75 % of the clamp opening (with the clamp at 25 % of its maximum travel measured from the retracted position)

NOTE The 75 % requirement is to ensure the measurement is made at the position that approximates the size of an operator's hand.

3.48
machine actuator
power mechanism used to effect motion of a machine

[ISO 13850:1996]

3.49
maintained-contact control
control that remains in an open or closed state after its activation

3.50
maintenance
operation(s) required to assure that the machine remains in acceptable operating condition and that is/are usually performed when the machine is not available for production

NOTE Maintenance (for example, repairing or replacing broken, worn or damaged parts; performing lubrication; preventive servicing; etc.) is normally performed by qualified maintenance personnel, or operators, who have been trained about the types of hazards in the area in which their tasks are to be performed and about how these hazards can be avoided. Such maintenance is generally performed with energy isolated, when possible.

3.51
manual clamping
operation of **clamps** (**3.20**) in which the dynamic and static forces and motion of the clamp are directly supplied by the operator

3.52
manual control device
mechanism comprising part of the actuating system to which a manual action is applied

[Adapted from IEV 441-15-22][39]

3.53
mechanical hazard
source of potential injury to a person created by motion of machinery, components or material (for example, crushing and shearing points; trapping points; in-running nips; cutting, punching and impact points)

EXAMPLES Gear, chain and worm drives; V-belt, flat belt, cord and rope drives; pulling and supporting elements on continuous conveyors; spoke wheels and fly wheels; shafts and shaft ends; rollers; slides; push rods and similar parts, tools and clamping devices.

3.54
mechanical hazard point
location of a mechanical hazard on a machine where a person can be injured by parts of a machine or by machine movement, such as tools of machines or parts thereof, work pieces or parts thereof, or materials being processed

3.55
momentary contact control
control that is opened or closed only during its actuation

3.56
motion control
control that initiates machine movement or movement at **zero speed** (**3.92**), or places the machine in the **armed condition** (**3.3**)

3.57
motion control station
device station that contains at least an emergency stop control and which may contain a motion-initiation control

3.58
motion zone
area defined by any machine component, or group of machine components, which is driven directly by the binding and finishing system drive motor(s) or indirectly by other means

3.59
movable control station
control station that is permanently wired to the equipment, but which can be moved within a range limited by the length of the attached cable

3.60
movable guard
guard (**3.35**) that does not require a tool to move or remove it to gain access to a significant hazard

3.61
nip guard
guard (**3.35**) located at an in-going nip

EXAMPLES Nip bar, finger bar, finger guard.

3.62
non-motion zone
area defined by any machine component, or group of machine components, which, due to system configuration, is not driven by the drive motor(s) of the binding and/or finishing system, or by the web

NOTE A freestanding (not machine-mounted) console is considered to be a non-motion zone.

3.63
non-operational machine
apparatus configured for functions other than delivering products, such as make-ready or wash-up

3.64
normal operation
usual functioning and conditions that exist during set-up, make-ready, production and minor servicing, adjusting and cleaning performed by operators, but not including **maintenance (3.50)** operations

3.65
operating position
location where normal functions (make-ready and other routine, repetitive tasks) requiring control of the main drive motor(s) are performed

3.66
operational machine
apparatus that is configured to deliver product, is composed of at least one motion zone, and may include non-motion zones

3.67
paper drill
machine used to drill holes into piles of paper

3.68
paper embossing machine
machine for finishing paper surfaces by using cylinders to press a design, etc., in relief into the paper

3.69
paper finishing machine
apparatus used for applying liquid or solid coating material on a substrate made of paper or a similar material

3.70
perfect binder
machine for the automatic production of brochures (soft-cover) or book signatures (hard-cover) where gathered folded sheets or single sheets are bound to form book or brochure signatures by applying glue on the pre-processed book back, and where book or brochure signatures are inserted into covers by gluing the cover on the back and/or sides

3.71
personnel warning lights
red and green lights used to indicate the ready, running and safe conditions of the machine relative to personnel safety

NOTE These lights are not the same as machine **status lights** (**3.85**).

3.72
portable control station
control station that can be disconnected from one location, moved to another location and be reconnected

3.73
positive mechanical action
linkage of one component with another component such that movement of the former inevitably compels movement of the latter, either by direct contact or by a rigid connection

NOTE 1 This definition also applies to a component that prevents any movement of another component by virtue of its presence.

NOTE 2 When the movement of one mechanical component simply allows another component to move freely (e.g. by gravity, spring force, etc.), there is no positive mechanical action of the former component on the latter.

3.74
positive opening
contact separation as the direct result of a specified movement of the **actuator** (**3.1**) through non-resilient members, e.g. those not dependent on springs

3.75
programmable system
apparatus which a machine operator can use to enter and record various data and functions, including cutting dimensions, auxiliary operations and, if so equipped, automatic cut sequences, and which, on command, will step the machine through the functions recorded in a specific programmed sequence

NOTE The system might be capable of storing one or more job sequences in its memory.

3.76
raised workplaces
areas where functions are regularly performed, and are at least 0,5 m above access level

3.77
ready condition
status of a machine in which motion can be initiated by the operator

3.78
remote control
connection to the control station of a machine by use of an external communication link

3.79
routine and regular access
repetitive access to a hazard point that is required for manual feeding of a machine during normal production activity

3.80
safe condition
machine status in which movement of the main drive motor(s) (prime mover) of the motion zone is prevented, which may apply to the entire machine or to one or more motion zones, and which exists only when one or more stop/safe or emergency stop pushbuttons is/are latched in the depressed position

3.81
sheet-folding machine
apparatus to cut, perforate and/or crease single or multiple folds in single sheets of paper

3.82
significant hazard
potential source of severe or disabling injury or death

3.83
single-cycle device
mechanism that ensures that only one cutting cycle occurs for each manual activation or automatic cut

NOTE See **anti-repeat device** (**3.2**).

3.84
smooth roller
cylinder
elongated solid body with a circular cross-section having a smooth surface; i.e. with grooves or elevations no more than 4 mm deep and with circumferential slots no more than 8 mm wide with no sharp or cutting edges (see Figure 2)

Dimensions in millimetres

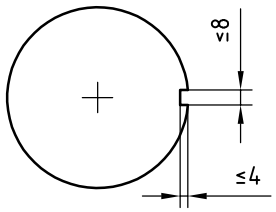


Figure 2 — Smooth roller/cylinder

3.85
status lights
lights that indicate machine status or machine process condition

NOTE These are not the same as **personnel warning lights** (**3.71**).

3.86
stored energy
potential energy that may be released without actuation of the machine drive or controls

3.87
tool
implement, such as a key or wrench, designed to operate a fastener

NOTE An improvised implement such as a coin or fingernail file is not considered to be a tool.

3.88
trip nip bar
movable protective bar located at an in-running nip which, when pushed, activates the interlocked safety system of the machine

3.89
two-hand control
safety device that consists of two manual control devices that must be operated simultaneously by a single operator to initiate potentially hazardous machine motion

3.90
warning period
time interval during which machine motion is prevented and a warning is given to personnel that machine motion is about to occur

3.91
wireless control
transmission of commands and signals between a machine-control system and the motion-control station(s) using means other than a physical connection

3.92
zero speed
condition of machine movement in which the drive control system is actively holding the machine at a position and while machine movement is not discernible, machine movement can be initiated without warning

NOTE **Zero speed** can be considered to be an **armed condition** (**3.3**).

4 Equipment subject to requirements

Equipment covered by this International Standard may be used in a stand-alone configuration, or in combination with other machines affected by an integrated control system. This International Standard is intended to apply to a wider range of equipment used in the binding and finishing process. These may include but are not limited to, the combinations of the machines noted in the following list:

— addressing equipment;

— attaching machines;

— book presses (press for pressing books after binding);

— book stackers;

— bundle presses (to compress bundles of product);

— bundle wrappers;

— bundling machines (strappers);

— case makers;

— casing-in machines;

— conveyors;

— counter-stackers;

— cutters and trimmers;

— depalletizers;

— die cutters;

— drilling and sewing machines;

— embossers;

— foil stampers;

— folders;

— gathering machines;

— gripper conveyors;

— guillotine cutters;

— imprinting equipment;

— inserters, card feeders;

— laminators;

— mailing systems;

— numbering equipment;

— off-line coaters;

— onserters, attaching machines;

— overcover/protective wrapper gluers;

— palletized product wrappers;

— perfect binders;

— pocket printers;

— polywrappers;

— robotics (e.g. automatic guided vehicles);

— rotary trimmers, slitters;

— scoring equipment;

— side gluers;

— stampers;

— stitching/sewing machines (e.g. gang stitchers, saddle stitchers);

— stream feeders.

5 Guarding of significant hazards

5.1 General

Guarding, consistent with operation of the machine, shall be provided in those areas where it is recognized that operators are exposed to significant hazards. Exposure to significant hazards is not considered to exist if, during normal operation, the distance to the hazard complies with those specified in ISO 13852:1996. Machinery shall be designed according to the principles of ISO 12100-1 and ISO 12100-2:2003 for hazards that are relevant, but not significant, and which are not covered by this International Standard.

Significant hazards (for example crushing, cutting, shearing, pinching, hot surfaces, explosion, etc.) vary from machine to machine. It is important that each machine be evaluated to determine what hazards might exist and that shall be guarded.

Machines should be designed to allow normal production operations such as make-ready, wash-up, operator-performed maintenance or troubleshooting without machine motion. Where machine motion is required to

perform these functions, guards and safety devices shall provide protection against hazards. These operations shall be carried out using a hold-to-run device as specified in 5.5.1.2 or 5.6.

Where moving components or product flow require surveillance, equipment shall be designed to allow the needed visibility and to allow adjustments, if needed, to equipment operation with the guards remaining closed.

EXAMPLES A transparent guard or remote viewing system.

5.2 Guards

5.2.1 Types of guards

For the purpose of this International Standard, there are two types of guards, fixed and movable.

Guards that do not have to be opened frequently shall be interlocked or shall be fixed in such a way that their removal necessitates the use of a tool, such as a key or wrench, designed to operate a fastener.

NOTE 1 An improvised tool, such as a coin or fingernail file, is not considered to be a tool in the context of this International Standard.

All movable guards shall be interlocked in accordance with 5.5.

Guards that are designed to be opened, removed, and/or moved at least once per working shift (on average) during normal operation, for make-ready (set-up) operations, or to permit access to a hazardous area, with or without the use of a tool, shall be interlocked.

NOTE 2 A typical shift is 8 h.

Guards and doors may be removed for set-up and for other purposes such as

— to supply the material to be processed;

— to change the format;

— to change tools;

— for make-ready.

The interlock system shall operate as described in 5.5.1.

When the interlocked guard is open, one of the measures set out in 5.6 shall become effective.

Where production processes need to be watched, guards shall be designed to ensure sufficient visibility of the functional process and not to impair vision by reflections.

EXAMPLES Mesh-type guards painted in matte black, placement of lighting behind the guard, etc.

Guards shall not create any additional significant hazards to personnel and shall satisfy the requirements of ISO 14120.

5.2.1.1 Automatic travel of movable guards

Automatic travel of movable guards shall not create any significant mechanical hazards.

This can be achieved, for example, by limiting the force of the guard movement. The following guidelines are suggested:

a) 50 N or less where the likely contact surface of the guard is a blunt edge or projection and there is no risk of cutting or stabbing injuries;

b) 150 N or less where the likely contact surface of the guard is a plane such that there is no risk of a crushing injury.

Higher values may be chosen based upon risk analysis.

5.2.1.2 Protection against gravity falls of guards

Guards that can be opened shall be safeguarded against gravity falls if such a fall creates a risk of injury. The following are examples of means that may be used for safeguarding:

— devices for balancing the mass;

— pneumatic springs;

— devices which automatically hold the parts open;

— power-driven worm gear drives actuated by hold-to-run controls if the hazard points can be observed from the position where the hold-to-run control is actuated;

— ensuring that the centre of gravity of the guard in the open position is sufficiently far behind the axis of rotation to prevent closing.

Springs used for balancing the mass shall be designed such that no hazard shall result from failure of the spring or movement of the guard. Compression-type springs are preferred. Springs shall not display any permanent deformation, even after extensive use.

5.2.2 Guard distances and gaps

The safety distance between the guard and the in-running nip is measured from that point where the distance between the rotating surfaces, or the rotating surface and a fixed surface, is 10 mm (see Figure 3). Safety distances shall be as specified in ISO 13852:1996.

The design and construction of the barrier guard shall ensure that personnel cannot encounter the hazard by reaching up, over, under, around or through the barrier guard.

The safety distance for guide rollers shall be 120 mm, as specified in ISO 13854.

Dimensions in millimetres

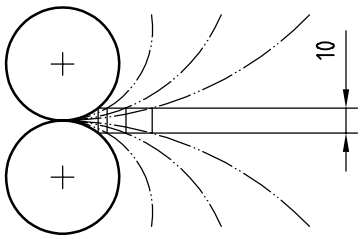


Figure 3 — Measuring safety distance at in-running nips

5.2.2.1 Reaching upwards

If there is a low risk (as determined by risk assessment) from the hazard zone when reaching upward, then the height of the hazard zone shall be 2 500 mm or more, as specified by ISO 13852:1996. Otherwise,

a) either the height of the hazard zone shall be 2 700 mm or more,

or

b) other safety measures shall be used.

NOTE For further information on risk assessment, see ISO 14121[35].

5.2.2.2 Reaching over protective structures

If there is a low risk (as determined by risk assessment) from a hazard zone when reaching over a protective structure, the horizontal distance to the hazard zone as specified in ISO 13852:1996, Table 1, shall be used as minimum values. There shall be no interpolation of the values specified in that table. Therefore, when the known height of the hazard zone (a), height of the protective structure (b), or horizontal distance to the hazard zone (c) is between two values in ISO 13852:1996, Table 1, the value used shall be that which provides the higher level of safety.

If there is a high risk (as determined by risk assessment) from a hazard zone when reaching over a protective structure, the horizontal distance to the hazard zone as specified in ISO 13852:1996, Table 2, shall be used as minimum values. There shall be no interpolation of the values specified in that table. Therefore, when the known height of the hazard zone (a), height of the protective structure (b), or horizontal distance to the hazard zone (c) is between two values in ISO 13852:1996, Table 2, the value used shall be that which provides the higher level of safety.

5.2.3 Guard openings

Guard openings shall comply with the requirements of ISO 13852:1996. For guarding in-running nips that are accessible while a movable guard is open, see 5.4.

5.3 In-running (in-going) nips

Hazards from in-running nips may exist between the following:

— two counter-rotating surfaces, powered or non-powered;

— one surface rotating toward an adjacent fixed part of the machine;

— surfaces rotating in the same direction, but with different peripheral speeds or surface properties, such as friction;

— guide roller and driving belt, conveyor belt, and possibly the web in unwind/rewind devices;

— non-powered riding rollers (guide rollers) that are driven by the movement of the product.

Examples of in-running nips are shown in Figure 1.

5.4 Guarding in-running nips

All in-running nips that are accessible during normal operation shall be guarded by one of the following types of guards:

a) barrier guard or fence guard with or without openings. If the guard has an opening, the safety distances shall be established in relation to the width of the opening, in accordance with of ISO 13852:1996, Table 4;

b) nip guard, on smooth-surface rollers, as bars designed in suitable sections and extending across the entire working width (see Figure 4 for examples of nip guards);

c) trip nip bars shall be in accordance with 5.7.4.

When machine motion is reversed, out-going nips that do not generally pose a hazard can become in-running nips and shall be guarded as such.

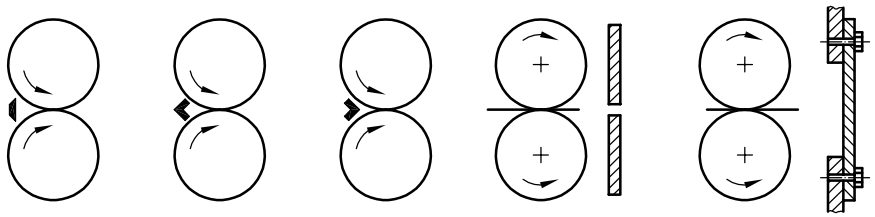
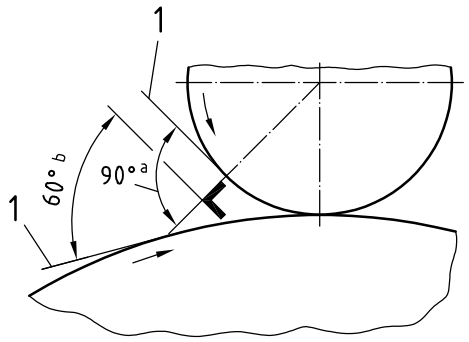


Figure 4 — Examples of nip guards

Whenever possible, the angle between the surface of the cylinder and the surface of the guard should be 90° to prevent wedging. However, if other design considerations, such as stiffness of the guard, web path, etc., make the use of a 90° angle less desirable, an angle of not less than 60° is permitted (see Figure 5).



Key

1 tangents

a Preferred.

b Acceptable.

Figure 5 — Minimum cylinder-to-guard angle

The clearance between the nip guard and the respective machine part shall not exceed 6 mm (see Figure 6). On small-format machines, the clearance should be smaller, if possible, considering both safety and production concerns.

Nip guards shall not be shaped or oriented such that a “wedge pocket” is created (see Figures 7 and 8). The shapes shown in Figure 7 may be used as trip nip bars, since activation of the trip nip bar stops hazardous motion, as specified in 5.7.4.

Dimensions in millimetres

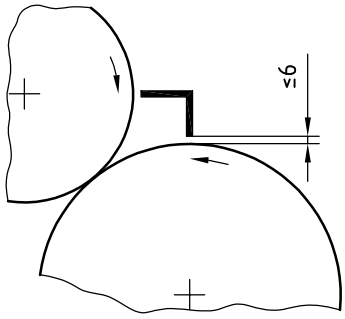
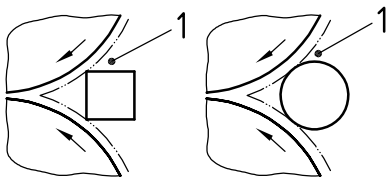


Figure 6 — Safeguarding an in-running nip by means of a fixed nip guard



Key

1 wedge pocket

Figure 7 — Shapes creating wedge pockets

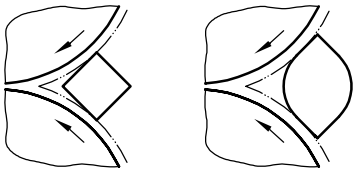


Figure 8 — Shapes not creating wedge pockets

Rollers rotating in the same direction do not create a hazardous in-running nip if the rollers have the same surface characteristics and circumferential speeds (see Figure 9).

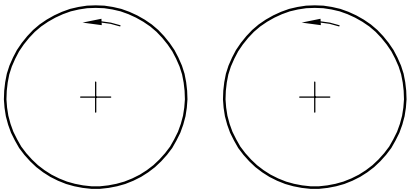


Figure 9 — Non-hazardous rollers rotating in the same direction

5.5 Interlocks

5.5.1 Opening an interlocked guard

When an interlocked guard is opened, moved or removed while the machine is in continuous motion, the machine shall stop, utilizing the maximum braking action established for that binding and finishing system. When any interlocked guard is open, initiation of continuous run shall not be permitted. Closing or replacing an interlocked guard shall not cause the machine to restart its operation (see 5.5.2). Machine motion shall not be able to be initiated without the operator going through a normal starting sequence.

The following exceptions are noted, but may be disallowed for specific types of equipment, as noted elsewhere in this International Standard.

5.5.1.1 Exception for machine motion at inching speed

If a machine is operating at inching speed and under conditions defined in 5.6, motion may continue.

5.5.1.2 Exception for machine motion at production speed

This exception shall apply only in accordance with the subclauses of Clause 7, dealing with specific machines, and does not apply to all equipment.

It is possible that this exception might not comply with current European standards or the Machinery Directive.

There may be parts of the equipment that cannot be observed or adjusted with the guard closed, and it may be necessary for an authorized person to access this area with an interlocked guard open. Under these circumstances, alternative safety measures shall be taken. All adjustments shall be made from outside the hazardous area.

The following alternative safety measures shall be taken:

a) A mechanical key lock shall be provided adjacent to the access area. There shall be only one key for this lock. The key for this lock shall be accessible only by an authorized person.

b) The key lock shall operate as a hold-to-run device as follows:

   — inserting the key shall initiate a timer that has a maximum setting of 2 min;

   — turning the key shall override the guard interlock of only that guard, up to the preset time limit;

   — as long as the key is held in the turned position, the guard may be opened with machine motion at production speed until such time as the timer reaches the preset time limit;

   — when the key is released, it shall automatically return to the neutral position and the guard interlock shall be automatically reactivated;

   — if the key remains in the lock for more than 2 min, the interlock on the guard shall be automatically reactivated and the equipment safety system shall stop machine motion.

c) The bypassing means shall meet the requirements of category 3 of ISO 13849-1:1999.

d) When adjustments are necessary, they shall be performed from outside the hazardous area.

e) A warning label identifying the possible existing hazards with the guard open shall be provided adjacent to the lock. The label shall clearly indicate that when the key is in the lock, the adjacent guard is overridden.

If a machine is provided with this alternative safety measure, information regarding its safe use shall be contained in the instruction handbook.

5.5.2 Closing an interlocking guard

Closing the interlocking guard shall not cause the machine to restart its operation. The machine shall go through the normal starting sequence.

5.5.3 More than one interlocking guard open

Where more than one interlocking guard is open and there are any unguarded hazard zones that cannot be observed from a single point of operation, only an inch function or reverse function (as specified in 10.2.3.5) shall be permitted if multiple operators depress and maintain a hold-to-run control at each unguarded area during the same permissive period. Releasing any hold-to-run control shall stop machine motion.

5.5.4 Remote control with interlocked guard open

When any interlocked guard is open, initiation of motion of the system by remote control shall be prohibited.

5.5.5 Interlock design for personnel safety

Interlocks shall be designed so that they cannot be overridden without the use of special tools.

NOTE While it is recognized that all interlocking schemes are capable of being defeated, the intent of the above requirement is to ensure that the interlocking arrangement is designed in such a manner that it cannot be defeated by commonly available items such as tape, paper, a single common magnet, etc., which are not considered to be tools.

The requirements of ISO 14119:1998, Clauses 5 and 6, shall be satisfied.

5.5.5.1 Personnel safety switches for interlocking guards

For personnel safety switches built in accordance with IEC 60947-5-1 and installed in accordance with IEC 60204-1:2000, it may be assumed that no malfunctions will occur.

For machines where routine and regular access (see 3.79) is not required, it is therefore sufficient to provide only one personnel safety switch for each interlocking guard.

Control systems of safety-position switches shall satisfy category 3 of ISO 13849-1:1999.

For manually fed devices where interlocking guards are used to safeguard routine and regular access to hazard points, control systems for safety-position switches shall satisfy category 4 of ISO 13849-1:1999.

5.5.5.2 Short circuits

Malfunctions of the interlock circuit as a result of short circuits between electric wires outside the switch cabinet due to physical impact shall be prevented, or redundancy shall be provided.

EXAMPLES Locating wires within ducts or within the machine frame to protect them from impact.

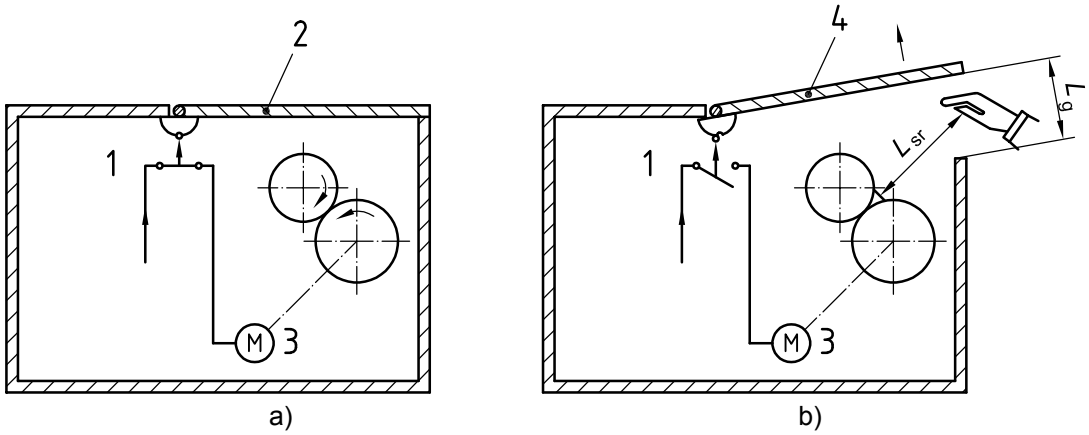
5.5.6 Interlocking with guard locking

Interlocked guards shall be designed so that the sensor (interlock) shall be activated within the limits specified in Table 1, depending on the distance to the hazard. Otherwise, guard locking shall be utilized.

NOTE This International Standard differs from prEN 1010-4[13] in that the latter requires guard locking where hazardous movement cannot be stopped within at least 10 s after actuation of the personnel safety switch.

Table 1 — Distance requirements for interlocked guards without guard locking

Safety distance[a] (L_{sr}) **between guard opening and hazard point** mm	**Maximum opening**[a] (L_g,) **of the guard while the detector changes its state** mm
< 80	$\leqslant 30$
$80 \leqslant L_{sr} < 500$	$\leqslant 40$
$500 \leqslant L_{sr} < 850$	$\leqslant 80$
$\geqslant 850$	$\leqslant 160$
[a] See Figure 10 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 10 — Distances related to requirements for guard locking — a) motor running; b) motor stopped

5.6 Hold-to-run controls

If all hazard points are safeguarded by nip guards in accordance with 5.4, the requirements for hold-to-run controls and speed limitations do not apply.

Where hold-to-run controls are used for safeguarding a hazard, running the machine in the hold-to-run mode after opening the interlocking guard shall be possible only when guards protecting hazardous areas that are not visible from the operating position are closed.

When the hazardous area can be viewed from the operating position, machine motion with an interlocking guard open and hazardous points unprotected may be initiated by means of a hold-to-run device only under the following conditions:

a) with a displacement limited to a maximum of 25 mm or with a maximum operating (surface) speed of 1 m/min;

or

b) with displacement limited to a maximum of 75 mm or with a maximum operating speed of 5 m/min where the measures defined in 5.6 a) would reduce the ability of the machine to perform its function and where there would be no substantial increase in hazard.

Guard circuitry for the hold-to-run condition shall satisfy the requirements of category 3 of ISO 13849-1:1999. Control circuitry (including selector switch relays and PLC circuits) which allows interlocked areas to be operated independently shall satisfy the requirements of category 1 of ISO 13849-1:1999.

For hold-to-run devices designed as two-hand controls, the same limitations of displacement and speed shall apply.

At speeds faster than 5 m/min, the maximum speed shall be as low as possible and no faster than 10 m/min, provided:

— a two-hand control is used;

or

— the control is located such that the hazard cannot be reached from the operating position and the operator has clear view of the hazard.

For machine-specific exceptions to this speed requirement, see Clause 7.

For machines included in Clause 4 and not having a specific exception in Clause 7, any speed greater than 10 m/min shall have a means of achieving a level of safety equivalent to that at 10 m/min.

EXCEPTION: Where machine-specific requirements allow for speeds greater than 10 m/min, all of the following requirements shall be met.

— Other interlocked guards in an area that cannot be observed by the operator from the operating position shall be closed.

— A selector switch for this kind of operation shall be provided in addition to a two-hand control.

— The hold-to-run speed shall be the slowest possible under procedural requirements.

Any two-hand control device shall meet the requirements specified in 10.5. The stopping path shall be as short as technically feasible.

See 12.1 for general requirements for control systems.

5.7 Other safeguarding measures

5.7.1 General

Where safeguarded accessible hazard zones cannot be observed from positions from which hazardous movements can be started, the requirements of 5.7.2 through 5.7.4 shall apply.

5.7.2 Fence-type enclosures

Where accessible hazard zones are safeguarded by a fence-type enclosure:

a) it shall not be possible for (a) person(s) within the enclosure to close the interlocking access gate;

or

b) an additional control device shall be provided outside the enclosure in such a position that it cannot be actuated from the inside. Any hazardous movement, with the exception of movement controlled by hold-to-run, shall be permitted only after the access door has been closed and the additional control device has been actuated.

EXAMPLES Additional control devices include reset buttons, captured keys, trapped keys, and similar devices.

Fence-type enclosures shall be designed such that the distance between base level and the lower edge is a maximum of 200 mm, and between base level and the upper edge is a minimum of 1 400 mm. Safety distance requirements shall be in accordance with ISO 13852:1996.

NOTE Fence-type enclosures are often used in areas such as behind reel stands, automatic pile changers, etc.

It shall not be possible to initiate machine motion while a person is within the hazard zone except under hold-to-run conditions as defined in 5.6.

5.7.3 Electro-sensitive protective devices

Where accessible hazard zones are safeguarded by means of electro-sensitive protective devices (ESPDs), an additional control device shall be provided outside the hazard zone and shall not be accessible from any position in the hazard zone. Provisions shall be made that the hazardous movement can only be started after the person has actuated the additional control element.

NOTE Accessible safeguarded hazard zones are areas generally protected by means of, for example, guards or electro-sensitive protective devices that allow whole-body access. The objective is to prevent anyone from starting the machine while a person is within the hazard zone.

Electro-sensitive protective devices shall comply with 10.6.

5.7.4 Pressure-sensitive mats, pressure-sensitive bumpers, trip nip bars

Pressure-sensitive mats, pressure-sensitive bumpers and trip nip bars shall function in accordance with 10.7.

Where accessible hazard zones are safeguarded by means of pressure-sensitive mats, an additional control element that is not accessible from any position in the hazard zone shall be provided outside the hazard zone. Any hazardous movement, with the exception of movement controlled by hold-to-run, shall be permitted only after the additional control device has been re-actuated.

EXAMPLE An example of an additional control device is a reset button.

For safety-related applications, the approach speed specified in ISO 13855 shall be used as a basis for determining the correct positioning of the pressure-sensitive mats.

6 Requirements for protection against other hazards

6.1 General

See Annex A for a list of hazards.

6.2 Fire and explosion

6.2.1 General

For a list of explosion zones, see Annex B.

6.2.2 Fans

Fans integrated in machines to exhaust potentially explosive atmospheres (fumes, dust, etc.) shall be explosion protected and built in compliance with requirements defined for individual explosion zones (see Annex B).

6.2.3 Hoses and pipes

Hoses and pipes used for combustible or explosive materials, or for impregnating material, shall be conductive and electrostatically grounded (resistance less than 10^6 Ω over the total length of the hose).

EXAMPLES Examples of combustible or explosive materials include, but are not limited to, paper, paper dust, plastic shavings, inks, coatings, glues, solvents over a certain concentration, etc.

Hoses and pipes used for exhausting solvent vapours shall be conductive and electrostatically grounded (resistance less than 10^6 Ω over the total length of the hose) where the solvent concentration under any single failure may exceed 25 % of the lower explosion limit (LEL).

Measurement of resistance shall be made in accordance with ISO 8031.

Reference shall be made in the relevant sections of the instruction handbook (see 16.2).

6.2.4 Electric motors for pumps

The electric motor for pumps on supply ducts for inks, coating substances, impregnating material or glues shall be protected as specified in IEC 60079-1. Where protective motor switches are mounted on the pump, compliance with IEC 60079-7 is considered to be sufficient.

6.2.5 Prevention of ignition of explosive atmospheres by electrical apparatus

If the build-up of explosive atmospheres under normal operating conditions or under operational disturbances cannot be avoided, especially by means of ventilation, additional measures, dependent on the zones defined in Annex B, shall be taken in order to avoid ignition of the explosive atmosphere.

— Electrical apparatus shall comply with IEC 60079-14.

— For electrical apparatus used in Zone 0, IEC 60079-11 shall also apply. Electrical apparatus used in Zone 1 shall additionally comply with one or more of the following standards for explosion protection: IEC 60079-1, IEC 60079-2, IEC 60079-5, IEC 60079-6, IEC 60079-7, IEC 60079-11 and IEC 60079-18.

— Electrical apparatus designed in accordance with IEC 60079-11 shall be designed to explosion group IIA.

NOTE 1 For groups of electrical apparatus, see IEC 60079-0[20].

— Depending on the type of solvent used, the chosen temperature class shall ensure that the electrical apparatus cannot be a source of ignition due to its surface temperature.

NOTE 2 For temperature classification, see IEC 60079-0[20].

— Brakes and clutches shall be designed such that they cannot be a source of ignition.

— Hazardous electrostatic charges shall be minimized, as far as technically feasible (e.g. by using static eliminators).

6.2.6 Explosion protection exceptions

Explosion protection is not required for machinery where there are no combustible liquids with a flash point below 55 °C being used and no combustible liquids are sprayed or heated to a temperature above flash point under operating conditions. All other machinery shall satisfy the requirements of EN 1127-1 as well as the requirements of 6.2.4 and 6.2.5.

The requirements of EN 1127-1 are satisfied, for example, where the build-up of explosive atmospheres is prevented by adequate ventilation systems. This applies where the level of 25 % of the lower explosion limit is not exceeded even if the system fails.

EXAMPLE An example of system failure would be a breakdown of the ventilation system.

6.3 Electrical equipment

6.3.1 General

All electrical equipment shall be designed in accordance with IEC 60204-1:2000, such that electrical hazards (for example electric shock, burns) are prevented. The requirements of IEC 60204-1:2000 shall be fulfilled, taking into account the additional requirements specified in 6.3.2 through 6.3.6.

6.3.2 Supply-disconnecting device

Machines shall be provided with a device to disconnect the electric power supply in accordance with IEC 60204-1:2000, 5.3.2 a) or 5.3.2 c). The device shall be provided with a means to be locked in the OFF position.

If actuation of a stopping device will cause a low-voltage (undervoltage) tripping of the circuit breaker (shunt-trip device), a circuit breaker in accordance with IEC 60204-1:2000, 5.3.2 c) shall be provided to prevent the contactors from welding in the closed position. Where circuits as specified in IEC 60204-1:2000, 5.3.5, are not disconnected by the supply-disconnecting device, such circuits shall be provided with their own disconnecting device.

EXCEPTION: Auxiliary devices used in binding and finishing operations may be equipped with supply-disconnecting devices in accordance with IEC 60204-1:2000, 5.3.2 d) or 5.3.2 e).

6.3.3 Installation

Electrical devices and conductors shall be installed in such a way as to prevent damage from mechanical stress and environmental influences.

6.3.4 Insulated single-core conductors

For insulated single-core conductors laid between two terminals inside an enclosure (for example, a switch cabinet), the conductor identification number or letter may be omitted if

— it is identified by colour in accordance with IEC 60204-1:2000, 14.2.4, paragraph 2;

or

— the conductors are secured in position (for example by using comb-type wire fixation) in such a way that there is no confusion of conductors when changing electric components.

6.3.5 Testing of electrical equipment

All electrical equipment shall be designed such that it will withstand the testing specified in IEC 60204-1:2000, 19.2 through 19.6. Voltage tests as specified in IEC 60204-1:2000, 19.4, are not required for electronic control circuits.

6.3.6 Measuring devices

Measuring devices shall comply with IEC 61010-1.

6.4 Working platforms, access stairs, passageways and raised workplaces

6.4.1 General requirements

For regular operation, the means of access and passageways to workplaces shall comply with the requirements of ISO 14122-1, ISO 14122-2 and ISO 14122-3. For infrequently used workplaces (see 3.42), the exceptions specified in 6.4.2 shall apply.

The usable width of machine gangways shall be at least 0,5 m. For gangways fitted at a height of more than 0,3 m, adequate means of access shall be provided.

The user should be aware of the effects of mathematical conversion and rounding when converting from SI units to U.S./Imperial units. Requirements stated by the U.S. Occupational Health and Safety Administration (OSHA) may supersede the resulting conversions in the U.S.

6.4.2 Exceptions for infrequently used platforms and access steps

6.4.2.1 General

As an exception to the requirements of 6.4.1, infrequently used platforms and access steps shall comply with the requirements of 6.4.2.2 through 6.4.2.6.

6.4.2.2 Ergonomics

Ergonomic principles shall be considered in the design of such access platforms.

EXAMPLES The following are examples of measures by which this can be achieved:

— sufficient number of handholds, part of which can be reached from the reference level;

— mobile platforms;

— permanently fixed and hinged platforms.

6.4.2.3 Footstep dimensions

For single footsteps (fixed or hinged), access levels may be permanent platforms or gangways. The following dimensions shall apply:

— normal step height ⩽ 300 mm;

— maximum step height 500 mm;

— minimum width (for 1 foot) 200 mm;

— minimum width (for 2 feet) 300 mm;

— minimum depth 300 mm.

Where multiple steps (fixed or hinged) are needed, the reference level shall have an effective width of at least 500 mm. The following dimensions shall apply:

— maximum height of upper footstep 1 200 mm;

— maximum height of intermediate steps 300 mm;

— minimum depth of footstep 200 mm;

— maximum height without railing 1 200 mm.

Footsteps shall always be provided with handles.

The size of platforms used infrequently for stepping or short-term standing shall be at least 200 mm × 200 mm.

Footstep dimensions should be kept as uniform as possible throughout the press system.

6.4.2.4 Handle dimensions

Where handles are required, the following dimensions shall apply (see Figure 11):

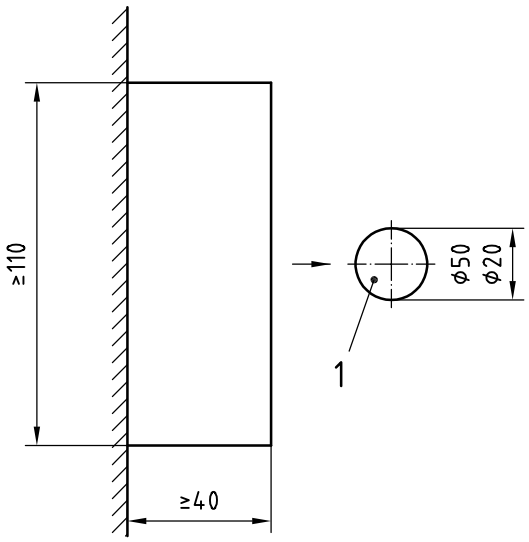
— minimum handle clearance 40 mm;

— minimum handle length 110 mm;

— minimum handle diameter 20 mm;

— maximum handle diameter 50 mm.

Dimensions in millimetres



Key

1 diameter of handle

Figure 11 — Handles for infrequently used access platforms

6.4.2.5 Hinged platforms

Hinged platforms shall be secured against unintended movement and shall be easy to position.

Hinged platforms between 0,5 m and 1,6 m high (the height is considered to be the maximum distance a person can fall from the hinged platform) shall be provided with at least one handrail. Where a handrail is not feasible and practical, a handhold shall be provided. For hinged platforms above 1,6 m high, the requirements of 6.4.1 shall apply.

Hinged platforms are generally provided in areas where space limitations prevent fixed platforms with handrails. Wherever feasible, the design of the platform should provide operators with sufficient support for ascending to or descending from the platform, as well as protection from falling off the platform.

6.4.2.6 Mobile hand-operated platforms

Mobile hand-operated platforms provided between stationary machine units do not require any fall-off protection on the machine side if the clearance between machine and platform does not exceed 200 mm (see Figure 12). For platforms more than 1,5 m high where the clearance exceeds 70 mm, toe-plates shall be provided as minimum protection.

Dimensions in millimetres

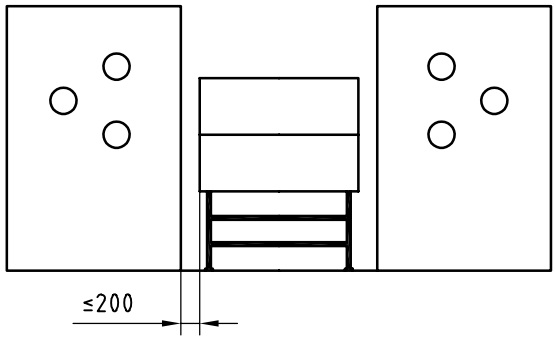


Figure 12 — Mobile platform

6.4.3 Platform, gangway, and step surfaces

Platform, gangway and step surfaces shall be slip resistant in accordance with ISO 14122-2.

EXAMPLE By using profiled metal plate.

Plates of material with a low slip-resistance capability (e.g. glass) fitted in access floors to allow the operator to observe the production process are permissible if they are fitted at a distance of at least 200 mm from the nearest fall-off edge (e.g. access stairs), and the accessible area of such materials does not exceed 18 000 mm^2 with a maximum width of 90 mm. Calculations or tests should be conducted to verify that a static load of 1 500 N applied to an area of 50 mm × 50 mm in the centre of such material will not lead to damage.

6.4.4 Access stairs and passageways

Access stairs and passageways shall have a clear height for passage of at least 2 m. If, for construction reasons, this height cannot be maintained, the protruding parts shall be padded and provided with hazard markings.

The maximum pitch angle on access stairs shall be 45°. Higher pitch angles may be allowed depending on the results of a risk analysis (see Annex C).

Where stairs with pitch angles between 20° and 45° are used, the height of one flight of stairs should not exceed 3 m. Only where spatial restrictions exist may the height of one flight be a maximum of 4 m. Stairs with a total height of more than 4 m shall be fitted with an intermediate platform; the flight above the platform shall have a maximum height of 3 m. The platform should be at least 800 mm long where possible, but shall in no case be less than 600 mm.

The user should be aware of the effects of mathematical conversion and rounding when converting from SI units to U.S./Imperial units. Requirements stated by the U.S. Occupational Health and Safety Administration (OSHA) may supersede the resulting conversions in the U.S.

6.4.5 Extended use raised workplaces

Raised workplaces at which personnel spend an extended period of time should have a clear working area of at least 1,5 m^2 per person and a width of at least 1 m unless this inhibits ergonomic requirements (e.g. handling of objects).

6.4.6 Infrequently used workplaces

For infrequently used workplaces (see 3.42) that cannot be accessed by stairs, secured ladders may be used if the access height does not exceed 2 m. Toe boards and intermediate rails on railings are not required if the falling height is less than 2 m.

6.4.7 Railings, toe plates and self-closing gates

Railings with handrails, intermediate rails, toe plates or self-closing gates shall satisfy the requirements specified in 6.4.1.

EXCEPTION: The toe plate is not required up to a falling height of 1,6 m; however, intermediate rails shall be fitted in the middle between handrails and floor.

6.5 Stability

6.5.1 Unforeseeable changes of position

Machines and their elements shall be designed and equipped to be stable and to ensure that no unanticipated changes of position can occur; i.e. so that they do not fall over and are not capable of being unintentionally moved by vibration, wind pressure, impact or other foreseeable external forces or internal dynamic forces (inertial forces, electrodynamic forces, etc.).

Means for preventing unanticipated changes of position include

— adequate size of the base;

— low centre of gravity;

— adequate means for anchoring;

— adequate design of wheels on track-mounted assemblies.

Such special safety measures may include, but are not limited to,

— restriction of the movements of parts of the machine;

— warning indicators or alarms if stability is endangered;

— provision of interlocks to prevent tipping;

— anchoring the machine securely to a foundation.

Both static and dynamic stability shall be considered. If special safety measures are required, a warning shall be provided on the machine and/or in the instruction handbook.

6.5.2 Unintended travel

Movable machines (machines on wheels) shall be safeguarded against unintended travel.

Measures to prevent unintended travel include, but are not limited to, the following:

— for machines with four wheels, providing a means of locking at least one wheel;

— for machines with two wheels and two caster wheels, providing a means of locking at least one caster wheel;

— for machines with four caster wheels, providing a means of locking at least two caster wheels.

Where possible, automatic locking devices should be fitted.

Unintended travel on wheels and caster wheels with no brakes may occur on machines such as the following: small UV dryers, dampening water devices, inserting devices, jogging tables, sheet folding, riveting, stitching and eyeletting machines, strapping and tying machines, bundling and baling presses, printing slotters, rotary die-cutters and combined machines (in-line).

NOTE Self-locking gears are an example of automatic locking devices.

6.6 High contact temperatures

Contact temperatures of accessible heated parts on machines shall not be greater than the limit values specified in EN 563.

NOTE The limit values in EN 563 are expected to be retained in the new International Standard EN/ISO 13732-1 currently under development.

Means to safeguard against contact with heated parts include the use of insulation or guarding by distance.

The surface temperature of those parts of continuous flow-drying devices where access is possible shall not exceed the limit values as specified in EN 563. Those parts of continuous flow-drying devices that are accessible after opening the interlocking device, and where temperatures are in excess of limit temperatures, shall be provided with a hazard warning.

6.7 Noise

Machines shall be so designed and constructed that risks from noise emission produced by the machines are reduced to the lowest practical level for that type of machine. Means to reduce noise include sound absorption materials, covers, silencers, vibration dampening or selection of component materials or other methods as specified in ISO/TR 11688-1.

Sound measurements to determine the noise emission shall be carried out in accordance with the requirements specified in EN 13023.

NOTE Examples of significant sources of noise include gears; hydraulic devices; compressors, pumps; exhaust fans; blast air nozzles; suction devices (paper dust, trimmings); paper embossing; cutting, die-cutting, creasing of paper, board, paper grinders; cylinder rolling motion; paper stops; separation of paper or board from printing form; power transmission systems; pneumatic systems.

6.8 Radiation hazards

6.8.1 Laser devices incorporated in machinery

Laser devices incorporated in machinery shall comply with the requirements of ISO 11553 and IEC 60825-1. The equipment shall be provided with fixed or interlocking guards in order to prevent access to positions where laser radiation emission is above the category 1 limit values as specified by IEC 60825-1 for the intended use of the machine.

During repairs, it may be necessary for trained personnel to operate the machine for short periods of time without fixed or interlocking guards. If this requires access to positions where laser radiation emission is above the category 1 limit values, additional safety measures shall be taken in accordance with IEC 60825-1.

Means of additional safety measures include providing instruction to personnel regarding the use of personal protective equipment.

NOTE For user information, see Clause 16.

6.8.2 Ultraviolet irradiance

The level of ultraviolet irradiance emitted by machinery shall not exceed category 1 limit values as specified in EN 12198-1:2000, Table B.1, for permanent workplaces, as well as for occasionally occupied positions. Actual irradiance values shall be determined as specified in EN 12198-1:2000, Annex B.1 and Table B.2.

NOTE UV radiation is emitted, for example, by UV dryers.

The values specified for category 1 of EN 12198-1:2000, Annex B.1, Table B.2, refer to the maximum duration of exposure of 8 h per day. Where the location of measurement points or normal conditions of operation allow the expected time, t_{exp}, in hours of exposure per person to be less than the maximum duration, the UV-B/C radiation limit value of 1×10^{-3} W/m^2 may be multiplied by the factor $8/t_{exp}$. The UV-A radiation limit value is 10 W/m^2 for exposure times from 1 000 s to 8 h. If the exposure time is less than 1 000 s, the limit value for radiation emission is calculated by dividing the radiation value of 10 000 J/m^2 by the exposure time, in seconds.

A lower maximum duration of exposure may be expected for equipment intermittently emitting UV, for example, where the emission of radiation is interrupted for procedural reasons in the preparatory phase of the exposing operation (feeding of the copy, travel to required position).

6.8.3 Ozone hazards caused by UV radiation or electron radiation

Every attempt shall be made at the design stage to eliminate hazards due to ozone creation by UV radiation or electron radiation. Measures for reducing ozone emission include the use of low-ozone UV dryers.

If the design cannot completely eliminate ozone creation, exposure to air containing ozone shall be prevented, for example, by adequate purification systems to filter out the ozone.

6.9 Stationary knives

The cutting edge of a stationary knife blade (a knife that does not move during use) shall be guarded.

Safeguards shall be provided to prevent contact with stationary knife blades that can be tilted, even when they are not in working position.

6.10 Rotary tools

On rotary tools, the in-running nips and that part of the peripheral area which is not used for the process shall be protected against contact by personnel. Preference shall be given to guards that do not have to be removed for tool change.

NOTE Examples of rotary tools include circular cutters, perforating knives, perforating tools, rotary slitting tools, rotary bending tools, circular saws.

Split rotary tools shall be securely fastened to the tool carrier.

6.11 Transport and storage of hazardous tools

Devices shall be provided that prevent injuries caused by the hazardous tools of machines during their transport and storage. This requirement also applies to an individual tool which forms part of an assembly.

NOTE Knives are an example of a “hazardous tool”. Knife boxes are an example of a “device”.

6.12 Protruding machine parts

Machine parts that unavoidably protrude shall be padded and provided with a distinctive and permanent hazard marking if they present a hazard of collision.

6.13 Handwheels and cranks

Handwheels and cranks shall be so designed that they do not automatically rotate during machine motion. One means of preventing automatic rotation is to decouple the handwheels and cranks by spring force.

6.14 Routine handling of heavy machine parts

Where heavy machine parts need to be removed and replaced regularly, necessitating the lifting of a load of at least 25 kg per person, the need for the user to provide adequate means of lifting and transport shall be indicated in the instruction handbook (see 16.2.4).

NOTE Examples of machine parts that need to be installed and removed routinely include hoppers, feeders, etc.

The 25 kg requirement shall apply when ideal lifting conditions exist. Under conditions that are less than ideal, e.g. where lifting is more difficult such as from positions that require unfavourable body postures, the use of lifting devices may be required for lifting loads less than 25 kg.

Determination of the lifting condition should take into consideration such things as distance between the body and the load, how high the load must be lifted, the shape of the object being lifted, the need to twist the body while lifting, etc.

The user should be aware of the effects of mathematical conversion and rounding when converting from SI units to U.S./Imperial units. Requirements stated by the U.S. Occupational Health and Safety Administration (OSHA) may supersede the resulting conversions in the U.S.

7 Machine-specific requirements

7.1 Machines-in-a-system configuration

Whenever any binding or finishing machines are combined in a system configuration such that the overall visibility of personnel by the operator is obstructed or communication is difficult, a warning system as specified in Clause 14 shall be used.

7.2 Guarding of hoppers and hopper feeders

7.2.1 Manually loaded hoppers

On machines using manually loaded hoppers, the hazard points on the separating elements of the hopper feeder shall be safeguarded in accordance with 7.2.4. The exception defined in 5.5.1.2 may be applied to the hopper feeder, if necessary.

7.2.2 Guarding of automatically fed hoppers

As an alternative to 7.2.1, on automatically fed hoppers where manual intervention during normal operation is not required and the material used makes access difficult, tunnel-type guards arranged with a safety distance of 550 mm from the nearest hazard point are considered adequate.

The exception defined in 5.5.1.2 may be applied to the hopper feeder, if necessary.

7.2.3 Protection of unused hoppers and hopper feeders

For hoppers that are not used and cannot be stopped, blanking boards shall be provided to safeguard the hazard points at the separating elements. Such boards shall ensure that the machine is not stopped by the residual-pile monitoring system.

7.2.4 Separating elements on hopper feeders

Separating elements on feeders shall be so designed that their movement does not create hazard points.

This safeguarding can be accomplished, for example, by maintaining a distance of at least 25 mm or a force limit of 50 N between moving separating elements or between a moving element and a fixed object. Where blanks are fed from the bottom of a pile, safeguarding may be done, for example, by residual-pile monitoring of feeders, which complies with category B of ISO 13849-1:1999.

The hazard points on separating elements outside the sidelays on feeders shall be safeguarded for every format size used. For hazard points within sidelays, residual-pile monitoring that complies with category B of ISO 13849-1:1999 shall be used.

This safeguarding may be achieved, for example, by using accordion-type bellows or additional guards.

7.3 Guarding on binding and finishing machines

7.3.1 Hand-fed riveting, eyeletting and attaching machines

Hazard points between tools on riveting, eyeleting and attaching machines shall be either prevented by design or safeguarded.

This requirement is satisfied, for example, by

— observing a maximum distance of 4 mm between the tools in the open position;

or

— ensuring that the closing force of the movable tool is less than 50 N; a stronger closing force is allowed to become effective only after a sensing device has confirmed that no part of a human body is located between the two tools.

The sensing device function may, for example, be based on the fact that the work piece and a body part have different electrical resistances or different thicknesses.

Hazard points are safeguarded if guards are provided in accordance with ISO 13852:1996, or the machine can be started only by two-hand control.

For machines that are not guarded by a fixed or movable guard, a work-piece support shall be provided and two-hand controls, in accordance with 10.5, shall be used. If the work piece needs to be held by hand outside the hazard zone, a hold-to-run control shall be provided for starting the machine instead of the two-hand control.

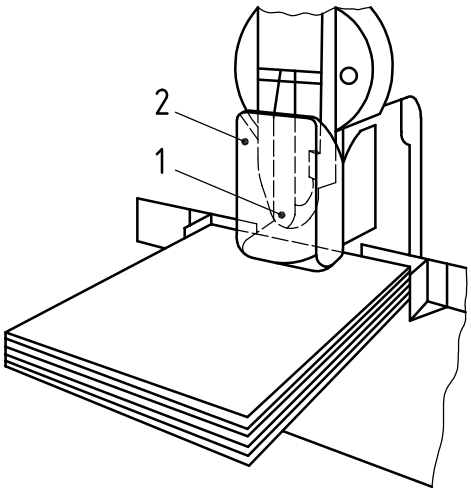
7.3.2 Hand-fed flat- and saddle-stitching machines

Adjustable guards shall be provided on flat-, saddle- and combined-stitching machines (see Figures 13 and 14) for operational reasons. Instructions that describe the safe adjustment of the guards in a clear and easily understandable format shall be provided on the machine.

This marking requirement is satisfied, for example, by providing labels that illustrate the safety distances required for the various stitching thicknesses by means of sketches and measurements.

On combination stitching machines in the saddle-stitching mode, the guard for the upper tool shall extend to the height of the upper edge of the lower tool (upper edge of the saddle) and shall snugly enclose the upper tool to prevent inadvertent access (see Figure 14).

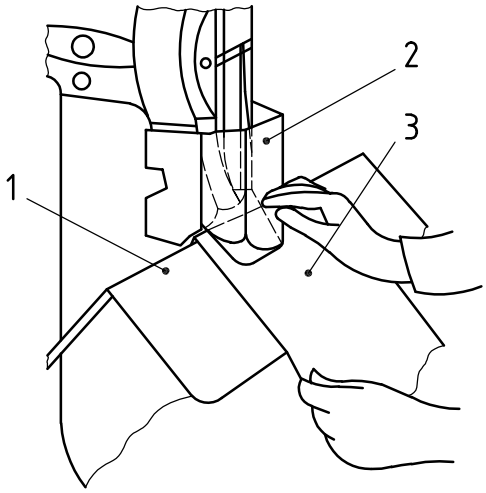
Guarding may be either by two separate guards or a combined reversible guard. Combined reversible guards shall therefore be suitable for saddle stitching as well as for flat stitching.



Key

1 upper tool
2 guard

Figure 13 — Flat stitching



Key

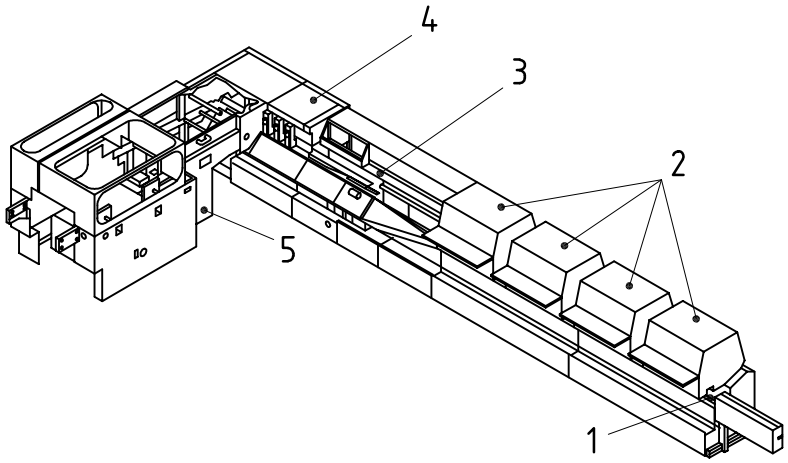
1 upper edge of saddle
2 guard
3 work piece

Figure 14 — Saddle stitching

7.3.3 Gang stitchers and drum stitchers

7.3.3.1 Feeders on gang stitchers and drum stitchers

The feeder shall be guarded in accordance with Clause 5. Depending on the design, fixed guards, movable guards, residual pile monitoring or other means of guarding may be used (see Figure 15).



Key

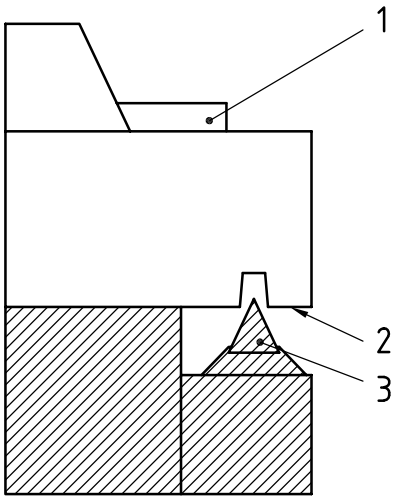
1 transport chain
2 feeder
3 thickness control
4 stitching unit
5 trimmer

Figure 15 — Gang stitcher

Where the bottom of the feeder on the transport channel side needs to remain open for functional reasons (see Figure 16), the lower edges of the guards on the transport channel side shall be extended as low as technically feasible.

EXAMPLE An example of a functional reason would be for the use of air vortexes.

The exception defined in 5.5.1.2 may be applied to the feeder, if necessary.



Key

1 hopper
2 bottom of feeder
3 transport chain

Figure 16 — Feeder

7.3.3.2 Guarding stitching section of gang stitchers

Hazard points on the stitching section shall be safeguarded by interlocked guards on the operator's side. The other side shall be guarded in accordance with Clause 5. Guard apertures shall be in accordance with ISO 13852:1996.

The transport pins shall be made of a flexible material to prevent a shearing hazard against the guard.

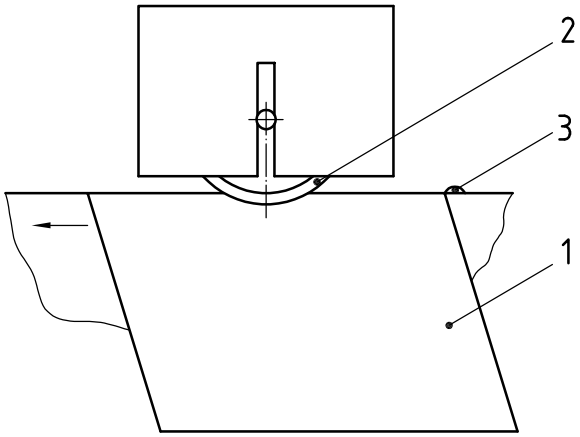
7.3.3.3 Calliper roll

Where an in-running nip exists on the calliper roll used for thickness control (see Figure 17), one of the following means of protection shall be used:

— maximum clamping force of 50 N with roller deflection at 20 mm;

or

— guarding in accordance with Clause 5.



Key

1 folded sheets
2 in-running nip of calliper roll
3 transport chain

Figure 17 — Calliper roll for thickness control

Hazard points on the calliper section shall be safeguarded by interlocked guards on the operator's side. The other side shall be guarded in accordance with Clause 5. Guard apertures shall be in accordance with ISO 13852:1996.

The transport pins shall be made of a flexible material to prevent a shearing hazard against the guard.

7.3.3.4 Transport-chain grippers on gang stitchers

A safety distance of at least 25 mm is required between transport-chain grippers and fixed machine parts.

7.3.3.5 Starting gang stitchers and drum stitchers with a guard open

Gang stitchers and drum stitchers may be started for make-ready by means of a two-hand control with interlocking guards in the open position and at a speed greater than 10 m/min provided that the requirements of the exception in 5.6 are met.

7.3.3.6 Trimmer on gang stitchers and drum stitchers

The trimmer on gang stitchers and drum stitchers shall be safeguarded in accordance with 7.9.

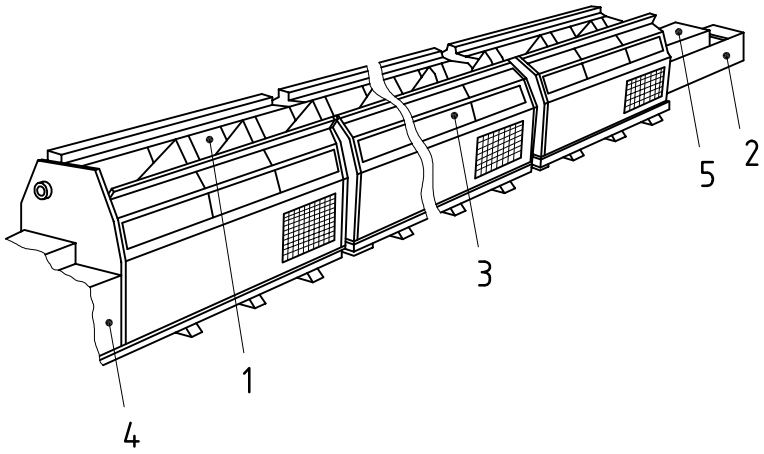
7.3.4 Gathering machines

Gathering machines shall be guarded in accordance with 7.3.4.1 through 7.3.4.2. The exception defined in 5.5.1.2 may be applied, if necessary.

7.3.4.1 Guarding transport chains

For safeguarding the hazard points on the manual feeding unit, a minimum distance of 25 mm is required between the transport chain and fixed machine parts. Where the minimum distance cannot be adhered to, trip bars meeting the requirements of 5.7.4 may be used for safeguarding. Hazard points that can be reached from the manual feeding section in the following feeder shall be safeguarded by fixed or interlocking tunnel-type guards having a minimum length of 300 mm (see Figure 18).

Hazard points on the gathering device (transport device) shall be safeguarded by fixed or interlocking guards.



Key

1 hopper
2 manual feeding
3 gathering device (transport device)
4 following machines
5 tunnel guard

Figure 18 — Gathering machine (plan view)

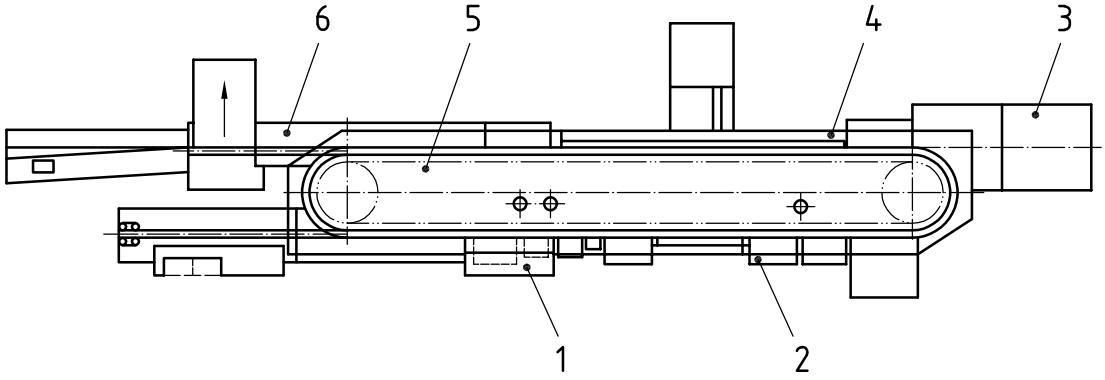
7.3.4.2 Starting gathering machines with a guard open

Gathering machines may be started for make-ready by means of a two-hand control with interlocking guards in the open position and at a speed greater than 10 m/min provided that the requirements of the exception in 5.6 are met.

7.3.5 Perfect binders

7.3.5.1 Guarding book carriage hazards

The hazard points existing between book carriages and between the book carriage and the machine frame, as well as during cover pressing, shall be guarded in accordance with Clause 5. Depending upon the design, fixed guards, movable guards or other means of guarding may be used (see Figure 19).



Key

1 milling unit
2 gluing unit
3 cover feeder
4 pressing unit
5 book carriages
6 delivery

Figure 19 — Perfect binder (plan view)

7.3.5.2 Hazards in the gluing unit

The hazard points existing in the gluing unit (glue rollers, glue applicators) and the hazard points that may exist between materials and machine parts (book backs and clamps, book backs and glue rollers, etc.) shall be guarded in accordance with Clause 5. Depending upon the design, fixed guards, movable guards, or other means of guarding may be used.

Guarding in accordance with Clause 5 shall be provided to protect personnel from hot glue spray, both during production and when routinely accessing other nearby areas. The guards adjacent to the hot glue mechanism shall be interlocked so that the hot-glue spray mechanism is deactivated when the guard is open.

7.3.5.3 Glue pans

The glue pans for hotmelt shall be provided with a temperature control and maximum-temperature monitoring in accordance with category 1 of ISO 13849-1:1999. Any hazardous hotmelt vapour shall be exhausted both from the perfect binder and from outside the machine for pre-melters, unless protection from exposure to the vapour is provided by other means.

Perfect binders using polyurethane hotmelt glues for binding shall be designed such that the machine does not emit hazardous concentrations of isocyanates. These requirements are met if the vapours are exhausted to the atmosphere. The requirements of ISO 14123-1 and ISO 14123-2 shall be met.

Contact with hot surfaces of the hotmelt pan shall be prevented by guarding or by insulation.

7.3.5.4 UV radiation dryers

Where radiation UV dryers are used, the maximum values of emitted radiation shall comply with 6.8.2.

Where the machine operates with an automatic feed and routine and regular manual intervention is not required, tunnel-type guards with a safety distance of 550 mm from the nearest hazard point are considered adequate.

7.3.5.5 Delivery area

It shall be ensured that the book-carriage (clamp) hazards of the delivery of the perfect binder cannot be accessed. The safety distance shall be a minimum of 550 mm.

7.3.5.6 Starting perfect binders with a guard open

Perfect binders may be started for make-ready by means of a two-hand control with interlocking guards in the open position and at a speed greater than 10 m/min provided the requirements of the exception in 5.6 are met.

Where functional circumstances require the cover to be fed manually during set-up of the perfect binder, the machine may be started when the interlocking guards are in the open position with a hold-to-run control and a maximum speed of 10 m/min.

7.3.5.7 Milling head cutter (saw)

On high-speed binding lines, where inertia may prevent effective stopping of the milling head cutter when the interlocking guard covering the book carriages (clamps) is opened, the following measures shall be used:

— access to the milling-head cutter shall be prevented as far as technically feasible by additional guarding;

and

— a warning sign shall be posted in the vicinity of the milling-head cutter.

7.3.5.8 Additional requirements for hand-fed perfect binders

Where there is a risk of injury if the operator's hand goes beyond the book clamp loading area, there shall be a sensing device that will stop machine motion before injury occurs.

The cover-scoring blades shall be guarded with fixed or interlocked guards in accordance with this International Standard.

The milling-head cutter shall be protected against unintended access by the use of self-adjusting plates that open to allow a book block to pass over the saw, then automatically close.

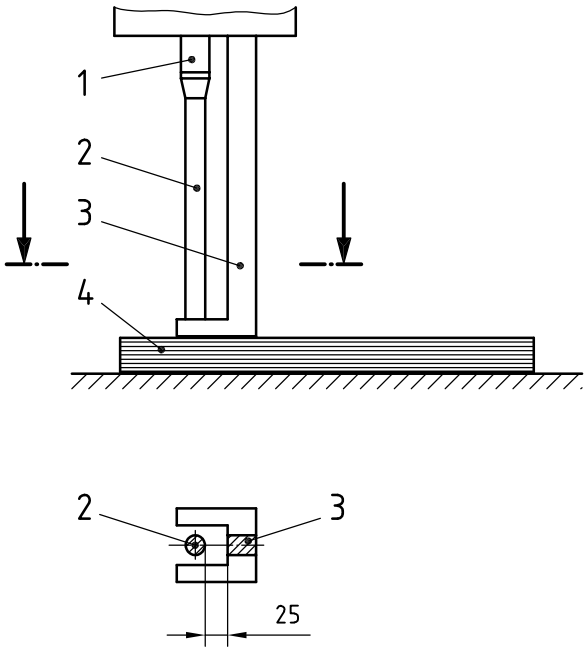
7.3.6 Paper drills

7.3.6.1 Single-head hand-fed paper drills

On single-head paper drills with manual feeding, the stroke of the drill or work piece shall be under hold-to-run control (hand- or foot-controlled) or hand-operated. In addition, a hold-down device (see Figures 20 and 21) shall be provided on the drill in order to prevent persons from coming into unintentional contact with the drill from the front. When the hold-to-run control is released, the drill or work piece shall retreat to its start position.

The distance between the hold-down device and the chuck jaw shall be at least 25 mm (see Figure 20).

Dimensions in millimetres



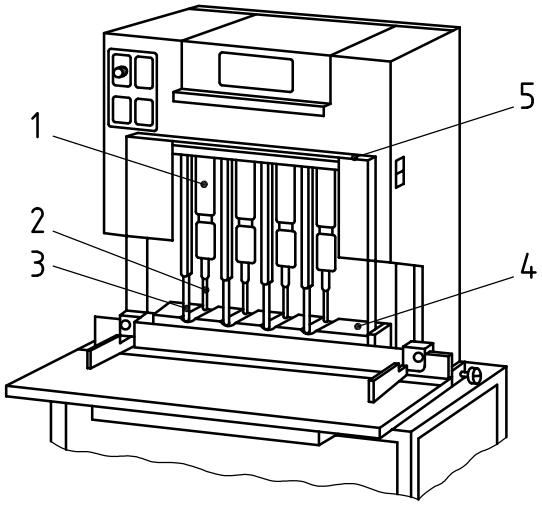
Key

1 chuck jaws
2 drill
3 hold-down device
4 material

Figure 20 — Paper drill

7.3.6.2 Guarding the trapping hazard on multi-head drilling machines

On multi-head drilling machines, the trapping hazard existing on drills and chuck jaws shall be safeguarded by a fixed or interlocking guard (cover). On multi-drill machines, hazard points on the chuck jaws shall be protected by the use of fixed or interlocking guards (see Figures 20 and 21). The distance between the hold-down device or guard (cover) and the chuck jaw shall be at least 25 mm.



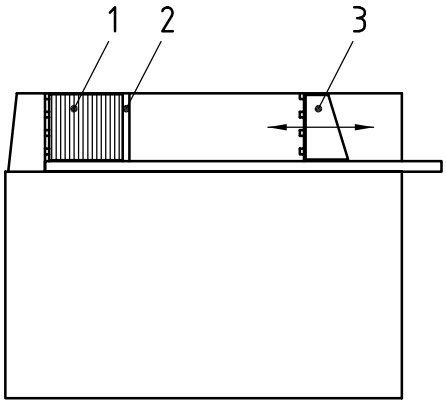
Key

1 chuck jaws
2 drill
3 hold-down device
4 material
5 guard (cover)

Figure 21 — Multi-head paper drill

7.3.7 Book-signature presses

On book signature presses, the hazard point between the moving pressing plate and the intermediate plate positioned against the material supply shall be safeguarded by using a hold-to-run control (see Figure 22).



Key

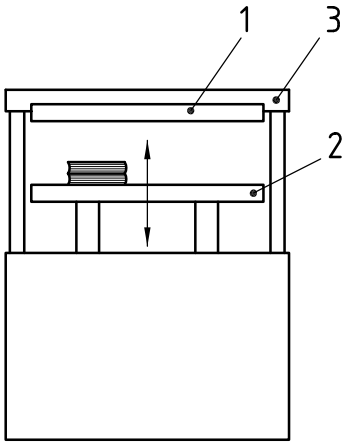
1 book signatures
2 intermediate plate
3 pressing plate

Figure 22 — Book signature press

7.3.8 Book press

The hazard points between the movable pressing plate and the fixed pressing plate or the forming bar, if any, shall be safeguarded. One means of safeguarding this area is by use of a trip device in accordance with 5.7.4 (see Figure 23).

NOTE This device is used to press air out of the signature.



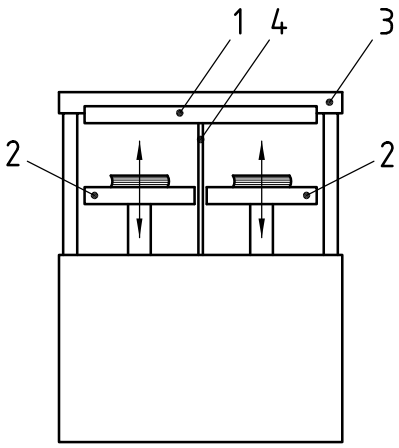
Key

1 trip device
2 movable pressing plate
3 fixed pressing plate

Figure 23 — Book press

On book presses where several pressing plates can be moved individually, the hazard points between the movable pressing plates shall be safeguarded. One means of safeguarding this area is by fitting a guard between the pressing plates (see Figure 24).

If the hazard is safeguarded by fitting a guard between the pressing plates, clearance between guard and moving pressing plates shall not exceed 6 mm (see Figure 24).



Key

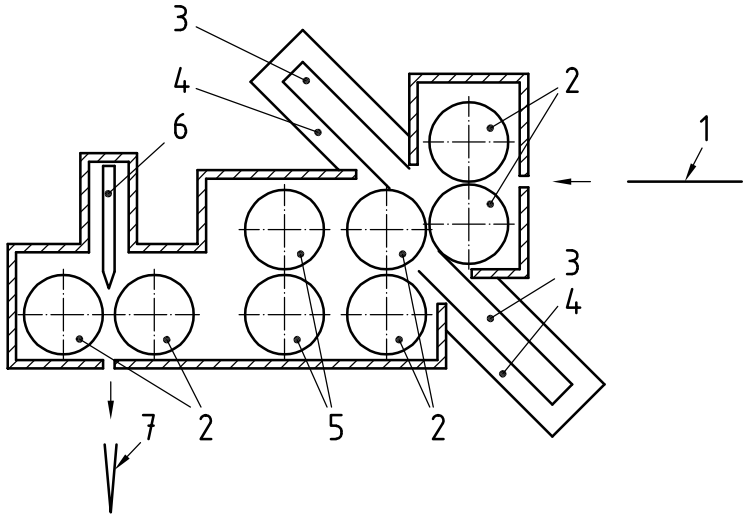
1 trip device
2 movable pressing plate
3 fixed pressing plate
4 guard

Figure 24 — Book press with two movable pressing plates

7.3.9 Sheet-folding machines

7.3.9.1 Guarding hazard points at the folding rollers

The hazard points at the folding rollers shall be protected by fixed or interlocking guards. Adjustments should be made from outside the guards. Safeguarding may also be accomplished by using a device with a guarding function (see Figure 25). An example of such a safeguarding device is a buckle plate.



Key

1	unfolded sheet	5	cutting, creasing device
2	folding roller	6	folding knife
3	buckle plate	7	folded sheet
4	sound enclosure		

Figure 25 — Sheet-folding machine

7.3.9.2 Hazard points on cutting, creasing and perforating devices

Hazard points on the cutting, creasing and perforating devices shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending on the design.

7.3.9.3 Safeguarding crushing points between folding knives and folding rollers

The crushing points between folding knives and folding rollers shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending on the design.

7.3.9.4 Safeguarding in-running nips on feeding and delivery belts

In-running nips on the feeding and delivery belts shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending on the design (see 7.6.2.1).

7.3.9.5 Machine motion with a guard open

When interlocked guards are in the open position, the machine may be operated by two-hand control at production speed provided that the requirements of 5.6 are met, with the further exception that a selector switch is not required.

NOTE The selector switch is not necessary because a sheet-folding machine is operated in a single mode by one person.

7.3.10 Book-production lines for the production of hard-cover books

7.3.10.1 General

Book production lines may be started for make-ready with interlocking guards in the open position by means of a two-hand control and at a speed no greater than 20 m/min, provided that the requirements of the exception in 5.6 are met.

NOTE Hold-to-run control speeds in production lines differ due to cycle variations so that a continuous machine speed may result in individual elements having higher speeds at the various stages of the process.

7.3.10.2 Safeguarding in-running nips on conveyor belts

The in-running nips on the belts of a feeding and delivery conveyor shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending on the design. Access from the conveyor belts to any hazard point in the machine shall be prevented (see 7.6.2.1).

7.3.10.3 Safeguarding hazard points on preheater

The hazard points on the preheater device shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending upon the design.

EXAMPLE Hazard points may be created by preheating rollers, hot parts and transport.

Where the preheater is accessible, a pictogram warning of hot parts shall be posted in the vicinity of the preheater.

With the guards in the open position, the preheater shall operate only under hold-to-run control in accordance with 5.6.

7.3.10.4 Safeguarding hazard points in glue sections

The hazard points in the glue sections shall be protected by fixed or interlocking guards. Safe glue replenishment should be possible during the production run.

Where hotmelt is used, the hotmelt pans shall be provided with temperature control and limit temperature monitoring.

EXAMPLE 1 Hazard points may exist, for example, at in-running nips between glue rollers and at in-running nips between book signatures and glue rollers.

EXAMPLE 2 Safe glue replenishment may be provided, for example, by a piping system or by a method of replenishment from outside the safety devices.

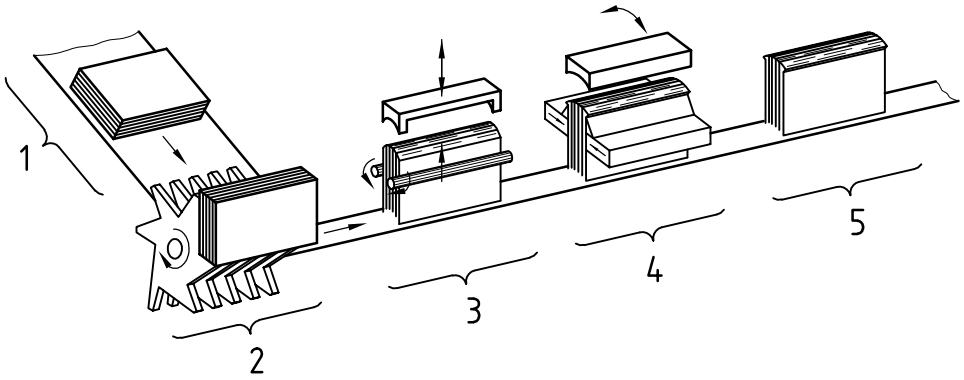
7.3.11 Back-rounding and pressing machines

7.3.11.1 Safeguarding in-running nips on feed and delivery belts

In-running nips on the feed and delivery belts shall be safeguarded (see 7.6.2.1). Access from the conveyor belt to any hazard point inside the machine shall be prevented. A safety distance of 550 mm is recommended.

7.3.11.2 Safeguarding hazard points on tipping section

Hazard points in the tipping section (see Figure 26) shall be protected by fixed or interlocking guards.



Key

1 feeding of book signatures
2 tipping of book signatures
3 pre-forming section
4 back rounding and pressing section
5 delivery

Figure 26 — Back rounding and pressing section (principle)

7.3.11.3 Safeguarding hazard points on pre-forming, back rounding and pressing sections

Hazard points in the pre-forming, back rounding and pressing sections (see Figure 26) shall be protected by fixed or interlocking guards.

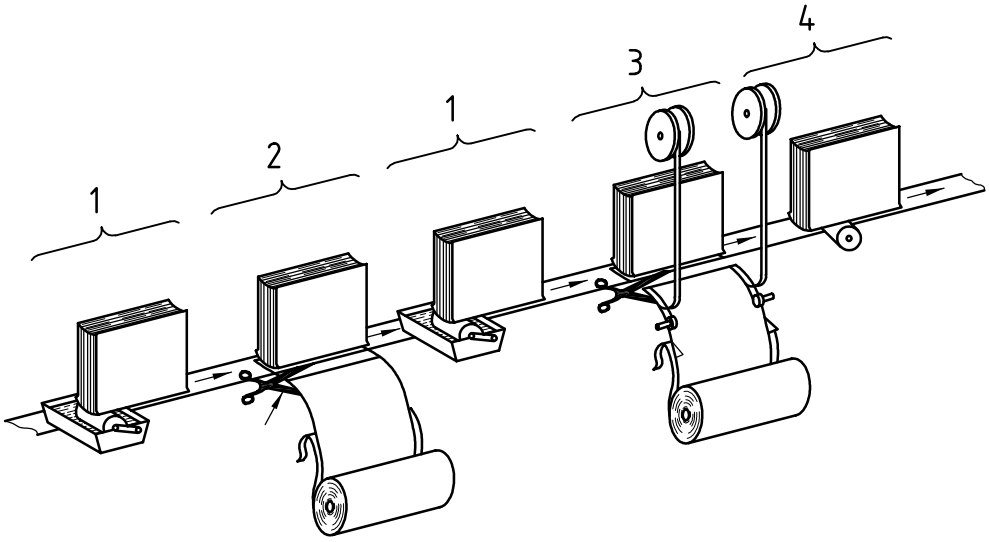
7.3.12 Backlining and head banding machines

7.3.12.1 Safeguarding in-running nips

Where book signatures are transported between vertically mounted conveyor belts, the in-running nip between the two conveyor belts on the feeding side shall be safeguarded by a tunnel-type guard at least 550 mm long.

7.3.12.2 Safeguarding hazard points on glue section

In the glue section (see Figure 27), hazard points (for example glue rollers) shall be protected by guards.



Key

1 glue section
2 gauzing section
3 head banding section
4 counter-pressure section

Figure 27 — Backlining and head banding machine (principle)

7.3.12.3 Safeguarding gauze section hazards

The cutting point at the gauze-cutting knife (see Figure 27) shall be protected by fixed guards. The in-running nips on the rollers of the gauze section (unwinding) shall be safeguarded in accordance with 5.3 and 5.4.

7.3.12.4 Safeguarding head banding section hazards

The hazard points inside the head-banding section (see Figure 27) and the cutting points at the cutting knives and at the rotary knives on the unwinding unit of the head banding section shall be protected by fixed or interlocking guards.

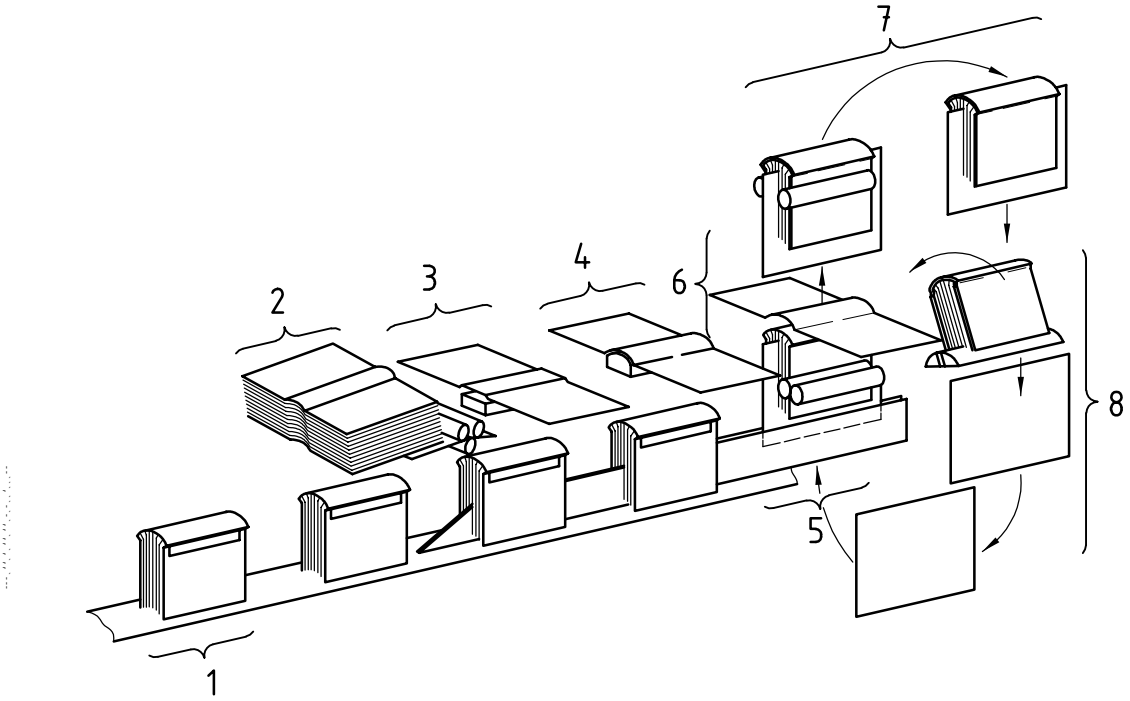
7.3.12.5 Safeguarding counter-pressure section hazards

The hazard points at the counter-pressure sections (see Figure 27) shall be protected by fixed or interlocking guards.

7.3.13 Casing-in (case binding) machines

7.3.13.1 Safeguarding hazard points between book transport and fixed machine parts

The hazard points between book-transport fingers and fixed parts of the machine shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending upon the design (see Figure 28). A tunnel-type guard 550 mm long is considered an adequate guard for the book-signature feed point.



Key

1	feeding	5	gluing section
2	book cover feeder	6	casing-in section
3	cover bending section	7	counter-pressure section
4	forming section	8	delivery

Figure 28 — Casing-in machine (principle)

7.3.13.2 Safeguarding hazard points at delivery

The hazard points (for example crushing points at the transport device) at the delivery (see Figure 28) shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending on the design. Hazard points inside the machine shall not be accessible from the delivery side. A safety distance of 550 mm is adequate.

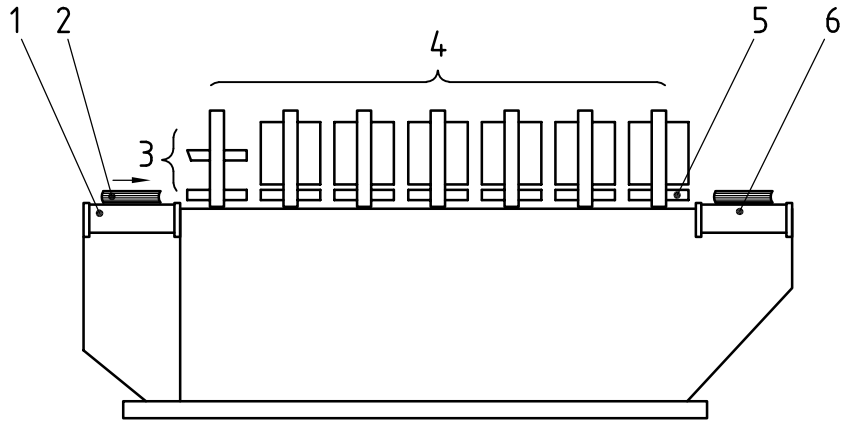
7.3.14 Book-cover crease-forming machines (presses)

7.3.14.1 Safeguarding in-running nips

In-running nips on the feed and delivery belts shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending on the design (see 7.6.2.1). It shall not be possible for a person to reach a hazard point inside the machine from the delivery. A safety distance of 550 mm is considered adequate.

7.3.14.2 Safeguarding hazard points in tipping section

The hazard points (e.g. crushing points created by the tipping and transport device) in the tipping section (see Figure 29) shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending upon the design.



Key

1	feeding belt	4	pressing section
2	book signature	5	crease-forming rail
3	tipping section	6	delivery belt

Figure 29 — Book-cover crease-forming machine (press)

7.3.14.3 Safeguarding hazard points at pressing section

The crushing points at the pressing section (e.g. between books and crease forming devices) shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending upon the design (see Figure 29). Pictograms warning of hot parts shall be posted in the vicinity of accessible heated book-cover crease-forming devices.

7.3.14.4 Motion with a guard open

Book-cover crease-forming machines may be started for make-ready by means of a two-hand control with interlocking guards in the open position and at a speed greater than 10 m/min but no more than 20 m/min provided the requirements of the exception in 5.6 are met. A hold-to-run speed greater than 10 m/min may be needed to ensure that the book in the machine does not burn during the glue melting process.

7.4 Inserting machines

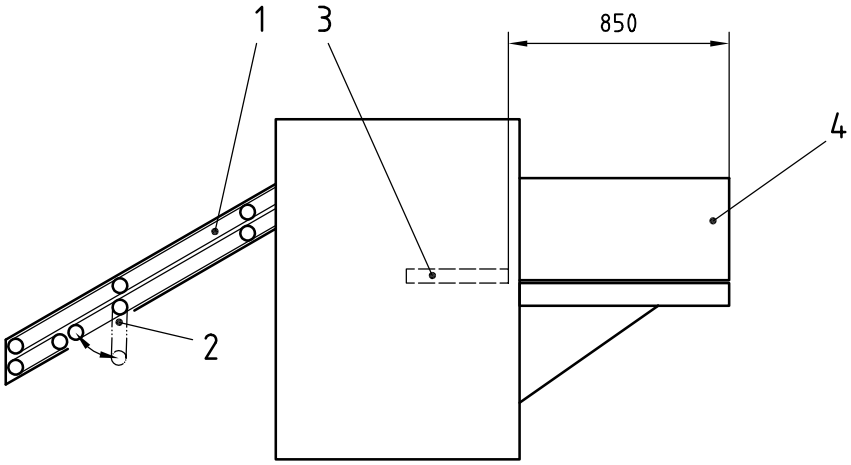
Machines with automatic feeders may be started for make-ready by means of a two-hand control with interlocking guards in the open position and at a speed greater than 10 m/min provided the requirements of 5.6 are met.

7.5 Counter-stackers

7.5.1 Safeguarding divert gates (waste separator)

The crushing point on the divert gate shall be safeguarded (see Figure 30). This safeguarding can be achieved, for example, by limiting the closing force to 200 N.

Dimensions in millimetres



Key

1 feeding belt
2 divert gate
3 turntable
4 delivery tunnel with delivery belt

Figure 30 — Counter-stacker

7.5.2 Safeguarding hazard points at turntable

The hazard points at the turntable shall be guarded in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending upon the design. Safety distances shall comply with ISO 13852:1996. At least one side of the turntable shall be protected by an interlocking guard in order to allow access for the removal of jams.

On the side where the stacked material is delivered, access to the turntable shall be prevented by a fixed or interlocked tunnel-type guard, or other means of guarding. The safety distance to the hazard point shall be at least 850 mm (see Figure 30).

7.5.3 Pneumatic system

When an interlocking guard is opened or the emergency stop device is activated, the pneumatic system of the counter-stacker, including any accumulators, shall be depressurized in order to prevent inadvertent hazardous movement of the counter-stacker.

7.6 Paper embossing machines

7.6.1 Web-threading devices

On machines, safe threading of the web-type material shall be ensured. For certain types of machines, this may require auxiliary threading devices.

On power-driven threading devices for web-type material, access to hazard points shall be prevented by the use of guards.

Access to hazard points is considered prevented if, for example,

— on rope-type threading devices, the in-running nips between the threading rope and the idler pulley are safeguarded. Safeguarding may include the provision, on the outside of the pulleys, of a fixed disc with a radius at least 120 mm larger than that of the pulley;

— on power-driven bar-type threading devices with transport chains, the in-running nips between chains and chain wheels are provided with guards filling the in-running nips as far as possible.

7.6.2 Reel unwinding, rewinding and transport devices

7.6.2.1 Hazard point between reel and belt

On unwinding and rewinding devices where the reel is driven by a belt on the reel circumference (see Figure 31), any accessible hazard point between the reel and the belt shall be safeguarded if the force between belt and reel is more than 300 N. Guards shall be provided for protecting the in-running nips on the drive-belt guide rollers (see Figure 32).

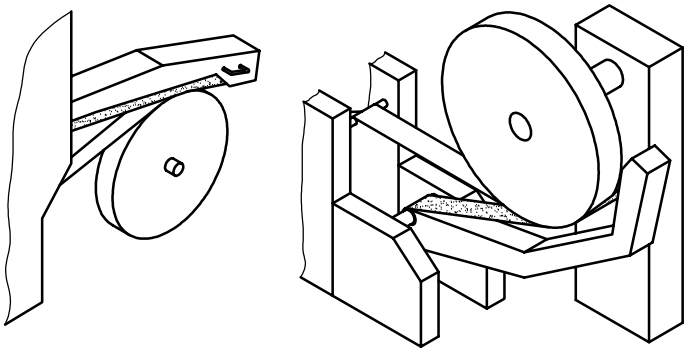


Figure 31 — Belt drives

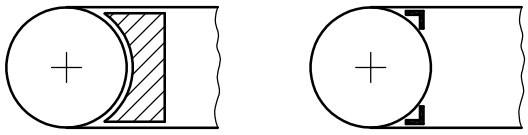


Figure 32 — Safeguarding of belt in-running nips on belt drives

7.6.2.2 In-running nips

On unwinding and rewinding devices, the accessible in-running nips at reels, pressure rollers or support rollers shall be safeguarded by means of guards or safety devices with approach reaction (trip nip bars, pressure-sensitive mats, electro-sensitive devices). The safety device selected shall be effective at all operating reel diameters. Access to the in-running nip from the side shall not be possible. Included in this requirement is the safeguarding of the in-running nip facing the machine, if drawing-in hazards exist as long as the diameter of the reel is small (at the beginning of the rewinding process) or the diameter of the pressure roller is small.

For trip nip bars and pressure-sensitive mats, see 5.7.4. For electro-sensitive devices, see 5.7.3.

7.6.2.3 Chucking cones on devices using non-automatic control

On unwinding or rewinding devices using non-automatic control, the chucking cones shall be designed so that they can be inserted only while the device moving the cones is in the hold-to-run control mode. Control devices shall be arranged such that hazard points between chucking cones and reel can be observed from the position of the hold-to-run control allocated to the unwinding and rewinding unit. The hold-to-run speed shall be as specified in 5.6.

For automatic reel loading, see 7.6.2.12.

7.6.2.4 Separation of chucking cones

Provision shall be made to prevent unintentional separation of the chucking cones after a reel has been lifted. For example, unintended separation may be prevented by allowing the chucking cones to separate only in the hold-to-run control mode at a maximum speed of 2 m/min or by two-hand-control.

Separation of the chucking cones during the unwinding or rewinding motion shall be prevented. For example, an interlocking system may be used to prevent separation of the chucking cones during roll movement.

7.6.2.5 Shaftless unwinding and rewinding units

Provisions shall be made to ensure that shaftless unwinding and rewinding units can be started only after the chucking cones are fully inserted. For example, this can be accomplished for manually operated machines by providing the operator with a clear view of the chucking cones using mirrors or a video monitor. For fully automatic machines, this can be accomplished by use of a pressure-sensing monitor.

7.6.2.6 Non-conical chucking devices

Where there is a risk of damaging non-conical chucking devices by lifting only one end of the roll (for example, when a long, heavy roll is stuck in the chucking device), provisions shall be made to prevent lifting only one end of the roll more than 50 mm. Generally, this risk increases in proportion to the width and mass of the roll.

NOTE This is to help prevent possible damage to the chucking device, which could possibly result in the unexpected release of the roll.

7.6.2.7 Small-diameter reels on shaftless unwinding and rewinding devices

Hazards caused by the ejection of small-diameter reels on shaftless unwinding and rewinding devices shall be prevented. Examples of means to prevent ejection of reels include the following:

— changing the reels at lower speed;

— preventing the reel from being reduced to a diameter less than the minimum reel diameter specified by the supplier;

— fitting an adequate safety device to the unwinding unit.

7.6.2.8 Lifting arm

If hazard points between lifting arm(s) and machine frame cannot be avoided by built-in design or be safeguarded, the lifting arm(s) shall be movable only in the hold-to-run control mode. Control devices shall be arranged such that hazard points can be observed from the place of actuation. The hold-to-run speed shall be as specified in 5.6.

7.6.2.9 Protection against drawing-in hazard

On reel unwinding and rewinding devices, provisions shall be made to guard against being drawn in between the end surface of a rotating paper reel and fixed parts or lifting arms if the distance is less than 25 mm.

7.6.2.10 Protection against crushing hazard

On reel stands and reel splicers with movable parts, all hazard zones where there is the risk of crushing from automatic movements shall be safeguarded in accordance with the distances and gaps defined in ISO 13852:1996 and ISO 13854. Risk of crushing exists between movable parts such as lifting arms, paper reels and devices for acceleration, cutting and gluing, or in connection with fixed parts such as side frames, connecting bars or the floor.

7.6.2.11 Transport of material-reel to reel-stand

On semi-automatic reel transport systems, transport of the material reel to the reel stand shall be done in the hold-to-run control mode at a maximum speed of 20 m/min. The stopping path shall not exceed 200 mm. It shall be possible to clearly see the total transport way from the respective hold-to-run control position.

7.6.2.12 Protection of hazard zones of unwinding unit of automatic reel-loading systems

On automatic reel-loading systems, the hazard zone associated with the unwinding unit shall be completely safeguarded by electro-sensitive devices or by guards. Hazard zones exist between the material reel and fixed machine parts, between the material reel and the lifting arm and the floor, and between the material reel and the chucking cone.

Where ESPDs, in accordance with 5.7.3, are used for safeguarding the automatic reel-loading area of unwinding units, the device may be muted while material reels or unwound cores are transported through the area safeguarded by the electro-sensitive device on the following conditions:

— an additional photoelectric device is provided at a height (h) of not more than 50 mm above the top of the largest reel that will cause immediate stopping of all hazardous movements on the unwinding unit whenever the beam is interrupted during insertion of the material reel or removal of unwound cores, caused, for example, by persons accessing the hazard area (see Figure 33);

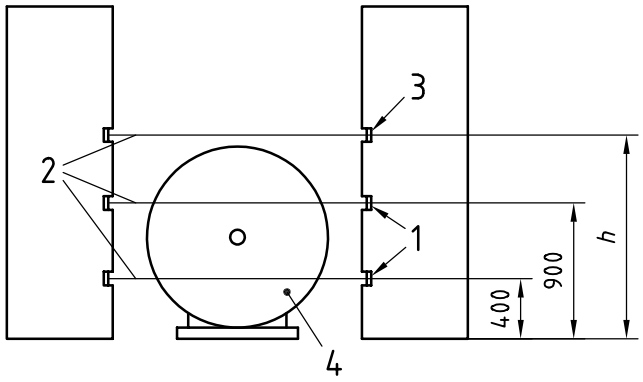
and

— emergency stop devices shall be provided within easy reach on the unwinding unit that will also stop the automatic loading operation.

For safeguarding the hazard zone by electro-sensitive devices, see 5.7.3.

EXCEPTION: If indexing (rotating motion) of the lifting arms toward the subsequent or prior operating position(s) is limited to no more than 1/60 Hz (1 rpm), and if indexing of the reel is preceded by a warning signal of at least 2 s duration, and if all pinch (crush) points have more than 120 mm separation, then all pinch points (crush points) between the indexing objects and fixed objects are considered to be safeguarded.

Dimensions in millimetres



Key

1 photoelectric device
2 photoelectric beams
3 additional photoelectric device
4 reel
h height to the top of the largest reel plus a maximum of 50 mm

Figure 33 — Use of ESPDs to guard automatic reel-loading of the unwinding unit on automatic reel-loading systems

7.6.3 Safeguarding in-running nips on guide rollers

The in-running nips between guide rollers and between guide rollers and fixed machine parts shall be safeguarded by providing a minimum separation of 120 mm, or by fixed or interlocking guards.

7.6.4 Stretch rollers and counter rollers

Stretch rollers and counter rollers shall have a minimum separation of 120 mm (clearance between the two rollers).

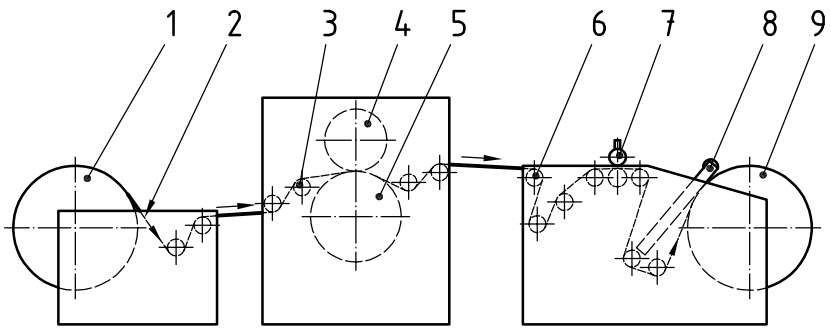
7.6.5 Safeguarding movement of counter-roller

The movement of the counter roller when travelling into and out of position shall be safeguarded.

If speed limitation is used as the safeguard, movement of the counter roller shall be limited to 5 m/min under hold-to-run, or to a non-hazardous speed of < 5 m/min.

7.6.6 Warning of heated parts

Where embossing rollers are heated (see Figure 34), a pictogram shall be posted on or near the machine warning the operator of hot machine parts. Hot pipes shall have adequate insulation up to a height of 2,7 m above the operator platform. In the case where the operator is standing on the floor, rather than on a raised platform, the floor is considered to be the “platform” for this requirement.



Key

1	unwinding unit	6	guide rollers
2	paper web	7	cutting unit
3	stretch roller	8	drive roller
4	embossing roller	9	rewinding unit
5	counter roller		

Figure 34 — Paper-embossing machine

7.7 Finishing machines

7.7.1 Coaters

7.7.1.1 Web-threading devices

The requirements for web-threading devices in accordance with 7.6.1 shall be fulfilled.

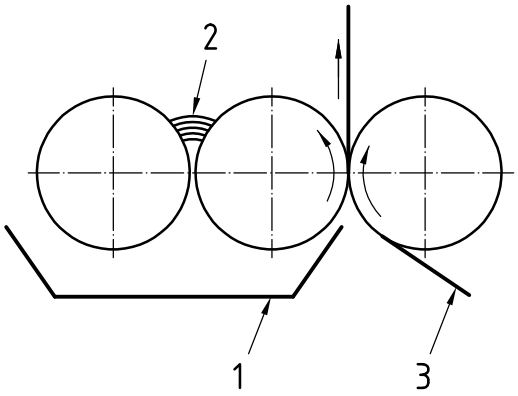
7.7.1.2 Safeguarding reel unwinding and rewinding units

Reel-unwinding and -rewinding units shall be safeguarded in accordance with 7.6.2.

7.7.1.3 Safeguarding in-running nips

The in-running nip between guide rollers and between guide rollers and fixed machine parts shall be safeguarded by providing a minimum separation of 120 mm, or by fixed or interlocking guards.

The in-running nip on the dosing gap shall be guarded (see Figure 35).



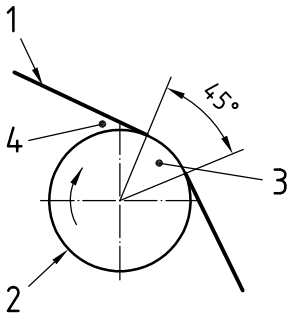
Key

1 collecting pan
2 dosing gap
3 material web

Figure 35 — Dosing gap

The in-running nips in the coating unit between coating roller and cooling roller/coating roller shall be protected by fixed or interlocking guards.

The in-running nips between the coated, tear-resistant material web and guide rollers that can be accessed in the machine from passageways and that have a wrapping angle of 45° or more shall be protected by fixed guards (see Figure 36).

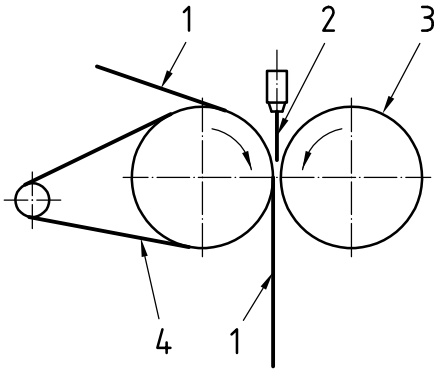


Key

1 coated web
2 guide roller
3 wrapping angle
4 in-running nip

Figure 36 — Wrapping angle on guide rollers

The in-running nips on the belt shall be safeguarded (see Figure 37).



Key

1 material web
2 polyethylene (PE)
3 cooling roller
4 polytetrafluoroethylene (PTFE) belt

Figure 37 — Coating with polyethylene

7.7.1.4 Safeguarding hot material and surfaces

Contact with hot melt material used for coating shall be prevented by fixed guards.

7.7.1.5 Exhaust equipment

Where coatings that emit hazardous vapours are being used, the machine shall be equipped with exhaust equipment at the point of application.

NOTE Because the requirements for exhaust equipment vary with the substances used, it is not possible to specify technical requirements in this International Standard.

7.7.1.6 Safeguarding movement of rollers

The traversing movement of the coating rollers or coating roller and cooling roller shall be safeguarded. This safeguarding can be achieved, for example, by operating at a speed of 5 m/min under hold-to-run control, or by the use of interlocking guards.

7.7.1.7 Explosion prevention

Explosion prevention and protection shall be as specified in 6.2.

7.7.1.8 Continuous-flow dryers on coating devices

7.7.1.8.1 Flammable substances

Where coating material that may emit flammable substances is being used during the drying process, the requirements of EN 1539 shall apply.

7.7.1.8.2 Safeguarding hazard points on dryers

The hazard points when closing the upper and the lower part of the dryer shall be safeguarded. This safeguarding can be achieved, for example, by hold-to-run control.

The automatic closing movement of the dryer shall be safeguarded by trip bars. Automatic closing shall be possible only for the last 300 mm of the aperture.

7.7.1.8.3 Prevention of ignition of web material

Ignition of the material web when passing through the continuous flow dryer shall be prevented. This can be achieved in case of a stoppage of the machine or the coating unit, for example, by adequately reducing the performance of the continuous flow dryer and maintaining the material web at an adequate distance from the source of radiation by an air wiper.

7.7.1.8.4 Surface temperature of accessible parts

The surface temperature of parts, which are accessible from the outside, shall not exceed the maximum values in accordance with EN 563.

7.7.1.8.5 Safety check valves

Where hydraulic or pneumatic cylinders are provided for opening the dryer, overridable safety rated check valves shall be fitted to the lifting cylinders.

7.7.1.8.6 Protection from falling shut

To prevent the dryer from falling shut during inspection operations, mechanical devices shall be provided to secure the dryer open.

NOTE For example, the dryer may be prevented from falling shut by means of struts which are inserted during inspection.

7.7.2 Laminators

7.7.2.1 Reel-unwinding and -rewinding units

Reel-unwinding and -rewinding units shall be safeguarded in accordance with 7.6.2.

7.7.2.2 Web threading devices

The requirements for web threading devices shall be in accordance with 7.6.1.

7.7.2.3 Safeguarding in-running nips

The in-running nips of the feeding and delivery belts shall be safeguarded (see Figure 32).

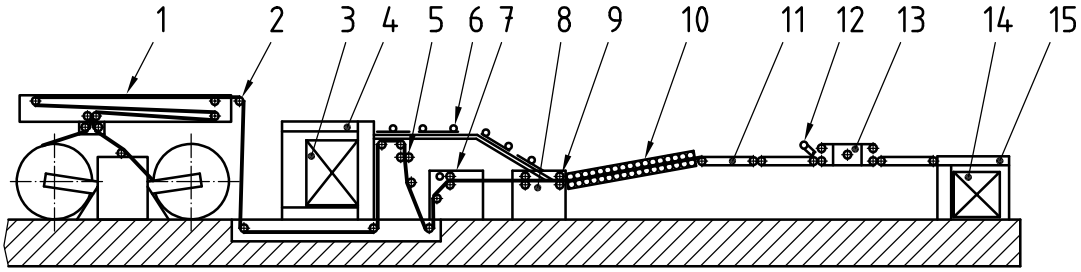
The in-running nips between guide rollers and between guide rollers and fixed machine parts shall be safeguarded. This safeguarding can be achieved, for example, by providing a minimum distance of 120 mm or by fixed or interlocking guards.

The in-running nips between the foil-laminated tear-resistant web and guide rollers which can be accessed in the machine from passageways and which have a wrapping angle of 45° or more (see Figure 36) shall be protected by fixed or interlocking guards.

The in-running nip on the laminating rollers shall be protected by fixed or interlocking guards. Where the thickness of the laminated material is 18 mm or more, the opening width shall be a maximum of 30 mm and the distance from the guard opening to the nip shall be a minimum of 200 mm.

The in-running nips on the rolls that feed sheets (see Figure 38) shall be safeguarded. This safeguarding can be achieved, for example, by ensuring that the rolls have a displacement of at least 25 mm or roller contact is by their own mass.

In-running nips on the glue rollers (see Figure 38) and on the dosing gap (see Figure 35) shall be protected by interlocking guards.



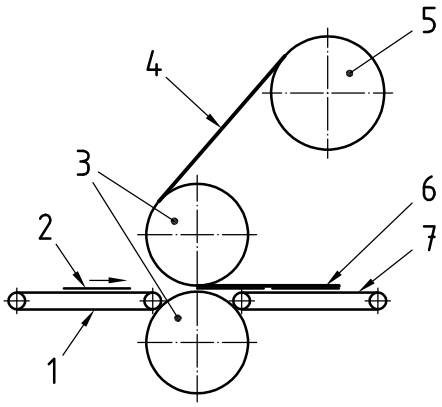
Key

1	unwinding unit	6	transport rolls	11	transport belt
2	guide roller	7	glue unit	12	package stop
3	Stack in feeder	8	sheeter	13	turning belt
4	feeder	9	laminating rollers	14	stack in delivery
5	rotary knife	10	pressing belt	15	delivery

Figure 38 — Web-fed laminator for sheet material

7.7.2.4 Safeguarding traversing movement of laminating rollers

During make-ready and cleaning, the traversing movement of the laminating rollers (see Figure 39) shall be safeguarded. This safeguarding can be achieved, for example, by a speed of 5 m/min or less under hold-to-run control or interlocking guards.



Key

1	feeding belt	5	unwinding unit
2	substrate (single sheets)	6	laminated single sheets
3	laminating roller	7	delivery belt
4	foil web		

Figure 39 — Foil laminator

7.7.2.5 Safeguarding opening and closing movement of laminating rollers

The opening and closing movement of the laminating rollers shall be safeguarded where the travel path is more than 6 mm. This safeguarding can be achieved, for example, by providing hold-to-run control at a speed of 5 m/min or less, or by using interlocking guards.

7.7.2.6 Safeguarding heated lamination rollers

Where hot foil is used for lamination, guards shall be used to prevent contact of personnel with the heated lamination rollers.

7.7.2.7 Safeguarding cutting devices

Cutting devices, including rotary knives (see Figure 38), shall be safeguarded by the use of interlocking guards in accordance with 6.10.

7.7.2.8 Safeguarding feeders in laminators

The feeder for the laminating material and delivery shall be safeguarded in accordance with the requirements for press systems as specified in ISO 12648:2003, 5.8.1.

7.7.2.9 Sheeters on laminating machines

7.7.2.9.1 Safeguarding hazard points on sheeter

Hazard points on the sheeter (see Figure 38) shall be safeguarded by fixed or interlocking guards.

7.7.2.9.2 Safeguarding in-running nips

The in-running nip between pressing rollers or guide rollers and a pressing belt (see Figures 38 and 40) shall be safeguarded. This safeguarding can be achieved, for example, by fixed guards or by ensuring that the pressure rollers are held in position by their own mass and have a displacement of at least 120 mm.

On pressing belts, the in-running nip between the upper and the lower pressing belt on the infeed point shall be safeguarded. One of the following measures is considered to be adequate:

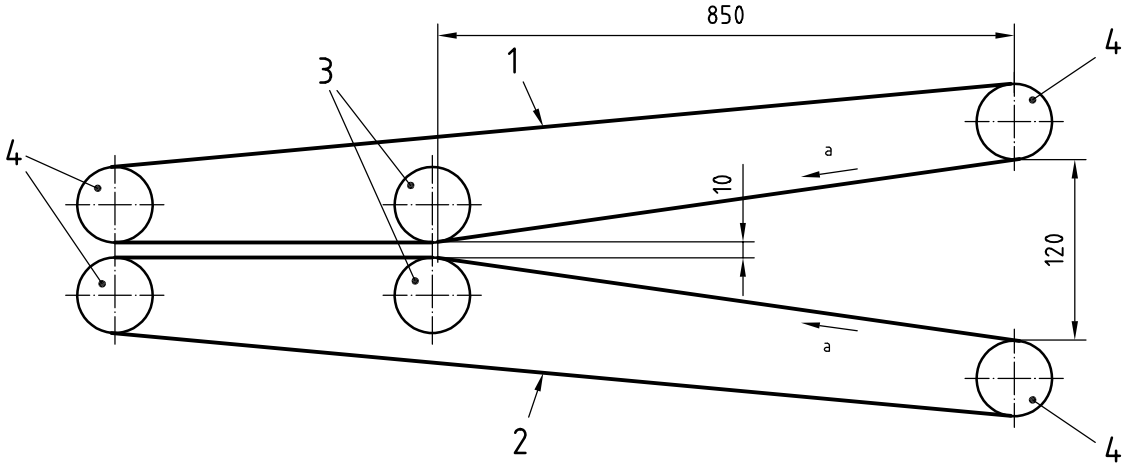
— guards;

— safety distance of 850 mm measured from the point of entrance of the pressing belt up to that point where there is a distance of at least 10 mm between the upper and the lower pressing belt, and with a pressure-belt entrance aperture of at least 120 mm (Figure 40);

or

— displacement of pressure rollers accessible in the 850 mm area adequate to ensure a clear distance of at least 120 mm between the pressing belts, with the force of the pressure rollers not exceeding 200 N.

Dimensions in millimetres



Key

1 upper pressing belt
2 lower pressing belt
3 pressure rollers
4 guide rollers
a Direction of belt.

Figure 40 — Pressing belt

7.7.2.9.3 Safeguarding crushing points

The crushing point between transport belt and package stop (see Figure 38) shall be safeguarded by fixed or interlocking guards if the maximum clamping force when closing is more than 200 N.

7.7.2.9.4 Safeguarding shearing points

Shearing points between the turning belt and the transport belts, ahead of and behind the turning belt, shall be safeguarded (see Figure 38).

7.7.2.9.5 Explosion prevention and protection

Explosion prevention and protection shall be as specified in 6.2.

7.7.2.10 Rotary tools on laminators

Rotary tools on laminators shall be safeguarded in accordance with the requirements of 6.10.

7.8 Guillotine cutters

7.8.1 Knife cycles

All knife drives and controls shall incorporate a single-cycle device. Any programmable sequence of knife and clamp motions shall be operator-initiated and shall be interlocked to safety devices. Actuation of a stop control shall override the programmed sequence and halt the hazardous motion.

At the end of each cutting cycle, the knife shall automatically stop in a fully retracted position, with the knife edge completely covered by the clamp. Failure of the knife to stop at this position shall place the machine in a condition in which it must be manually reset or restarted.

Motion of the knife in the cutting direction shall stop upon any interruption of the cutting cycle or activation of safety devices, and the knife shall return to a fully retracted position (see also 7.8.2).

Machines without interlocking guards shall monitor stopping performance (both stopping time and position) at any knife stop. Failure of the knife to stop within the designed stopping performance shall place the machine in a condition in which it must be manually reset or restarted.

This requirement is intended for machines that use guarding methods such as light curtains, rather than interlocking guards. See 7.8.6 for requirements for the use of interlocking guards on guillotine cutters.

Machines with a hydraulically-operated knife can be monitored only after an interruption of the cutting cycle.

The method used to monitor stopping performance shall be capable of determining whether the knife stops within the specified stopping criteria, and if not, shall place the machine in a condition in which it must be manually reset or restarted.

Machines incorporating motor/flywheel/clutch knife drives shall be equipped with an anti-repeat device. Examples of mechanical devices to accomplish this include safety bolts, latches, safety clutches, cut out/flat spot in main drive gear, etc.

The cutting edge of the knife shall not extend beyond the clamp during the clamping and the unclamping portions of the cutting cycle. The clamping and unclamping portions of the cutting cycle are those times when the clamp is in motion. Once the clamp has come to rest on the product to be cut, the knife will pass beyond the clamp to complete the cutting portion of the cutting cycle. This is the only time during which the knife is permitted to extend beyond the clamp.

7.8.2 Interruption of cutting cycles

In machines with knife drives utilizing stored energy, the knife shall stop in the event of loss of any power source affecting the knife drive (electrical, hydraulic, pneumatic, etc.).

Machines with a crank-driven knife movement without the possibility of reversing its movement shall be so designed that the clamp is not allowed to retract to its starting position automatically after the cutting cycle has been interrupted.

Machines with a hydraulically operated knife movement shall be so designed that, in the event of the cycle being interrupted, knife and clamp automatically retract to their starting position.

7.8.3 Clamping

7.8.3.1 Clamping pressure

During manual loading, positioning and unloading of material by an operator, high-pressure clamping shall be prohibited through design. Low-pressure or manual clamping is permissible during positioning of the material within the cutting zone. High-pressure clamping shall be possible only while machine operation is under two-hand control or during an automatic cut sequence.

During loading, unloading or positioning by a gripper, high-pressure clamping is allowed.

In machines equipped with power-driven clamps, the interruption of any function which incorporates high-pressure clamping shall cause all clamping motion in the downward direction to stop.

NOTE Power failure is considered as an interruption of function.

7.8.3.2 Low-pressure clamping

The clamping force of a power-driven clamp during low-pressure clamping shall not exceed 300 N on cutting machines of up to and including 1,6 m wide, or 500 N force on cutting machines greater than 1,6 m wide.

The clamping force shall be measured using a spring-ring combination tool, which is designed so that when the specified force is placed on the spring, the height of the compressed spring is greater than the height of the ring.

7.8.3.3 Low-pressure and manual clamping

Low-pressure clamping may be obtained by the use of either a manual control, or a power-driven clamping device.

Low-pressure power-driven clamping, as defined in 3.47, may be obtained by means of an operator-initiated control, which is separate from the control used for high pressure clamping.

The control for power-driven low-pressure clamping shall not be a latching type. Upon release of the control, the clamp shall immediately return to its retracted position.

For manual clamping controls, release of the clamp actuator shall cause the clamp to remain stationary or return to the retracted position.

During knife servicing, the clamp may be latched by a separate control.

7.8.3.4 Clamps

Cut-outs, lips or holes on the side of the clamp facing the knife shall be safeguarded by the use of covers or plugs.

7.8.3.5 Automatic clamp operation

Any programmable system sequence of clamp motion shall be operator-initiated and shall be interlocked to safety devices. Actuation of a stop control shall override the programmed sequence and halt the hazardous motion.

7.8.4 Failure of transmission components

A failure of the components of a knife-carrier holding device or clamp shall not result in hazardous movement of the knife or clamp. This requirement is satisfied, for example, by providing mechanical or other means to prevent the knife or clamp from falling.

7.8.5 Backgauge

Any power-driven backgauge shall be interlocked with the knife and the clamp controls to prevent forward backgauge movement during high-pressure clamping and cutting.

If a programmable sequence is stopped as the result of the activation of a safety device, hazardous movement of the backgauge shall also stop.

Power-up shall not result in backgauge motion.

Actuation of a stop control shall override the programmed sequence and shall halt hazardous motion.

7.8.5.1 Guarding the rear of machines

Guards and/or other safety devices shall prevent access to knife, clamp and backgauge hazard points on guillotines from the rear of the machine.

7.8.5.2 Automatic backgauge travel

Where the backgauge can travel automatically, the hazard point between the back edge of the clamp and the backgauge shall be safeguarded by one or more of the following measures:

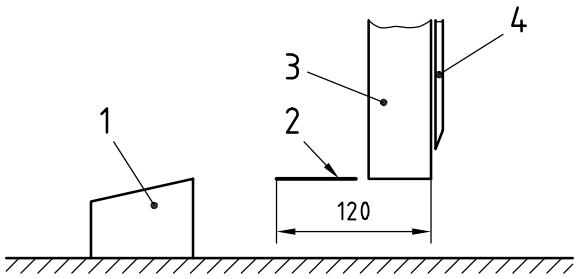
— active ESPDs;

— automatic travel limited to up to 25 mm before the clamp, with further travel possible only under hold-to-run control with a maximum speed of 3 m/min;

— protection against reaching below the clamp by providing a guard which makes the hazard point between guard and backgauge at least 120 mm behind the front edge of the clamp (see Figure 41);

— hold-to-run control.

Dimensions in millimetres



Key
1 backgauge
2 guard
3 clamp
4 knife

Figure 41 — Protection against reaching below the clamp

7.8.5.3 Backgauge spindle

Access to any part of the backgauge spindle from the top shall be prevented.

Access to the spindle from the underside of the rear table shall be prevented by fixed guards, unless access is prevented by the position of the spindle. An example of safeguarding this point would be the use of a guard that can be moved back and forth (like a window blind) covering the spindle on the rear table.

7.8.6 Guarding front (operating side) of a guillotine

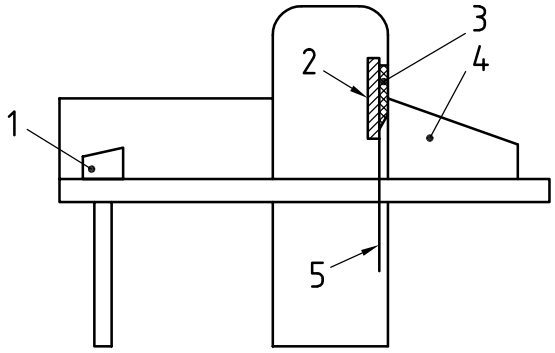
ESPDs protecting against incidental contact with the knife and the clamp shall be active during that portion of the cutting cycle and/or high-pressure clamping during which hazardous motion is occurring or is possible.

Access to knife and clamp hazard points shall be prevented from the front (operating) side of the machine by one of the following means, which shall be incorporated with the use of two-hand control:

— an interlocking guard in accordance with ISO 14119:1998 and ISO 14120 without side openings; any openings on the front side of the guard shall be designed in accordance with ISO 13852:1996 (see Figure 42);

— active ESPDs extending to the machine table without side openings in the guard. The front table shall extend at least 30 mm beyond the safety distance (outermost beam) of the ESPD. Positioning of the ESPD shall be in accordance with Figure 43;

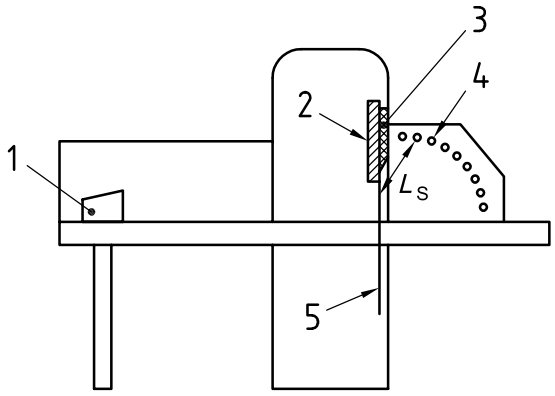
— active ESPDs that do not extend to the machine table. The front table shall extend at least 30 mm beyond the safety distance (outermost beam) of the ESPD. Positioning of the ESPD shall be in accordance with Figures 44, 45, 46, 47 and 48.



Key

1 backgauge
2 clamp
3 knife
4 interlocking guard
5 cutting plane

Figure 42 — Guillotine (side view) with interlocking guard on the front side

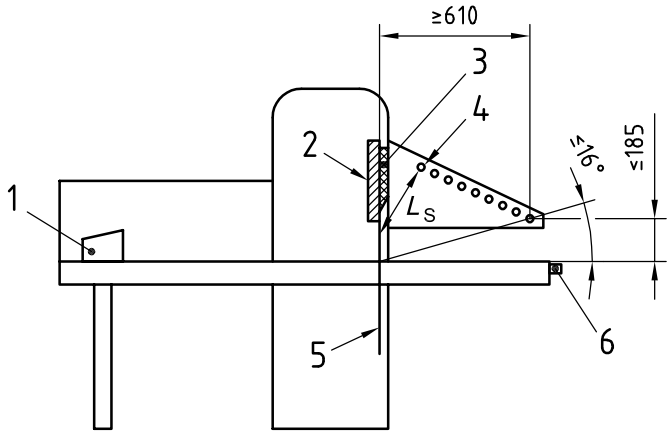


Key

1 backgauge
2 clamp
3 knife
4 ESPD
5 cutting plane
L_S safety distance

Figure 43 — Guillotine (side view) with ESPDs

Dimensions in millimetres



Key

1 backgauge
2 clamp
3 knife
4 beam of front ESPD
5 cutting plane
6 two-hand-control
L_S safety distance

Figure 44 — Guillotine (side view) with ESPDs and two-hand control

The minimum distance of the ESPD is calculated as shown in Equation (1), based on a resolution capability of equal to or less than 40 mm and measured when projected on the centre point between the machine table and the lower edge of the clamp (see Figures 43 and 44).

$$L_S = (2\,000 \times t) + [8 \times (d_R - 14)] \quad (1)$$

where

t is the total response time, in seconds, of the machine;

d_R is the resolution (minimum object detection) capability, in millimetres, of the ESPD;

L_S is the safety distance, in millimetres.

Equation (2) applies to all safety distances, L_S, up to and including 500 mm, with a minimum permissible distance of 250 mm. If L_S, when calculated by this formula, results in a distance of more than 500 mm, the distance may be reduced using the following formula, while maintaining a minimum distance of 500 mm:

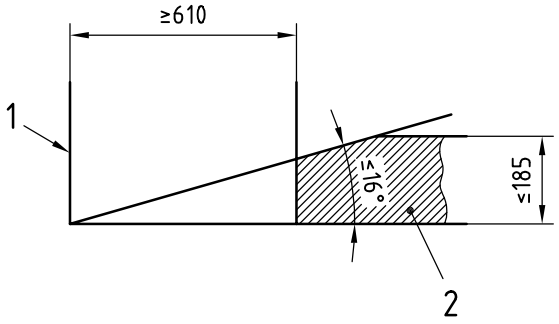
$$L_S = (1\,600 \times t) + [8 \times (d_R - 14)] \quad (2)$$

where the symbols are the same as for Equation (1)

The maximum distance of the ESPD beams, measured between the centres of the optical systems, shall not exceed 55 mm for a resolution capability of equal to or less than 40 mm.

The outermost beam of the ESPD shall be arranged on the side of the maximum opening angle of 16°, but the distance to the machine table shall not be more than 185 mm (see Figure 44). The minimum distance to the cutting plane shall be 610 mm (see Figure 45).

Dimensions in millimetres



Key

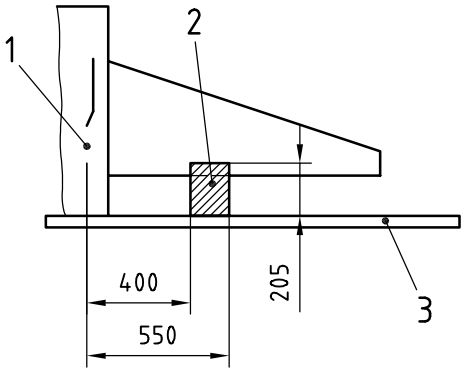
1 cutting plane

2 area admissible for outermost beam of ESPD

Figure 45 — Arrangement of the outermost beam of the ESPD for clamp openings of less than or equal to185 mm

On guillotines with an automatic cutting sequence, an additional ESPD shall be provided at a distance of between 400 mm and 550 mm from the cutting plane and at a height of between 0 mm and 205 mm from the table surface (see Figure 46). The first cutting cycle shall be started by two-hand control. Following cutting cycles are started automatically. During the automatic cutting sequence, the backgauge shall be allowed to travel only toward the front (direction of the clamp).

Dimensions in millimetres



Key

1 cutting plane

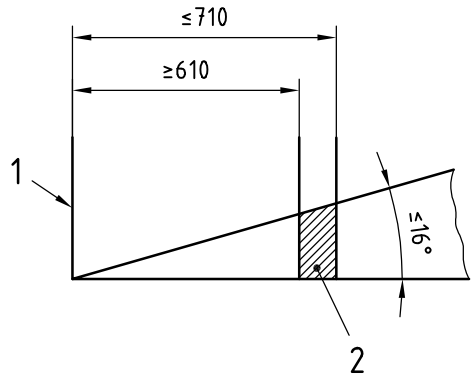
2 area admissible for additional ESPD

3 front of table

Figure 46 — Position of additional ESPD

As an exception, on machines with a usable pile height of more than 185 mm, the outermost beam of the ESPD may be arranged at a maximum angle of 16° to the lowest point of the cutting plane and at a distance of 610 mm minimum and 710 mm maximum from the lowest point of the cutting plane (see Figure 47).

Dimensions in millimetres



Key

1 cutting plane

2 area admissible for outermost beam of ESPD

Figure 47 — Arrangement of the outermost beam of the ESPD for clamp openings of greater than 185 mm

On guillotines with openings of equal to or less than 165 mm between the outer housing of the ESPD and machine table, the safety distance depicted in Figure 48 shall be 550 mm, as specified by Equation (3), and shall be observed between the lowest point of the cutting plane and the outer edge of the housing, or guards shall be provided. Otherwise, a safety distance of $\geqslant$ 850 mm shall be required.

$$L_S = L_A + L_B \tag{3}$$

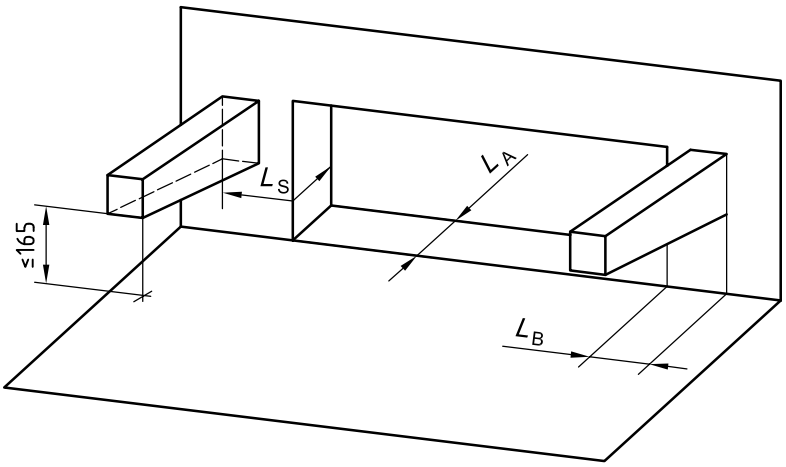
where

L_S is the safety distance, in millimetres;

L_A is the distance, in millimetres, from the lower edge of cutting plane to the outer plane of the machine frame;

L_B is the distance, in millimetres, from the outer edge of the ESPD to the inner edge of the machine frame.

Dimensions in millimetres



Key

L_S safety distance

L_A distance from the lower edge of cutting plane to outer plane of machine frame

L_B distance from the outer edge of the ESPD to the inner edge of the machine frame

Figure 48 — Safety distance

7.8.7 Pile-support angles (jogging blocks)

For cutting strips, a pile-support angle (jogging block) shall be provided (see Figure 49 for an example of a pile support angle).

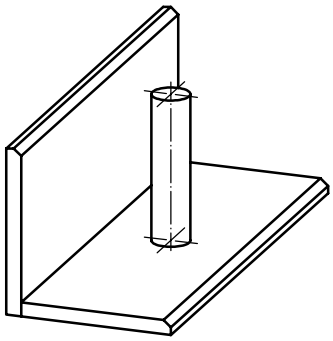


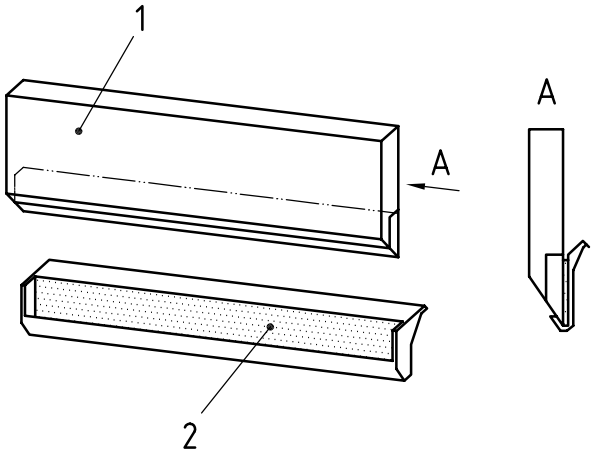
Figure 49 — Pile-support angle

7.8.8 Knife changing and adjustment

Changing and adjusting the knife shall be performed only by an authorized person (see 3.5).

Means shall be provided to install or remove the knife without necessitating that the knife handler contact the cutting edge of the knife. When changing knives, the full cutting edge of the knife shall be covered by a holding device fitted to the knife (see Figure 50).

When changing or adjusting knives, both the knife blade and hazardous movements shall be safeguarded.



Key

1 knife blade

2 front view of holding device covering the cutting edge of the knife blade

Figure 50 — Protection of knife blade using holding device

Knife descent shall be possible only by one of the following:

— two-hand controls and safeguarding by ESPDs;

— two-hand controls with the interlocking guard closed;

— mechanical means to engage the clutch.

In the United States, this method is considered to be a maintenance task, and lockout/tagout procedures as defined by OSHA shall apply (see The Control of Hazardous Energy Sources (Lockout/Tagout) OSHA 29CFR1910.147[42], or ANSI Z244.1[1]).

7.8.9 Hazards from integral feeding and delivery equipment on guillotines

7.8.9.1 Crushing point at gripper

The crushing point at the gripper on the feeding table shall be safeguarded.

Examples of safeguarding this area using photoelectric devices include the following measures:

— functional photoelectric device detecting the upper edge of the paper pile;

— functional photoelectric device detecting the front edge of the paper pile;

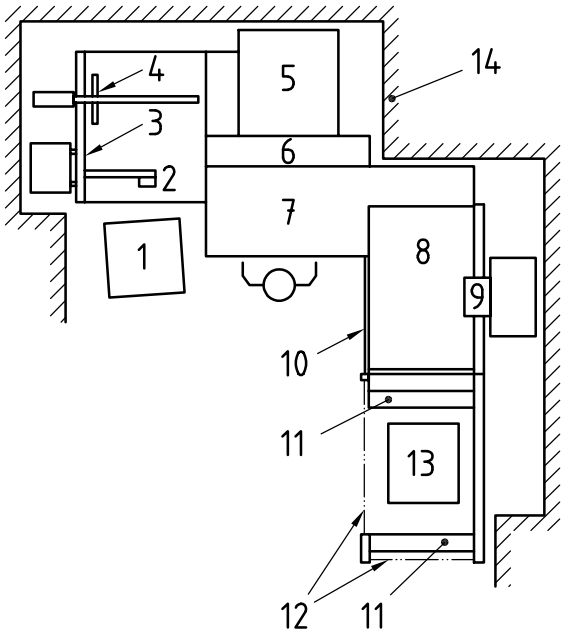
— functional photoelectric device detecting the presence of paper in the gripper.

If photoelectric devices are used to safeguard this area, the gripper shall be allowed to close only after all photoelectric devices have been operated in the given sequence.

7.8.9.2 Hazard point between feeding table and guillotine

The hazard point between the feeding table and the guillotine caused by the vertical movement shall be safeguarded (see Figure 51).

Safeguarding can be achieved, for example, by providing a trip device.



Key

1	paper pile	6	guillotine	11	aligning gauges
2	gripper	7	front table	12	ESPD
3	feeding table	8	delivery table	13	pallet
4	pusher	9	hold-down	14	fence guard
5	Rear table	10	guard		

Figure 51 — Loading and unloading (feeding and delivery) equipment

7.8.9.3 Hazard point between pusher and table

The hazard point between the pusher on the feeding table and feeding table or rear table of the machine shall be safeguarded.

Safeguarding can be achieved, for example, by limiting the distance between the lower edge of the pusher and the table to no more than 6 mm.

The safety distance between back of the pusher and fixed machine parts shall be at least 100 mm.

7.8.9.4 Hazard point between delivery table and front table

The hazard point between delivery table and front table of the guillotine caused by the horizontal movement shall be safeguarded.

Safeguarding can be achieved, for example, by providing guards or trip bars.

7.8.9.5 Hazard point between delivery table and fixed parts

The hazard point between delivery table and fixed machine parts caused by vertical movement of the table shall be safeguarded.

Safeguarding can be achieved, for example, by providing trip devices.

7.8.9.6 Hazard points between delivery table and floor or pallet

The hazard points between the delivery table and the floor or pallet shall be safeguarded.

This can be achieved, for example, if all of the following requirements are met:

— access from the back of the equipment is prevented by guards in accordance with ISO 13852:1996 (see Figure 51);

— guards are provided on the front (see Figure 51);

— there are two ESPDs safeguarding the delivery area (see Figure 51);

— an emergency stop device is provided in the delivery area.

7.8.9.7 Hazard points between delivery table and aligning gauge

The hazard points between the delivery table and the aligning gauge shall be safeguarded.

This can be achieved, for example, by providing an ESPD or a trip device on the delivery table.

7.8.9.8 Hazard point between hold-down and delivery table

The hazard point between the hold-down and the delivery table shall be safeguarded.

This can be achieved, for example, by one of the following:

— hold-down devices are fitted at a minimum distance of 850 mm from the edge of the delivery table;

— the maximum force of the hold-down is limited to 500 N.

7.9 Trimmers

The hazard zone at the knives shall be guarded on the feeding and delivery sides in accordance with Clause 5. Fixed guards, movable guards, or other means of guarding may be used depending upon the design. Emergency stop devices shall be provided at each operating position as specified in 10.2.3.1.2.

For manually fed machines using a conveyor that puts the product into the cutting zone, feeding and delivery openings shall be designed in accordance with ISO 13852:1996.

On the feeding and delivery side, a safety distance of 550 mm to the nearest hazard point is acceptable if the trimmer is mounted in-line and manual take-off is excluded (see Figure 52).

Dimensions in millimetres

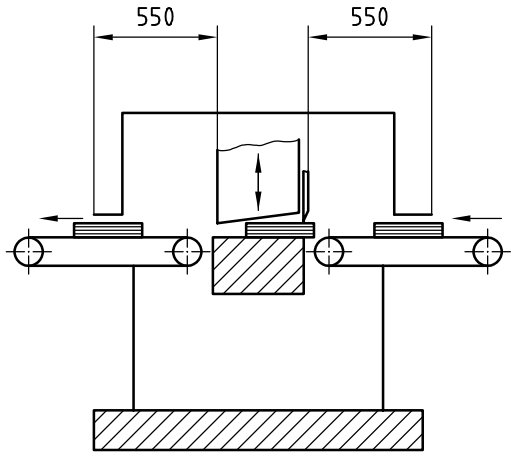


Figure 52 — Trimmer with automatic feed

Where material is fed manually in to the hazard zone by the operator, the hazard points on the operator side of the trimmer shall be safeguarded by a two-hand control located on the front edge of the feed table. The requirements for two-hand controls as specified in 10.5 shall be met. Feeding apertures on the operator side of the trimmer shall be as small as possible, consistent with the size of the format cut.

When the interlocking guard is opened, it shall be possible to start the trimmer only by means of two-hand controls. Operation of the control with the guard open shall allow only a single stroke of the knives, regardless of how long the control is held. The means to control a single stroke of the knife shall comply with category 1 of ISO 13849-1:1999.

Knife covers to be applied for knife changing and transport of knives shall be supplied with the machine.

Openings and safety distances on waste discharge chutes shall satisfy ISO 13852:1996.

For trimmers with an automatic vacuum system to remove paper cuttings or an automatic exhaust system, the system shall comply with the requirements for explosion prevention and protection as specified in 6.2.

7.10 Onserters/attaching machines

The exception specified in 5.5.1.2 may be applied to feeder guards for onserters/attaching machines, if necessary.

7.11 Overcover/protective wrapper gluers

The exception specified in 5.5.1.2 may be applied to feeder guards for overcover/protective wrapper gluers, if necessary.

8 Release from hazardous situation

Means shall be provided for the release of persons in the event of entrapment.

NOTE Release mechanisms may include

— provisions for moving some elements by hand or with the use of a tool;

— reversing the direction of the machine;

— opening the entrapment space.

Where means for manual movement are provided, indication of the direction of rotation should be provided near such means to assist in the release of persons.

9 Control zones

A binding and finishing system can consist of a multitude of machines and control systems. These may be divided into one or more subsystems creating “control zones” governing machine motion or non-motion for separate portions of the complete binding and finishing system. Small control zones may be used for independent operation. In other cases, these control zones may be combined to form a larger control zone.

The motion-control stations within each control zone shall affect the hazardous motion of all equipment within that control zone. When multiple control zones are combined into a larger control zone, all motion-control stations within the larger control zone shall be able to control all hazardous motion in that zone.

EXCEPTION: Some auxiliary equipment, although part of the binding and finishing system, does not affect motion of other portions of the system. The function or motion of this auxiliary equipment is affected only by its own motion control station(s) and/or the motion of specific other equipment within the system. Motion control stations on this auxiliary equipment shall not cause motion of any other machine within the system.

Examples of such auxiliary equipment include stream feeders, hopper loaders, ink jet devices, labelling machines, card blowers, etc.

Any motion-control station that can initiate motion shall also have a stop function to stop that same motion.

Portable motion-control stations shall function in accordance with 11.2.2. Wireless motion-control stations shall function in accordance with 11.1.2.

If some portion of the control zone is not currently being used, the stop/safe and guard interlock functions of that unused portion shall not be disabled.

EXCEPTION: Guard interlocks on the unused portion of the control zone may be disabled, but only if

— the unused portion of the machine is disengaged;

— all energy sources are locked, blocked or otherwise effectively controlled;

— after opening the guard, the hazardous area of another zone cannot be reached.

If the motion-control station for the unused portion of the control zone can initiate motion, the stop/safe function shall not be disabled.

If portions of the system are being used independently, thus creating separate control zones, the motion-control stations for each control zone shall be independent of any other.

For example, for a system that contains a gatherer, binder, trimmer, conveyor, and polywrapper, the trimmer, conveyor and polywrapper may be temporarily used together as a small independent system. This will create two independent control zones: one consisting of the trimmer, conveyor and polywrapper (control zone A); the other consisting of the gatherer and binder (control zone B). In this case

— the motion-control station of each machine within control zone A affects motion of all machines within control zone A;

— the motion-control station of each machine within control zone B affects motion of all machines within control zone B;

— the motion-control station of each machine within control zone A does not affect motion of any machine within control zone B and vice versa.

Generally, the purpose of zone configuration is to avoid the situation where pushing an emergency stop in one zone stops motion in all zones. However, it is possible to configure the system such that an emergency stop control would affect all motion zones of the system (see 10.2.3.1.1).

Each control zone shall have a safety signalling system as specified in Clause 14, if the overall view of the personnel by the operator is obstructed or communication between operating personnel is difficult within that control zone. Each control zone shall also have a motion-control station as described in Clause 11.

10 Controls

10.1 General

This subclause addresses specific controls, which shall meet the criteria put forth in this International Standard. The binding and finishing system may have other controls not specified in this International Standard, but such additional controls shall not interfere with the function of those specified, nor shall their function be liable to be confused with the function of those specified.

10.2 Manual control devices

The requirements in this subclause apply only to the system drives that cause hazardous motion.

Unless otherwise specified by this International Standard, the manual controls specified by this International Standard shall be flush. An exception to this requirement is the controls on touchpads, which may be slightly raised or slightly recessed to enhance tactile recognition.

Operating elements of manual controls for starting hazardous movements shall be safeguarded against unintended actuation.

Manual control devices shall be designed and located so that

— they are clearly visible and identifiable, and appropriately marked where necessary;

— they can be safely operated without hesitation or loss of time and without ambiguity (e.g. by the adoption of a standard layout of controls to reduce the possibility of error when an operator changes from one machine to another of similar type having the same pattern of operation);

— their location (for pushbuttons) and their movement (for levers and handwheels) are consistent with their effect;

— their operation cannot cause additional risk.

Where a control is designed and constructed to perform several different actions, the action to be performed shall be clearly displayed and subject to confirmation where necessary.

Controls shall be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking into account ergonomic principles. Constraints due to the necessary or anticipated use of personal-protection equipment (such as footwear, gloves, etc.) by personnel during the operation of controls shall be taken into account.

A stop control shall be placed near each start control. Where the start/stop function is performed by means of a hold-to-run control, a separate stop control shall be provided if there is a risk that the hold-to-run control will fail to stop the hazardous motion when it is released.

Controls shall be located outside the hazard zones, except for certain controls such as emergency stop, teach pendant, etc. which, of necessity, are located within a hazard zone.

As far as possible, controls (especially start controls) shall be located so that the operator can see the controlled elements when actuating them.

Controls shall be designed or protected so that their effect, where a risk is involved, cannot occur without intentional operation.

Control switches for starting and stopping machine motion and their operating elements shall satisfy the requirements of IEC 60204-1:2000.

For emergency stopping devices, the requirements of ISO 13850 and IEC 60204-1:2000 shall be satisfied.

If symbology is used, the symbol shall be as defined in ISO 15847.

10.2.1 Types of manual control devices

10.2.1.1 Flush control devices

Flush controls shall be flush with their respective collars or with their adjacent surfaces.

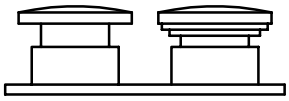
10.2.1.2 Guarded control devices

Guarded control devices shall utilize raised collars or borders that extend beyond the surface of the control to protect the control from inadvertent actuation.

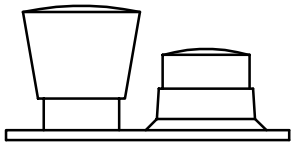
10.2.1.3 Mushroom-head and palm-type pushbuttons

Mushroom-head and palm-type pushbuttons shall protrude at least 9 mm beyond their respective collars. They shall also protrude above the actuators of adjacent unguarded, non-stop function controls. The head of the mushroom-head or palm-type pushbuttons shall be at least 25 % larger than the surrounding pushbuttons, and have a minimum diameter of 28 mm (see Figure 53).

NOTE The intent is to make these pushbuttons more prominent than surrounding pushbuttons.



a) Mushroom-head pushbuttons



b) Palm-type pushbuttons

Figure 53 — Types of emergency stop pushbuttons

10.2.2 Colours for manual control devices

Colours used for control devices shall be as specified in Table 2.

Although Table 2 indicates both required and preferred implementations, for the purpose of promoting safety through uniformity in the industry manufacturers are encouraged to use the preferred colours for the control as specified in Table 2.

The colour of the controls, illuminated or non-illuminated, shall be as specified in IEC 60204-1:2000, and shall be uniform throughout the binding and finishing system. If illuminated controls are used in conjunction with personnel warning lights, they shall be distinct in design and/or location so as not to be confused with personnel warning lights.

Table 2 — Colours for manual control devices

Control	Required	Preferred	Remarks
Emergency stop	red on yellow background	—	—
Stop/Safe	grey, black, white red, if used as emergency stop	red	red required in U.S.
Other motion stop	grey, black, white or red	red	red required in U.S.
Run	black, white, grey, or green	black	—
Forward inch	black, white or grey	grey	—
Reverse inch	black, white or grey	black	—
Forward/Reverse inch	black, white or grey	black	used with a selector switch
Ready	black, white or grey	black	—
Reset	blue, black, white or grey	blue	—
Faster	black, white or grey	grey	—
Slower	black, white or grey	white	—
Other motion-initiating controls	black, white or grey	—	—

10.2.3 Functions, operations and mechanical specifications of manual control devices

10.2.3.1 Emergency stop

Emergency stops shall satisfy the requirements of ISO 13850 and IEC 60204-1:2000.

10.2.3.1.1 Emergency stop function

The emergency stop function shall be able to be initiated by a single human motion.

The emergency stop function shall override all other functions in all operating modes of the machine but shall not disable any system designed to release trapped persons as defined in Clause 8. It shall not be possible for any start command (intended, unintended or unexpected) to be effectuated until the emergency stop function has been manually reset.

The emergency stop function shall be designed so that after the activation of the emergency stop control

— all hazardous motion of all devices in the system is stopped as quickly as possible, without creating an additional hazard;

or

— all hazardous motion of the device(s) in the stop-button control zone is stopped as quickly as possible, without creating an additional hazard. In this case, it shall be readily apparent through labelling, marking, warning lights or other means (including training) which devices will be affected by the actuation of the emergency stop function.

The emergency stop function shall not be bypassed.

The emergency stop function shall not be used as a substitute for safeguarding measures and other safety-related devices, but should be designed for use as a backup measure.

The emergency stop function shall not impair the effectiveness of protective devices or of devices with other safety-related functions. For this purpose, it may be necessary to ensure the continuing operation of auxiliary equipment such as braking devices.

10.2.3.1.2 Emergency stop devices

Emergency stop devices shall be designed in accordance with IEC 60204-1:2000, 9.2.5.4.2, either as a category 0 stop or as a category 1 stop.

EXCEPTION: If a.c. drives are used, the activation of an emergency stop control device may cause the drive to make a category 2 stop, as defined in IEC 60204-1:2000, 9.2.2, if pulse blocking in the inverter and disconnection of the power to the control circuitry are separate functions, in accordance with category 3 of ISO 13849-1:1999.

At the present time, the *U.S. Electrical Standard for Industrial Machinery* (NFPA 79)[40] permits only category 0 or category 1 for emergency stops in the United States.

Every machine shall have at least one category 0 stop. This may be satisfied by the requirements of IEC 60204-1:2000, 5.3.2.

Where a category 0 stop is used for the emergency stop function, it shall have only hard-wired electromechanical components. In addition, its operation shall not depend on electronic logic (hardware or software) or the transmission of commands over a communications network or link.

Where a category 1 stop is used for the emergency stop function, ultimate removal of power to the machine actuators shall be ensured and shall be by means of electromechanical components.

The emergency stop device shall be designed for easy actuation by the operator and others who may need to operate it.

Types of controls that may be used include

— mushroom-type or palm-type;

— wires, ropes, bars;

— handles;

— in specific applications, foot pedals without protective cover.

Keypads and touch screens shall not be used for emergency stop functions.

Emergency stop devices shall be provided on each machine unit, and at all operating positions in control zones where hazardous motion may exist (see 11.1.1).

Emergency stop devices shall be located on or within arm's reach of each motion-control station and operating position, and at other locations where the initiation of an emergency stop may be required. The emergency stop devices shall be positioned for easy access and for non-hazardous operation by the operator and others who may need to operate them.

The emergency stop device shall apply the principle of positive mechanical action (see ISO 12100-2:2003, 4.5).

An example of the application of this principle is an emergency stop device employing electrical contacts having positive opening operations. Positive opening operation of a contact element is the achievement of contact separation as the direct result of a specified movement of the switch actuator through non-resilient members (e.g. not dependent upon springs).

Once the emergency stop command has been generated as a result of actuation of the emergency stop device, the emergency stop command shall be maintained by engagement or latching-in of the actuating means. The emergency stop command shall be maintained until the emergency stop device is manually reset (unlatched). It shall not be possible for the control device to engage without generating the stop command.

In case of a failure in the emergency stop device (including the engagement mechanism), generation of the stop command shall have priority over the engagement means.

Actuation of an emergency stop control does not place the machine in the safe condition, unless it meets the criteria of a stop/safe function. Therefore, unless a stop/safe control has been activated, personnel warning lights or area warning lights shall not indicate a safe condition.

Resetting the emergency stop device shall not by itself generate a restart command.

It shall not be possible to restart the machine until all emergency stop devices that have been actuated are reset. The operator shall go through the normal starting sequence in order to initiate machine motion.

If a pushbutton is used as an emergency stop control, it shall comply with the provisions of IEC 60204-1:2000, 9.4. The use of an emergency stop control other than a pushbutton does not meet the requirements for the safe or safe-ready functions.

If an emergency stop device other than a pushbutton is used, its function shall be clearly identified by colour and labelling and its function shall comply with that specified in this subclause.

If using wires or ropes as emergency stop controls, consideration shall be given to the following:

— the amount of deflection necessary for generating the emergency stop command;

— the maximum deflection possible;

— the minimum clearance between the wire/rope and the nearest adjacent object;

— the force to be applied to the wire/rope (at maximum deflection) in order to engage the emergency stop device;

— making such wires/ropes visible for operators (e.g. by use of marker flags).

An emergency stop command shall be generated automatically in the event of disengagement, breakage or slack/sag in the wire/rope.

The reset mechanism for the emergency stop device should be placed so that the whole length of the wire or rope is visible from the location of the reset mechanism.

10.2.3.1.3 Emergency stop and auxiliary devices

For auxiliary devices built into a binding and finishing system that require an emergency stop device according to this International Standard, the emergency stop buttons on the binding and finishing system shall function in accordance with the requirements of Clause 9.

The emergency stop function shall be designed so that after the actuation of the emergency stop control

— all hazardous motion of all devices in the system is stopped as quickly as possible, without creating an additional hazard;

or

— all hazardous motion of the device(s) in the stop-button control zone is stopped as quickly as possible, without creating an additional hazard. In this case, it shall be readily apparent through labelling, marking,

warning lights or other means (including training) which devices will be affected by the actuation of the emergency stop function.

10.2.3.2 Stop/safe pushbutton

This International Standard does not require that a stop/safe pushbutton be provided. However, if provided, it shall meet the provisions of this subclause.

The stop/safe function is required in the United States and may be required in other countries.

Stop/safe functions shall be controlled only by the use of a stop/safe pushbutton as specified in this International Standard. Keypads and touch screens shall not be used for stop/safe functions.

The stop/safe pushbutton shall be an extended-head maintained-contact pushbutton which, when depressed, latches in the depressed position. In addition, it shall not be possible for the stop/safe control to mechanically engage without generating the stop command.

A stop/safe control shall be clearly distinguishable from an emergency stop control, if separate controls are used for each function. Stop/safe controls not designed to function also as an emergency stop control shall not have a yellow background.

Releasing the stop/safe pushbutton shall place the machine in the ready condition.

Single-point failure of the latching component shall not result in the machine automatically reverting to the ready condition.

The latching mechanism shall be designed such that a person is prevented from unintentionally releasing the pushbutton to the ready condition.

This pushbutton may be designed to be used also as an emergency stop control. If so used, it shall comply with the requirements for both the stop/safe and emergency stop functions and controls as defined in this International Standard, shall be a mushroom-head or palm-type pushbutton, and shall have a yellow background.

All stop/safe pushbuttons shall be operational and shall not be bypassed.

The stop/safe function shall be designed so that, after actuation of the stop/safe pushbutton, all hazardous motion of the machine(s) in that control zone is stopped without creating an additional hazard. When the pushbutton is latched in the depressed position, machine motion is prevented and the machine is placed in the safe condition.

The stop/safe function shall override all other motion functions, except the emergency stop function, and shall not be bypassed.

The stop/safe function shall not impair the effectiveness of protective devices or of devices with other safety-related functions.

For this purpose, it may be necessary to ensure the continuing operation of auxiliary equipment such as clutches or braking devices.

After a stop/safe pushbutton is released, the machine shall not automatically start. The operator shall go through the normal starting sequence in order to initiate machine motion.

10.2.3.3 Other motion stop control devices

If a manual control device is used to initiate a stop function (other than emergency stop or stop/safe), it shall be a momentary-contact control.

Activating a stop control as defined in this subclause shall stop hazardous machine motion at least in the motion zone, or part of the motion zone, with which it is associated. When the stop is complete, the motion zone affected shall be in the fault or ready condition.

This stop control shall not be used for the stop/safe or emergency stop functions.

10.2.3.4 Run control device

The run control device shall be a momentary-contact control.

Activating a run control initiates continuous (maintained run) machine motion as described in 10.3.2. A binding and finishing system including smaller subsystem components may run at zero speed even though the binding and finishing system is in the run condition, as long as these components do not pose a hazard.

NOTE A binding and finishing system may have any number of run controls, labelled differently, allowing the machine to run at different particular or set speeds, including speeds which are slower than production speed.

See Clause 14 and Annex E for the requirements of a warning period in systems using either a personnel warning-light signalling system or an area warning-light signalling system.

Once motion is established, the machine shall run continuously at the speed set by the speed-setting device.

10.2.3.5 Inch control (jog) device

10.2.3.5.1 Forward inch-control device

The forward inch device shall be a momentary-contact control that functions as described in 10.3.1, and moves the binding and finishing system in a forward direction.

The control shall be designed and mounted so as to minimize inadvertent operation. For example, this can be achieved by the use of a double-push activation as described in 10.3.1 b).

During the permissive period, the machine shall respond promptly to any inch control and shall continue to operate at inching speed as long as the control is depressed, or until the displacement limitation specified in 5.6 is reached. The machine shall stop when the control is released.

Motion with an inch-control device while one or more guard(s) is/are open shall be permitted in accordance with 5.5.1 and 5.6.

The inch-control device may also be used to activate the reset function, which shall reset the machine and initiate a warning period as specified in Clause 14 and Annex E.

10.2.3.5.2 Reverse inch-control device

A reverse inch control shall be a momentary-contact guarded control. The control shall be designed and mounted so as to minimize inadvertent operation.

A reverse inch control initiates binding and finishing system motion at inch speed in a reverse direction as specified in 10.3.1.

10.2.3.5.3 Forward/reverse inch control

A forward/reverse inch control shall be a single device incorporating a two-position selector and a momentary-contact control, which initiates binding and finishing system motion as defined in 10.3.1.

With the selector switch in the forward position, the inch control shall function in accordance with 10.2.3.5.1. With the selector switch in the reverse position, the inch control shall function in accordance with 10.2.3.5.2.

10.2.3.6 Reset

The control used for the reset function shall be a momentary-contact control that resets a tripped circuit.

It is permitted to use the inch control to activate the reset function. In this case, the colour of the control conforms with the requirements for the inch control.

Motion controls shall not be enabled until all faults are cleared, all interlocks are made and all stop/safe pushbuttons are released. The reset function shall not automatically enable motion controls unless these conditions have been satisfied.

If these conditions have been satisfied, activating the reset function shall place the machine in the ready condition. Activating a reset control shall not initiate a warning period or machine motion.

See 10.2.3.5.1 for use of an inch control to accomplish the reset function.

10.2.3.7 Faster control

A faster control shall be a momentary-contact control.

Depressing a faster control while the machine is in the run mode increases machine speed.

The faster control may also be used in conjunction with the inch control to initiate machine motion as defined in 10.3.2 at a minimum continuous run speed.

10.2.3.8 Slower control

A slower control shall be a momentary contact control that decreases the speed of the binding and finishing system.

The slower control may also be used in conjunction with the inch control to initiate machine motion as defined in 10.3.2 at a minimum continuous run speed.

10.2.3.9 Other motion-initiating controls

Other controls used to initiate motion of the main drive shall be momentary-contact controls.

10.3 Initiating machine motion

10.3.1 Initiating machine motion at inch speed

Machine motion at inch speed may be initiated for a machine at standstill by either of the following methods:

a) activating the inch or reverse inch control through the warning period;

b) sequential activation of the same inch or reverse inch control.

Regardless of which implementation is chosen, it must be uniform throughout the binding and finishing system.

10.3.2 Initiating continuous machine motion (run)

Continuous machine motion may be initiated by any one of the following methods:

a) double-push activation of the run-control device;

b) activation of the run, the slower or the faster control with the inch control at the same motion-control station while the machine is in the ready condition will initiate a warning period, followed by machine motion at a speed set by a speed setting device;

c) activation of the run, the slower or the faster device with the inch device at the same motion-control station while the machine is in the permissive period initiates machine motion at a speed set by a speed setting device without going through an additional warning period if all hazards are protected.

Regardless of which implementation is chosen, it shall be uniform throughout the binding and finishing system.

10.4 Hold-to-run controls

A hold-to-run control shall require continuous actuation of the control device(s) to achieve operation.

10.5 Two-hand controls

Two-hand controls as safety devices are acceptable only if all hazardous movement stops when one manual control device is released. The hazardous movement shall come to a stop in a time period that, taking into consideration the hand-approach speed, ensures there is no hazard for the operator. The hand-approach speeds specified in ISO 13855 shall be taken as a basis (see 5.6 for hold-to-run devices designed as two-hand controls).

10.5.1 Two-hand controls on cables

Two-hand controls on cables (pendant-style control station) used for make-ready and trouble-shooting shall be permissible if, from the place of operation of the two-hand control, it is possible to observe the hazard points and hazard zones. In these circumstances, ISO 13855 is not applicable. Cables shall have sufficient strength to withstand any anticipated mechanical stresses and be provided with tension-relief measures.

10.5.2 Two-hand controls safeguarding hazard points

Where two-hand controls are used to safeguard hazards that are infrequently accessed, hydraulic/pneumatic two-hand controls shall meet the requirements specified for type IIIA, and electric/electronic two-hand controls shall meet the requirements specified for type IIIB of ISO 13851.

Where two-hand controls are used for safeguarding hazard points requiring routine and regular access, hydraulic/pneumatic two-hand controls shall satisfy the requirements specified for type IIIB, and electric/electronic two-hand controls shall satisfy the requirements specified for type IIIC of ISO 13851.

10.6 Electro-sensitive protective devices

10.6.1 General requirements

Electro-sensitive protective devices shall satisfy the requirements of type 2 of IEC 61496-1 and IEC 61496-2.

10.6.2 ESPDs which safeguard routine/regular access

In deviation from 10.6.1, electro-sensitive protective devices that safeguard routine and regular access to the hazard zone shall satisfy the requirements of type 4 of IEC 61496-1 and IEC 61496-2.

10.6.3 Positioning of ESPDs

The hand-approach speed specified in ISO 13855 shall be used as a basis for determining the correct positioning of the electro-sensitive protective device (ESPD).

10.6.4 Use of ESPDs to prevent whole-body access

Where electro-sensitive protective devices are used to prevent whole-body access to hazard zones, a minimum of two photoelectric beams shall be provided, one at a height of 400 mm and another at 900 mm (see Figure 33).

10.7 Pressure-sensitive mats, pressure-sensitive bumpers, trip devices

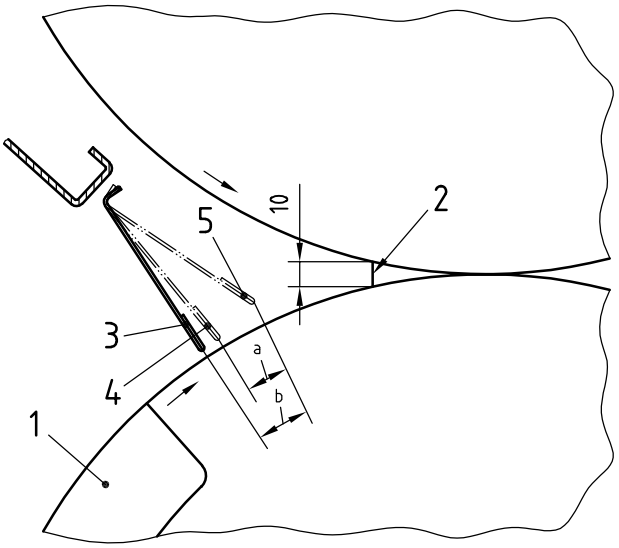
Pressure-sensitive mats and pressure-sensitive bumpers shall satisfy the requirements of ISO 13856-1.

Trip devices shall satisfy the requirements of EN 1760-2 and of category 3 of ISO 13849-1:1999.

Trip devices and pressure-sensitive mats which safeguard routine and regular access to a hazard point and their related signal processing shall comply with category 4 of ISO 13849-1:1999.

Pressure-sensitive bumpers and trip devices shall function such that the hazardous movements, which they are safeguarding, shall be stopped before personnel can reach the hazard (see Figure 54).

Dimensions in millimetres



Key

1 cylinder gaps
2 nip point
3 normal guard position
4 tripped guard position
5 maximum guard position

a Maximum stopping path of hazardous motion.

b Maximum length of movement of trip device.

Figure 54 — Tripping devices

10.8 Braking devices and clutches

10.8.1 Switch-off of braking device

The braking device may be switched off only

a) by a maintained-contact control, if the disengagement of the brake is interlocked with the hazardous machine movement;

or

b) by means of a momentary-contact control which, when released, re-engages the braking device.

Braking devices are switched off, for example, when powered machines operate in a non-powered mode.

10.8.2 Clutch or brake failure on single-stroke machines

On single-stroke operation machines, clutch or brake failures shall not cause any hazardous movement.

NOTE A single-stroke operation machine is one that completes a single cycle, then pauses before the next cycle is initiated. For example, trimmers, paper drills, and bundling machines are single-stroke operation machines. A guillotine cutter is the most common example of a single-stroke machine.

11 Control stations

11.1 Motion control stations

The use of a motion-control station is determined by the desired functions to be performed at its location. The contents and location (if necessary) of motion-control stations are specified in 11.1.1 and 11.1.2.

In a motion-control station, controls shall be arranged so that the emergency stop is readily accessible from an operating position.

The stop/safe may function as an emergency stop if it meets the criteria defined for an emergency stop.

In most cases, the emergency stop control is located closest to the operating position.

The respective order of controls should be uniform throughout the binding and finishing system. When a motion-control station is located with another (non-motion control) station, the functions of the motion-control station shall be distinctly set apart from the non-motion functions by spacing, marking or framing.

When a motion-control station contains both a motion control and a stop/safe pushbutton or emergency stop control, the stop/safe or emergency stop function shall affect the same machine or group of machines within the system affected by the motion control in that motion-control station.

The respective order of stop and motion controls should be uniform throughout the system. When a motion-control station includes a separate emergency stop function in addition to a separate stop/safe function, the emergency stop function shall be distinctly set apart by spacing, marking or framing.

11.1.1 Minimum motion-control station

Each operating position capable of initiating hazardous motion shall have an emergency stop function on or at the operating position.

EXCEPTION: If the control station contains only two-hand hold-to-run controls used to move the machine at inch speed, an emergency stop function on the control station is not required. However, the emergency stop function shall be provided in accordance with 10.2.3.1.2.

A motion-control station at a location where an operator has access to a hazard through a movable guard shall contain an emergency stop pushbutton or a stop/safe (if it serves as the emergency stop function).

A single stop/safe pushbutton that is also used as an emergency stop control may be used as long as it meets the requirements for both an emergency stop and a stop/safe pushbutton.

11.1.2 Motion-control station location

Motion-control stations shall be securely affixed and readily accessible for normal make-ready and other routine, repetitive operations integral to the operation of the equipment and which require control of the main drive motor(s).

Examples of routine, repetitive operations are clearing jams, adjusting operations, etc.

Every operating position of the system shall have a motion-control station within arm's reach of the operator and shall be placed so that the operator does not have to reach past moving parts.

Within a hazardous zone, the only motion-initiating control permitted shall be a forward inch-control device and a reverse inch-control device as specified in 10.2.3.5.1, 10.2.3.5.2 and 5.6.

Emergency stop controls on operator and motion-control stations shall be pushbutton controls and shall latch in the safe condition.

Controls shall be easily viewed from the operating positions associated with that control station.

If a motion-control station is movable (not portable), the station shall be physically supported by a suitable means other than the electrical wiring.

All safety-related stop functions shall be wired in a manner that takes into consideration the level of risk. If the stop function is hard-wired, redundancy or mechanical protection of the wires may be required under higher levels of risk. Redundancy may be achieved by redundant hard-wired circuits, or a combination of a hard-wired and an electronic circuit. Electronic-only circuits always shall be redundant.

Portable motion-control stations shall meet the same criteria as other motion-control stations. In addition, cables shall be protected from damage and shall not pose an additional hazard to personnel. If a portable motion-control station can extend into a hazardous zone in which the guard could be closed while the operator is within the hazardous zone, that control station shall not permit motion at a speed greater than that specified in 5.6.

11.2 Remote access

11.2.1 Remote control via datalink

Binding and finishing systems which utilize warning periods as defined in 14.2.2 and permissive periods as defined in 14.2.3 may use remote-control communications links for the purposes of performing diagnostic and calibration functions, including those functions requiring remote activation of machine motion.

11.2.1.1 Maintaining system and data integrity

The equipment manufacturer or service provider shall take into consideration the following measures, and shall comply with category 3 as specified in ISO 13849-1:1999, and/or the measures shall be accomplished by a computer system in accordance with category 3 of ISO 13849-1:1999.

Measures shall be in place to perform the following.

— Guard against transmission of faulty data. Data integrity during transmission can be achieved, for example, by the implementation of a block protection process or other comparable measures with block replication. The size of the data block should not exceed 512 bytes. For every single block, at least a

16-bit cyclic redundancy check should be made. The selection of the polynomial should be such that the so-called burst errors are recognized by the cyclic redundancy check (CRC) algorithm. In the event of a CRC error, the faulty block should be rejected and be transmitted anew. The generator polynomial $P(x) = x^{16}+x^{15}+x^2+1$ is recommended as this 16-degree polynomial allows the recognition of all burst errors up to a length of 26 bits. Additionally, 99,996 % of all 17-bit errors and 99,998 5 % of all burst errors larger than 15 bits are recognized, including all odd-bit positions.

— Ensure that the remote-control data link is connected to the intended binding and finishing system control computer. Identification of the binding and finishing system may be achieved, for example, by use of a unique machine-identification code, normally a multi-digit number. This number is posted in a safe portion of the control system and should be compared with the identification number associated with the remote transmission. The identification code should, for example, be checked by means of the CRC mechanism or comparable measures.

— Guard against the possibility of the establishment of unauthorized data links to the binding and finishing system control computer. Unauthorized entry to the binding and finishing system control computer may be prevented, for example, by requiring the use of a password and a subscriber identification with so-called transaction numbers which should contain at least a 64-bit coding method equivalent to those in on-line banking, and should also include a check of the unique machine identification.

11.2.1.2 Datalink line blocking

It shall be possible to disable (block) access to a local binding and finishing system control computer via a remote-control datalink by disconnecting the remote-control communications line connection to the binding and finishing system control computer.

There shall be a minimum of two such disconnects as follows:

— a switch (safety relay) controlled by the safety-guard interlock system (see 5.5.4);

— a manually operated switch requiring a key or a password to close the connection.

11.2.1.3 Indication of enabled condition of remote-control datalink

Whenever the power supply to the local binding and finishing system control computer is ON and the capability exists for remote control communications link to be enabled (unblocked), there shall be a method to alert personnel at the local binding and finishing system of the enabled condition.

This can be achieved, for example, by

— indicator light(s) on one or more control stations;

or

— notification message on a display screen(s).

11.2.1.4 Indication of activated condition of remote control datalink

Whenever a remote-control communications link has been established to the local binding and finishing system control computer, there shall be a method to alert personnel at the local binding and finishing system of the active condition of the remote-control datalink.

This can be achieved, for example, by

— blinking indicator light(s) on one or more control stations;

or

— a blinking notification message on a display screen(s).

11.2.1.5 Remote-control use of warning and permissive periods

A remote-control datalink shall not be able to initiate machine motion without the use of the same warning and permissive periods defined in 14.2.2 and 14.2.3 and in effect during normal local operation of that binding and finishing system.

11.2.1.6 Response to motion command from remote-control datalink

The design of the binding and finishing system controls shall require that every command initiated by the remote-control datalink which causes the binding and finishing system to enter warning and permissive periods for machine motion shall be responded to by a local manually generated ready signal issued within the warning or permissive periods before motion may begin.

It shall not be possible to initiate motion by remote control on any equipment for which hold-to-run control serves as the only hazard protection. Remote control shall not override any safety-related functions.

Failure to receive the local ready signal shall cause the binding and finishing system to stop under the same conditions, and with the same effects, as a trip of the binding and finishing system safety-guard interlock system, including blocking the datalink line.

11.2.1.7 Remote-control datalink time-out

The binding and finishing system shall be equipped with a time-out function which, when a remote control data link is established, will cause the binding and finishing system to stop under the same conditions and with the same effects (including blocking of the datalink line) as a trip of the binding and finishing system safety-guard interlock system if the time-out function is not reset manually by local personnel within a period of less than 30 min from the last manual reset.

11.2.1.8 Acceptance test for software changes

After any software change that may potentially affect safety functions of a machine, (an) authorized person(s) shall conduct a comprehensive acceptance test at the machine (not by remote access) on the basis of broad functional tests of the safety functions that may be affected by the newly recorded data. The manufacturer (or manufacturer's agent) shall provide detailed instructions to the authorized person(s) at the installation site (for example, in the form of checklists) for this acceptance test.

The machine may be returned to operation after successful completion of the on-site test(s).

The process for the acceptance-test procedure and the subsequent return of the machine to service shall be documented in a protocol, which shall be recorded by the responsible authorized person(s) at the machine site and retained by the manufacturer.

11.2.2 Wireless motion-control stations

Although wireless control is not generally used to control production motion of equipment, it is recognized that there are operations for which it is desirable. This subclause addresses the minimum requirements for such controls, if they are used.

Wireless motion controls shall be permitted only under the following conditions and shall meet the following requirements:

a) Wireless motion controls shall be used only if the equipment to be controlled is in full compliance with all requirements of this International Standard.

b) The emergency stop control shall remain functional at all times and shall override all functions, both local and remote.

c) Controls shall be designed so as to allow sending a signal only on an unobstructed path to a receiver, and shall require that the operator be in direct line-of-sight of the equipment being moved; i.e., with no machinery, walls or other objects blocking the operator's ability to see the equipment being moved.

d) Each motion-control station that is not attached to the machine it controls shall carry a clear indication of which machine is controlled by that control station.

e) The controls shall meet the requirements specified in Clause 10.

f) The wireless control station shall contain a control which, when activated, shall generate an emergency stop command. As specified in 10.2.3.1.2, generation of an emergency stop command does not place the machine in the safe condition and the warning lights shall not indicate a safe condition. Therefore, this control shall not be labelled as an emergency stop control or a stop/safe control. Following such a stop, the machine shall go through a normal starting sequence before motion can be initiated.

   EXCEPTION: If the wireless control station contains only hold-to-run controls used to move the machine at inch speed with all guards closed, a stop control on the control station is not required.

g) Measures shall be taken to ensure that control commands affect only the intended machines and machine functions.

h) Measures shall be taken to prevent the machine from responding to signals other than those from the intended motion control station(s).

i) Any fault or single-point failure in a wireless control station shall result in the automatic initiation of a stop command, which shall stop the machine as quickly as possible without creating a hazard or damaging the machine, and shall prevent potentially hazardous operation. Such a stop does not place the machine in the safe condition. Following such a stop, the machine shall go through a normal starting sequence before motion can be initiated.

   An example of such a failure is when a valid signal has not been detected within a specified period of time.

j) In a machine where the control of safety-related functions relies on serial data transfer, correct communications shall be ensured by using an error-detection method that is able to cope with up to three error bits in any command sequence.

k) On battery-powered control stations, a variation in the battery voltage shall not cause a hazardous condition. If one or more potentially hazardous motions are controlled using a battery-powered motion-control station, a clear warning shall be given to the operator when a variation in battery voltage exceeds specified limits. Under those circumstances, the motion control station shall remain functional long enough to put the machine into a non-hazardous condition.

Instructions on the use of wireless control shall be included in the instruction handbook. These instructions shall provide the basis for training of authorized personnel.

12 Control systems

12.1 General requirements

12.1.1 Hydraulic, pneumatic, electric and electronic control systems

On hydraulic/pneumatic control systems, the safety-related parts shall comply with the requirements for category 1 of ISO 13849-1:1999. On the electric/electronic control system, the safety-related parts shall comply with the requirements for category 3 of ISO 13849-1:1999. Single main power contactors that comply with the requirements for category 1 of ISO 13849-1:1999 might be used.

Faults in the auxiliary relays and contactors of the control circuit shall be detected and cause the machine to shut down. When computers, modems or programmable logic controls (PLCs) are used, safety-related malfunctions shall be detected and shall cause the machine to shut down.

When computers, modems or PLCs are used, this requirement may be satisfied, for example, by monitoring the function of safety-related signals using parallel control systems or redundant contact-type circuit breaking principles.

Safety-related parts of control systems include, for example, emergency stop circuits, electric interlocking circuits, limiters of displacement or operating speed on hold-to-run controls. (See also ISO 13849-1:1999 for definitions.)

External influences as well as faults in the control system could result in hazardous movements and hazards. Examples of hazardous movements, depending on the type of machine, include the following:

— unintended start-up;

— unintended speed increase up to production speed with a guard open;

— unintended movement following an intended movement (unintended cycle);

— unintended continuation of a movement when the movement is intended to stop.

The build-up of potentially explosive atmospheres might constitute a hazard.

12.1.2 Electronic adjustable speed drives

On electronic adjustable speed drives, the control system shall be designed such that in the event a guard or safety device causes the machine to stop, either the main contactor will also be switched off or any other appropriate measure will be taken.

“Safety devices” include, for example, emergency stop devices, electro-sensitive protective devices, trip devices.

“Other appropriate measures” include, for example, the application of a mechanical brake with a braking torque greater than the drive torque of the motor. An “additional control measure” is, for example, an electric/electronic device (timer) which switches off after a preset time.

On electronic adjustable speed drives which feed energy back into the electric circuit during stopping, appropriate control-related measures (in addition to pulse blocking) shall be taken to ensure that the main contactor is switched off no later than after the elapse of the normal stopping time, or any other adequate measure to that effect. During hold-to-run control operations, there is no need to disconnect the main contactor during release time.

NOTE On electronic adjustable speed drives, the speed of rotation of the motor is changed, for example, by shifting the supply voltage and/or frequency.

12.1.3 Cut-off of main energy source

When an emergency stop device is fitted with a main contactor that detects a low-voltage condition, the main contactor shall meet at least category 1 of ISO 13849-1:1999, and shall disconnect the main power supply.

NOTE Opening the contact of the emergency stop device directly disconnects, for example, the power supply to the low-voltage tripping coil.

12.1.4 Residual-pile monitoring systems

Residual-pile monitoring systems used as a safety device shall comply with the requirements of at least category B of ISO 13849-1:1999.

12.1.5 Unobserved unguarded hazard zones

When more than one interlocking guard is open and there are any unguarded hazard zones that cannot be observed from a single point of operation, the circuits controlling mutual interlocking of safety devices that prevent machine motion under hold-to-run condition shall comply with the requirements of at least category 1 of ISO 13849-1:1999. The interlocking may be computer controlled.

For areas that are not visible from the operating position, see 5.7.1.

All other safety-related parts of control systems, including limiters of displacement or operating speed on hold-to-run controls and mechanisms for preventing machine motion under continuous-run condition, shall comply with the requirements of 12.1.

12.2 Additional requirements for hand-fed machines where the operator's hands enter the point of operation

For those hand-fed machines where the operator has routine and regular access to hazard points at which the operator's hands can come in contact with the tools or the path of tool movement (knives, milling heads, punching tools, etc.), the additional requirements of 12.2.1 through 12.2.4 shall apply.

For example, this may apply to guillotine cutters, hand-fed trimmers and hand-fed label punching machines.

12.2.1 Hydraulic/pneumatic control system

The safety-related parts of the hydraulic/pneumatic control system shall comply with the requirements of category 3 of ISO 13849-1:1999.

12.2.2 Electric/electronic control system

The safety-related parts of the electric/electronic control system shall comply with the requirements of category 4 of ISO 13849-1:1999.

12.2.3 Main contactors

Main contactors shall be redundant. Faults in the main contactors shall be detected and shall lead to shutdown.

12.2.4 Systems using electronic braking

Systems using electronic braking shall have, as back-up, an additional electro-mechanical or pneumatic-mechanical brake, which works independently of the electronic brake. The mechanical-brake torque shall be greater than the maximum electric-drive torque of the electronic drive.

NOTE Electronic brakes exist, for example, on electronic drives where the braking effect is caused by energy being fed back into the circuit.

13 Ergonomics and labelling of indicators and actuators

Unless otherwise specified in this International Standard, the ergonomic design and labelling requirements relating to indicators and actuators shall comply with the requirements as specified in IEC 61310-1 and IEC 61310-2.

14 Signals and warning devices

14.1 General

A warning system shall be required for systems in which the overall visibility of personnel to the operator is obstructed, or communication between operating personnel may be difficult. This condition may exist, for example, on binding and finishing systems

— if the machine length exceeds 7 m;

— the system includes machines on different floors.

An audible alarm as defined in 14.2, or an area warning-light system as described in Annex E, shall be used. A warning system using an audible alarm is preferred. The audible alarm system is required in Europe.

Optional personnel warning lights as defined in 14.2.4 may be used in addition to an audible alarm.

In some countries, such as in the United States, the use of personnel warning lights is required unless the area warning light system is used. In such cases, national requirements take precedence over this International Standard.

A combination of audible alarm and area warning lights may be used. Use of personnel warning lights without an audible alarm is not permitted except as noted in 14.2.6.

Warning signals shall

— occur before the initiation of machine motion;

and

— be clearly recognized and differentiated from all other signals used.

If the binding and finishing system can be reconfigured into multiple control zones, each zone should have a warning system capable of operating independently (see Clause 9).

14.2 Audible warning system

14.2.1 Audible alarm

The audible warning system shall consist of an audible alarm, a warning period and a permissive period. Different audible characteristics may be used to distinguish between different machines.

14.2.2 Warning period

The warning period shall end not less than 2 s after depressing a motion control. Machine motion shall not occur during the warning period. Machine motion may occur at the end of the warning period.

The audible alarm shall sound throughout the entire warning period.

For warning systems equipped with personnel warning lights, the red personnel warning lights shall have a discernible flash.

The light may need to flash more than once for the warning to be discernible.

At the end of the warning period, one of the following two procedures is permitted. Although option b) is not considered to be unsafe, option a) is preferred for the purpose of consistency.

a) The following “double push” sequence is preferred.

   At the end of the warning period, machine motion will occur as the result of releasing a motion control during or after the warning period, and reactivating a motion control during the permissive period.

   The warning period shall be cancelled by depressing a stop/safe pushbutton or opening a safety circuit.

b) Alternatively, machine motion will occur as the result of holding a motion control through and beyond the warning period.

   The warning period shall be cancelled by depressing a stop/safe pushbutton or opening a safety circuit.

   The warning period may also be cancelled by releasing a motion control before the end of the warning period. If the warning period is cancelled by releasing a motion control prior to the completion of the warning period, the machine shall return to the ready condition.

14.2.3 Permissive period

The permissive period shall be a period that shall be initiated after the completion of a full warning period. A permissive period shall also be initiated when an inch or reverse-function control is released after machine motion has been established.

If the “double-push” is used to initiate motion (e.g. a motion button is activated during the warning period, released, and reactivated during the permissive period), the permissive period shall not exceed 6 s. Each successive inching operation during a permissive period initiates a new permissive period.

If a single push to initiate motion at inch speed (e.g. an inch button is depressed and held through the warning period) is used, machine motion at inch speed will occur at the end of the warning period. When the inch button is released, a permissive period not exceeding 4 s shall be initiated. During this permissive period, an inch button may again be depressed and motion initiated at inch speed without going through an additional warning period. Each successive inching operation during a permissive period initiates a new permissive period.

If an inch button is not pressed during the permissive period, the machine shall revert to the ready condition and a new warning period is required before further machine motion.

It is permissible to use a combination of double-push and single-push to initiate inch and run.

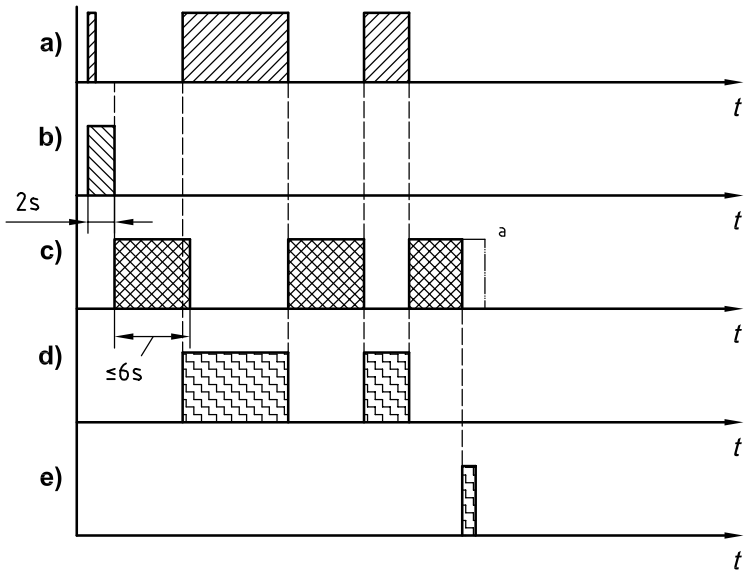
For example, for production reasons it may be preferable to use the double-push system to initiate inch, but a single-push to initiate a run at production speed.

The permissive period is cancelled by depressing a stop or stop/safe pushbutton, or by breaking a safety circuit.

A change in direction of machine motion at inch speed within the same permissive period is permitted without the initiation of a new warning period (see Figure 55).

If the optional personnel warning light system is used, refer to Table 3.

NOTE The permissive period allows for successive inch or reverse operations without each being preceded by a warning period.



Key

[a] cancellation of the permissive period

Figure 55 — Audible warning system with double-push sequence: a) inch reverse; b) warning period and audible alarm; c) permissive period; d) machine motion; e) stop, stop/safe, breaking a safety circuit

14.2.4 Optional personnel warning lights with audible alarm

If a personnel warning-light system is used, red and green lights shall be used to indicate the ready/running and the safe conditions, respectively; e.g. the red colour indicates a ready or running condition and the green colour indicates a safe condition. Personnel warning lights shall be clearly visible from any motion-control station. These personnel warning lights shall be distinct from any machine status lights.

In a vertical orientation, the red personnel warning light shall be above the green personnel warning light. In a horizontal orientation, the red personnel warning light shall be to the left of the green personnel warning light. Horizontal orientation shall not be permitted if personnel warning lights mounted in a horizontal orientation could be viewed from both sides, resulting in a reversal of the colour sequence.

NOTE The restrictions for horizontal orientation are to ensure that personnel, especially those with visual impairments such as colour blindness, can expect the colour sequence to always be the same.

The personnel warning lights and audible alarms shall comply with the requirements specified in Table 3.

Table 3 — State of warning devices for audible warning system with personnel warning lights

Warning-device status	Machine condition					
	Stop/Safe	Ready or Fault	Warning period	Permissive period	Machine motion	Armed
Green light	ON[a]	OFF	OFF	OFF	OFF	OFF
Red light	OFF	ON	FLASH	FLASH	ON/OFF[b]	ON/FLASH[c]
Audible alarm	OFF	OFF	ON	OFF	OFF	OFF/PULSE[c]

[a] An option for indicating the location of the stop/safe pushbutton is for the green personnel-warning light at that location to flash, while the green personnel-warning light(s) at all other locations shall be ON (steady burn, not flashing).

[b] If the red personnel warning light is off when the machine is in motion, first it shall be on until at least 30 s after the machine reaches production speed before turning off. Machines at which no lights are illuminated shall be considered to be in an unsafe condition.

[c] Either condition is permitted.

14.2.5 Optional personnel warning lights for automatic set-up operations

Red lights may be used to warn of the machine motion of an automatic set-up system on binding and finishing systems. The light shall flash for 2 s prior to the initiation of the automatic sequence and during the entire period of automatic motion. These personnel warning lights shall be distinct from any machine-status lights.

14.2.6 Optional personnel warning lights for auxiliary equipment having armed status

If auxiliary equipment connected to a system is capable of running at zero speed (armed condition), this equipment may use personnel-warning lights to indicate the armed condition, the running condition, and the safe condition. A separate audible alarm is not required on the auxiliary equipment.

When this auxiliary equipment is used in a stand-alone mode, if overall visibility of personnel by the operator of the equipment is not obstructed, warning signals as specified in Clause 14 are not required.

14.3 Area-light warning system

An area-light warning system, as specified in Annex E, may be used instead of the audible warning system defined in 14.2. The use of the area-light warning system is not permitted in Europe.

15 Warning signs and labels

If a national or regional regulation exists for the use of warning labels or signs, that regulation shall take precedence over this International Standard. If no such regulation exists, the provisions of this International Standard shall apply.

The following standards are known to specifically address the design and use of warning signs and labels:

— European Council Directive 92/58/EEC of 24 June 1992[18]

— ANSI Z535.3[2], *Criteria for Safety Symbols*

— ANSI Z535.4[3], *Product Safety Signs and Labels*

— IEC 61310-1 and 61310-2, *Safety of Machinery — Indication, marking and actuation*

Warning signs and labels shall be provided to warn of the following hazards:

— exposed sharp edges of tools including milling heads, slitter blades, sawing blades, stitching heads, sewing needles and cutting knives;

— burn hazard on hot surfaces of glue pots, gear boxes, dryers and motors;

— burn hazard from hot wax, glue, or chemicals;

— electrical hazards in boxes or enclosures that do not otherwise clearly show that they contain electrical devices;

— explosion hazards;

— laser hazards.

Warning signs or labels shall be affixed on or posted as close as possible to the hazard.

16 Information for use

16.1 Minimum requirements for machine markings

16.1.1 Markings, signs and warnings

Machinery shall be provided with the markings, signs and warnings as specified in ISO 12100-2:2003, 6.4, and as follows:

— name and address of manufacturer;

— CE mark (for machines and products to be launched on the EEC market), or other relevant mark as appropriate to the market (e.g. UL, TUV, etc);

— year of manufacture (for machines and products to be launched on the EEC market);

— designation of series or type, if any;

— serial number, if any;

— rating information (voltage, frequencies, power etc.).

16.1.2 Additional requirements for pile-lifting and lowering devices

On pile-lifting and lowering devices (feeding and delivery devices), the following additional information shall be clearly marked:

— permissible operating pressure on pneumatically driven pile-lifting and lowering devices;

— permissible operating pressure on hydraulically driven pile-lifting and lowering devices inasmuch as the pressure generator is not a component part of the pile lifting and lowering device;

— maximum carrying capacity;

— sign saying that riding on the device is forbidden for format sizes larger than 2,5 m^2.

16.1.3 Machinery fitted with laser equipment

On machinery fitted with laser equipment, the classification of the equipment shall be indicated together with any warnings in accordance with IEC 60825-1, where required.

16.1.4 Machinery with UV radiation emission

On machinery where UV radiation of at least category 1 as specified in EN 12198-1:2000 is expected, the category number as specified in EN 12198-1:2000 and the type of radiation shall be indicated.

16.1.5 Machines having hot parts

Extra warnings need to be provided on machines with hot machine parts if the surface temperature is above 65 °C and if the surfaces are not protected against contact by insulation or additional guards.

16.2 Contents of instruction handbook

16.2.1 Each machine

Each machine shall be accompanied by an instruction handbook containing the minimum information listed in 16.1 and basic specifications in accordance with ISO 12100-2:2003, 6.5.1. Instruction handbooks shall be devised in accordance with ISO 12100-2:2003, 6.5. The instruction handbook shall also give the declared noise-emission levels of the machine. It shall provide reference to the noise-test code in EN 13023, and to the basic noise-emission standards on which the determination of the declared noise-emission levels are based. See Annex D for examples of instruction handbook layout.

16.2.2 Machines using flammable liquids

The instruction handbook for machines using flammable liquids with a flash point below 55 °C shall contain the instruction that the flooring in an area extending 1 m beyond the zone 1 hazardous area shall be conductive in order to dissipate static electricity before coming into contact with flammable liquids.

16.2.3 Machines with cutting knives

The instruction handbook for machines with cutting knives shall contain information regarding total response time, in milliseconds, for all electronic and mechanical lag times associated with stopping the hazardous motion of a knife at any point in the cycle.

The handbook shall describe safe working practices for the changing of knives, including the means of safeguarding knife blades and the adjustment of knives in order to prevent hazards from exposed knife edges. The handbook shall give detailed instructions as to the removal of the knives using the tools and the knife covers supplied, and the subsequent storage in knife boxes.

16.2.4 Handling heavy machine parts

Where heavy machine parts need to be installed and removed regularly, necessitating the lifting of a load of a least 25 kg per person, the instruction handbook shall indicate the need for the user to provide adequate means of lifting and transport.

16.2.5 Machines with automatic paper loading

The instruction handbook for machines with automatic paper loading shall describe the correct positioning of the paper supply for feeding to ensure safe working conditions. An example of this type of information is stating the distance and the angle between paper pile and feeding table.

16.2.6 Additional requirements

In addition to the requirements in 16.2.1 to 16.2.5, the instruction handbook(s) shall, where required

a) describe the protective measure, if any in addition to 16.1.5, to prevent accidental contact with hot machine parts with a surface temperature of more than 65 °C;

b) indicate those areas on the machine suitable for fitting suction devices in order to avoid the emission of hazardous gases, vapours and dusts and shall specify the required suction capacity;

c) describe any residual risks that cannot be excluded despite the safety measures provided and shall identify where special training is required and which personal protective measures (for example wearing protective gloves, eye protection, clothing and hearing protectors) are required;

d) provide all information and instructions relating to safety requirements where it is anticipated that equipment may be used in potentially explosive atmospheres;

e) give a warning in the installation instructions to place the machines at sufficient distances from elements of the building (the walls, pillars, etc.) such that persons avoid being crushed between them and the moving machine parts;

f) provide information about the requirements for interfaces connecting a machine to the preceding or following equipment and to external power supplies (operation of emergency stop control systems, overall system control, etc.);

g) give instructions for the proper handling and adjusting of guards;

h) give instructions for safe threading of the web for machines working with web material (roll laminators, coaters, feeding systems for case makers, etc.).

See Annex D for examples of instruction-handbook layout.

16.2.7 Information for gang stitchers

Where production circumstances require the gang stitcher to be started by two-hand control at speeds greater than 10 m/min with the interlocking guards open, the instruction handbook shall contain the following warning:

WARNING — The person operating the two-hand control shall make sure that, before operating the control, there is no other person in the hazard area.

16.2.8 Information for gathering machines

Where production circumstances require the gathering machine to be started by two-hand control at speeds greater than 10 m/min with the interlocking guards open, the instruction handbook shall contain the following warning:

WARNING — The person operating the two-hand control shall make sure that, before operating the control, there is no other person in the hazard area.

16.2.9 Information for perfect binders

Where production circumstances do not allow the milling cutter to be stopped when opening the interlocking guard covering the book carriage, the instruction handbook shall indicate the residual risk and the stopping time.

Where production circumstances require the perfect binder to be started with interlocking guards open, either by hold-to-run control at a speed greater than 5 m/min or by two-hand control at a speed greater than 10 m/min, the instruction handbook shall contain the following warning:

WARNING — The person operating the hold-to-run/two-hand control shall make sure that, before operating the control, there is no other person in the hazardous area.

Where polyurethane hotmelt glues are used, the instruction handbook shall give the following instructions:

— indication of the need to provide adequate exhaust equipment in the area of the glue duct and the preheater and specifying the minimum exhaust volume;

— instructions for removing hotglue ducts from the perfect binder and for cleaning the glue ducts, for example:

  — move the duct immediately under exhaust hood,

  — clean duct with low-risk non-aromatic solvents,

  — close glue-duct cover during removal;

— indication of the need for adequate ventilation in the working area;

— indication of the need to follow the instructions on the material-safety data sheet;

— warning not to leave glue reservoirs and glue ducts open;

— indication that an appropriate protective mask shall be provided for the operating personnel where the liberation of isocyanates cannot be excluded when the glue reservoir is changed or the glue ducts are cleaned or removed from the perfect binder. Instructions for use of the mask shall also be given;

— indication that appropriate protective glasses and gloves shall be used when there is a hazard of spilling of the hot glue (e.g. during pressure clearing). Eye-washing and cleaning equipment should be readily available in case glue gets into the eyes. For spills on skin, washing facilities should be available in the working area;

— indication to thoroughly clean hands when finishing work or taking breaks. Operating personnel dealing with this type of glue should use a barrier hand cream or protective hand lotion;

— indication that soiled clothes must be changed immediately;

— indication that eating, drinking and smoking is forbidden throughout the working area;

— warning of residual risks in case of non-observance.

16.2.10 Information for sheet folding machines

Where production circumstances require the sheet folding machine to be started by two-hand control at a speed greater than 10 m/min with guards open, the instruction handbook shall contain the following warning:

WARNING — The person operating the two-hand control is responsible for safe working practices. Before starting the machine, the operator shall make sure that there is/are no other person(s) in the hazard area.

16.2.11 Information for inserting machines

Where production circumstances require the inserting machine to be started by two-hand control at a speed greater than 10 m/min with guards open, the instruction handbook shall contain the following warning:

WARNING — The person operating the two-hand control is responsible for safe working practices. Before starting the machine, the operator shall make sure that there is/are no other person(s) in the hazard area.

16.2.12 Information for machines for the production of envelopes

The instruction handbook for machines for the production of envelopes shall contain a warning of the residual risk existing between the staggering wheel and the paper guides, if operator intervention is required at this point during production runs.

Where production circumstances require the machine to be started at a speed of more than 5 m/min with guards open, either when using a stroboscope and hold-to-run control or at a speed greater than 10 m/min by two-hand control, the instruction handbook shall contain the following warning:

WARNING — The person operating the hold-to-run/two-hand control shall make sure that, before operating the control, there is/are no other person(s) in the hazard area.

16.2.13 Information for machines for the production of sanitary items

Where production circumstances require the machine to be started at a speed of more than 5 m/min with guards open, either when using a stroboscope and hold-to-run control or at a speed greater than 10 m/min by two-hand control, the instruction handbook shall contain the following warning:

WARNING — The person operating the hold-to-run/two-hand control shall make sure that, before operating the control, there is/are no other person(s) in the hazard area.

The handbook for machines for the production of sanitary items shall give instructions for adjusting the tunnel of the band saw on the delivery side and shall point out the residual risk (cutting risk).

16.2.14 Information for guillotines

The instruction handbook for guillotines shall contain the following additional information:

— total response time of the system, in milliseconds;

— resolution capability of ESPDs, in millimetres;

— minimum distance of ESPDs, in millimetres.

The handbook for guillotines shall also contain the instruction that safety devices shall be checked for effectiveness before each work shift and each time a knife has been changed and that test results shall be recorded.

Measures to be taken in case of failure of transmission elements shall be described in order to enable safe repair. It shall be indicated, for example, that the paper pile shall not be withdrawn by force.

The instruction handbook shall indicate that there is a residual risk caused by the spindle under the rear table of the guillotine.

The instruction handbook shall describe safe working practices for changing the knives, including the means of safeguarding knife blades and of adjusting the knives in order to prevent hazards from exposed knife edges. It shall give detailed instructions on the removal of the knives using the tools and the knife covers supplied and on the subsequent storage in knife boxes.

The instruction handbook shall indicate the need for regular checks of the guillotine against manufacturer specifications. Tests shall include the functioning of the control systems, monitoring of the stopping performance, clamping force, functioning of the ESPD, functioning of the two-hand control, and overrun protection in accordance with 7.8.1. The instruction handbook shall indicate that test results shall to be recorded.

16.2.15 Information for trimmers

The instruction handbook for trimmers shall indicate that knife covers shall be used during setting-up operations.

16.2.16 Information for corner rounding machines

The instruction handbook for corner-rounding machines shall indicate that the guard shall be adjusted to the maximum height of the pile inserted in order to safeguard the hazard point on the knife or saw.

16.2.17 Information for integral feeding and delivery equipment for guillotines

The instruction handbook for integral feeding and delivery equipment for guillotines shall warn of the residual risks associated with the feeding and the delivery table (impact hazards from the travelling table in front of the feeding table, hazards from travelling delivery table in the delivery area) and with the gripper (crushing hazard from gripper).

The instruction handbook shall describe the correct positioning of the paper pile for feeding to ensure safe working conditions. It shall state, for instance, the distance and the angle between the paper pile and the feeding table.

The instruction handbook shall indicate that the floor area in front of the feeding table shall be painted in yellow and black warning colours in order to inform persons that this area is reserved for the paper pile.

The instruction handbook shall indicate that the floor area over which the delivery table passes shall be painted in yellow and black warning colours.

Annex A
(informative)

Hazards associated with binding and finishing equipment and systems

Table A.1 lists many significant hazards that may be encountered in binding and finishing systems. When performing risk assessment for an individual piece of equipment, this list may assist the manufacturer in identifying the risks on their piece of equipment. The manufacturer should be aware there may be other hazards not included in this list which need to be identified during the risk assessment process.

NOTE Additional information on hazard analysis is given in ISO 14121[35].

Table A.1 — Significant hazards, hazard zones, and safety measures

Significant hazards	Hazard zone
Mechanical hazards	Guillotines
— crushing	— hazard zone knife/clamping bar
— shearing	— knife
— cutting or severing	— clamping bar
— entanglement	— backgauge
— drawing-in	— automatic mode
— trapping	Integral feeding and delivery equipment for guillotines
— impacts	— feeding table
	— rear table of guillotine
	— gripper
	— delivery table
	Index cutting machines
	— feeding and delivery
	— automatic feeding and delivery
	— knives
	Trimmers
	— knives
	— manual feeding
	— automatic mode
	Rotary cutters
	— rotary knives
	Round cornering machines
	— knives, saws
	Label punching machines
	— punching knife
	— waste opening
	Stitching, riveting, eyeletting and attaching machines
	— between tools
	— hold-to-run control
	— entire machine

Table A.1 (*continued*)

Significant hazards	Hazard zone
Mechanical hazards (continued)	Gang stitchers — trimmer feeder — stitching section — thickness control — difficult overall vision — transport chain — hold-to-run control — entire machine Gathering machines — hand-fed, feeder — automatic feeding/delivery — manual feeding, transport chain — gathering device (transport device) — difficult overall vision — hold-to-run control with guards open — entire machine Perfect binders — book carriages — gluing rollers — heating of glue — cover feeder — delivery — difficult overall vision — hold-to-run control with guards open — milling head cutters — entire machine Paper drills — drill — drill/clamp jaws — entire machine Book signature presses — clamping plate/material — entire machine Book presses — clamping plate/pressing plate, forming bar — pressing plates — entire machine Sheet folding machines — folding device — cutting, creasing, perforating unit — folding knife — in-running nips on belts — hold-to-run control — entire machine

Table A.1 (*continued*)

Significant hazards	Hazard zone
Mechanical hazards (continued)	Book production lines — in-running nips on belts — preheater — pressing section — glue section — gauze section — head banding section — book cover magazine — cover bending section — casing-in section — hold-to-run control with guards open — entire machine Back rounding and pressing machines — in-running nips on belts — tipping section — preheater — pre-forming, back rounding, pressing sections — entire machine Backlining and head banding machine — in-running nips on belts — glue section — gauze section — head banding section — counter-pressure section — entire machine Casing-in machine — transport finger — book cover feeder — cover bending section — forming section — casing-in, gluing section — counter-pressure section — delivery — entire machine Book cover crease forming machine — in-running nips on belts — tipping section — pressing section — hold-to-run control with open guards — entire machine Inserting machines — feeder — automatic feeding/delivery — difficult overall vision — hold-to-run control with open guards — entire machine Counter-stackers — in-running nips on belts — waste separator — turntable — delivery — pneumatic system — entire machine

Table A.1 (*continued*)

Significant hazards	Hazard zone
Mechanical hazards (continued)	Paper embossing machine — difficult overall vision — web threading device — reel unwind, rewind — guide rollers — stretch roller — in-running nip embossing roller/counter roller — counter roller — rotary knife — entire machine Coaters — difficult overall vision — web threading device — reel unwind, rewind — guide rollers — dosing gap — coating unit — in-running nip on belt — continuous flow dryers — entire machine Foil laminators — reel unwind, rewind — in-running nips on belts — guide rollers — laminating rollers — cutting unit — entire machine Laminators with glue application — difficult overall vision — web threading device — reel unwind, rewind — feeder, delivery — in-running nips on belts — guide rollers — rotary knife — transport rolls — glue unit — laminating rollers — sheeter — pressing belt — package stop, conveyor belt — turning belt — entire machine

Table A.1 (*continued*)

Significant hazards	Hazard zone
Slipping, tripping, falling	Production area — work platforms, access stairs, passageways, steps
Electrical hazards — direct or indirect contact — thermal radiation (burns)	All machinery — electrical equipment — equipment made live under electrical fault conditions
Thermal hazards — burns due to possible contact with hot surfaces	Perfect binders — hotmelt glue reservoirs Book production lines — preheating section — hotmelt glue reservoirs Back rounding and pressing machines — preheater Backlining and head banding machines — hotmelt Casing-in machines — heated forming section Book cover crease forming machines (press) — heated crease forming rails Machines for the production of hot air nozzles Paper embossing machines — heated embossing roller Coaters — hot liquid material — continuous flow dryer Foil laminators — heated laminating rollers
Hazards generated by noise resulting in hearing loss	Sheet Folding machines
Hazards generated by radiation UV radiation, laser	Binders — radiation dryers (UV dryers, HF dryers)
Hazards from substances and material used for processing, machine operation or which are emitted during the process — hazards resulting from contact with or inhalation of harmful fluids, gases, fumes, dusts	Perfect binders — polyurethane hotmelt Coaters — hazardous substances
Hazards caused by neglect of ergonomic principles in machine design — unhealthy body postures	Guillotines — knock-up devices — optical cutting line indicators Stitching, riveting, eyeletting and attaching machines — adjustments Book production lines — glue replenishment

Table A.1 (*continued*)

Significant hazards	Hazard zone
Faults, malfunctions in the control systems — faults or failures in safety circuits	Guillotines — knife and clamping bar, ESPDs and their related signal processing Label punching machines — punching area Stitching, riveting, eyeletting, attaching machines Gang stitchers Gathering machines Perfect binders Paper drills Book signature presses Book presses Sheet folding machines Book production lines Back rounding and pressing machines Backlining and head banding machines Casing-in machines Book cover crease forming machines Machines for the production of envelopes Inserting machines Counter-stackers Paper embossing machines Coaters Foil laminators Laminators with glue application
Hazards from fire and explosion	Coaters Laminators with glue application

Annex B
(normative)

Explosion-protection zones

B.1 General classification of hazardous places

To determine the extent of measures necessary to avoid effective ignition sources, the hazardous places are classified into zones based on the frequency and duration of occurrence of a hazardous explosive atmosphere.

NOTE 1 In the following text where the term “gas” or “gas/vapour” is used, it implicitly covers mist atmospheres.

A place in which an explosive atmosphere is not expected to occur in such quantities as to require special precautions shall be regarded as non-hazardous within the meaning of this International Standard.

Based on the sedimentation of dust and the possible formation of an explosive atmosphere from the dispersion of dust layers, different sets of zones have been defined for gasses/vapours and dusts.

In view of this, avoiding the creation of effective ignition sources for combustible dusts requires different measures than for combustible gasses/vapours.

NOTE 2 Information on the control and classification of hazardous places for gases and vapours by the use of ventilation is given in IEC 60079-10[22].

B.2 Zones for gases/vapours

The following definitions of zones shall apply:

Zone 0: A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

In general these conditions, when they occur, arise inside containers, pipes and vessels, etc.

Zone 1: A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mists is likely to occur occasionally during normal operation.

This zone can include, among others

— the immediate vicinity around zone 0;

— the immediate vicinity around feed openings;

— the immediate vicinity around filling and emptying openings;

— the immediate vicinity around fragile equipment, protective systems, and components made of glass, ceramics, etc.;

— the immediate vicinity around inadequately sealed glands, for example on pumps and valves with stuffing-boxes.

Zone 2: A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for only a short period.

This zone can include, among others, places surrounding zones 0 or 1.

Table B.1 — Explosion zones

Equipment type	Zone	Zone description
Roller-coating units with closed side frames reaching down to floor level	1	The area of the roller coater between the side frames of the roller coating unit. The service walkway between the roller coating units up to a width of 2 m and up to a height of 2 m, including the area between the side frames. The area of the fountain for coating, impregnating and gluing materials, the area of the container which is connected with the roller-coater unit and the area of the storage tank, defined by a 500 mm radius on all sides. The area of the web-type material, defined by a 250 mm radius on all sides, based on the maximum coating width, extending up to the entry of the web-type material into the dryer tunnel, with a maximum length of 2 m of the freshly coated web-type material.
Roller coaters with side frames with cut-outs or with side frames that do not reach to floor level	1	The area of the fountain for coating, impregnating and gluing materials, defined by a radius equal to the length of the rollers, on all sides; however, not exceeding 500 mm. The space underneath the roller coaters down to floor level in an area defined by the vertical projection of the danger areas of the roller coater units. The area of the container which is connected to the machine and the area of the storage tank, defined by a 500 mm radius on all sides. The area of the web-type material itself, defined by a 250 mm radius on all sides, based on the maximum coating width, from the entry of the web material into the first roller coating unit up to the entry of the web material into the dryer tunnel or 500 mm after leaving the last roller coating unit.

Annex C
(informative)

Risk analysis relating to the pitch angle of access stairs

Access stairs for raised workplaces should preferably be stairs with a maximum pitch angle of 45°. If, due to lack of space, stairs cannot be installed, the following exceptions shall be permitted based on a calculated E value [see Equation (C.1)]:

— with an evaluation value of $E \leqslant 6$:

  solid stepladders, safeguarded against skidding, with a pitch angle of 46° to a maximum of 60° and lateral handrails;

— with an evaluation value of $E \leqslant 3$:

  solid stepladder with a pitch angle of from more than 45° up to 75°;

— with an evaluation value of $E \leqslant 2$ and $E_2 = 0$:

  ladders with a pitch angle of 75° to 90°

The evaluation is computed using Equation (C.1):

$$E = E_1 + E_2 + F_1 + F_2 \quad \text{(C.1)}$$

where

E is the sum of the individual factors

E_1 is the numerical factor determined in accordance with Table C.1

E_2 is the numerical factor determined in accordance with Table C.2

F_1 is an additional numerical factor determined in accordance with Table C.3

F_2 is an additional numerical factor determined in accordance with Table C.3

Table C.1 — Evaluation E_1 for the frequency of use

Frequency of use	E_1
less than once per week	1
once per week	2
more than once per week, and not more than once per day	3
more than once per day	4

Table C.2 — Evaluation E_2 for carrying objects

Objects to be carried	E_2[a]
no objects to be carried in the hands	0
light objects ($\leqslant$ 5 kg)	1
objects of moderate mass ($>$ 5 kg and $\leqslant$ 10 kg)	2
heavy objects ($>$ 10 kg)	3

[a] Where the height to which an object is lifted is less than 1,6 m, the value is deemed to be 0.

Table C.3 — Additional factors F_1 and F_2

Additions for the following conditions	F_1	F_2
at least one bulky object has to be carried	1	—
the height to be to which the object is lifted is more than 3 m	—	1

Annex D
(informative)

Example layout of instruction handbooks

D.1 General

It is suggested that the following information, in addition to that required by this International Standard, be included in instruction handbooks. The lists presented in D.2 are not all-inclusive and are intended to serve as a guideline.

D.2 Types of information

D.2.1 Information relating to the machine includes

— name and address of the manufacturer or supplier;

— designation of series or type;

— performance data and data on noise emission;

— description of application of machinery (intended use);

— specification of workplaces on the machine.

D.2.2 Information relating to safety includes

— diagrams or cross-sections of the machine showing safety devices and measures;

— risks caused by neglecting safety measures;

— safe working practices;

— safety information for the operator;

— possible results of unintended use.

D.2.3 Information relating to transport, handling and storage of the machine includes

— safety measures;

— dimensions and mass of the machine.

D.2.4 Information relating to installation, commissioning and removal includes

— assembly and mounting;

— de-commissioning;

— fixing and anchoring conditions;

— space needed for operation, preventive maintenance and maintenance;

— permissible environmental conditions;

— instructions for connecting the machine to power supply.

D.2.5 Information relating to the use of the machine includes

— description of manual controls;

— instructions for setting-up and adjustment and the handling of guards;

— information about residual risks;

— information about prohibited applications and errors of operation;

— instructions for fault detection and repair;

— instructions relating to the use of personal protective equipment.

D.2.6 Information relating to maintenance of the machine includes

— nature and frequency of inspections;

— preventive measures (parts with defined life, lubrication);

— spare parts;

— troubleshooting.

Annex E
(normative)

Area-light warning system

E.1 Area-light warning system

The area lights shall consist of white lights positioned about the machine in sufficient number and of adequate intensity so that when flashing OFF (dim) and ON (bright), the varying reflected intensity is apparent in the appropriate machine motion zone(s). The status of area warning lights shall be as specified in Table E.1.

E.2 Warning period

The warning period is initiated by clearing all stop/safe pushbuttons and ends not less than 2 s later. Actuation of a motion control prior to the completion of the warning period shall not induce machine motion. During the warning period, the area warning lights are flashing and a minimum of two complete flash cycles shall occur.

E.3 Permissive period

The permissive period is a period of not more than 6 s which is initiated after completion of a full warning period.

A permissive period is also initiated when an inch or reverse function control is released after machine motion has been established.

The permissive period is cancelled by initiating a change in direction of machine motion or by depressing a stop/safe pushbutton under the following conditions.

— If the permissive period is cancelled by initiating a change in machine direction, a new full warning period shall be automatically initiated.

— If the permissive period is cancelled by depressing a stop/safe pushbutton, the machine is returned to the safe condition.

During the permissive period, the area warning lights shall flash. When machine motion is established, the area lights shall be ON (bright).

At the end of the permissive period, the binding and finishing system automatically reverts to a ready condition. The area warning lights shall be ON (bright).

NOTE The permissive period allows for successive inch or reverse operations without being preceded by a warning period.

E.4 Armed or zero-speed condition

If a machine is in the armed condition or running at zero speed, the area warning lights shall flash.

E.5 Safe condition

During the safe condition, the area warning lights shall be ON (bright).

E.6 Flashing operation

Flashing operation is initiated by the release of all stop/safe pushbuttons.

Flashing operation when machine motion will be in the forward direction shall have a period of 1 s or less with a duty cycle of 50 %.

Table E.1 — Status of warning devices for area warning lights

Warning Device	Machine condition					
	Stop/Safe	Fault	Warning period	Permissive period	Machine motion	Armed
Area warning light	ON/OFF[a]	ON/OFF[a]	Flash	Flash	ON/OFF[a]	Flash/ON[a]
Audible alarm[b]	OFF	OFF	ON	OFF	OFF	OFF/Pulse[b]

[a] Either condition is permitted.

[b] If used.

Bibliography

[1] ANSI Z244.1, *Safety Requirements for the Lockout/Tagout of Energy Sources*

[2] ANSI Z535.3, *Criteria for Safety Symbols*

[3] ANSI Z535.4, *Product Safety Signs and Labels*

[4] EN 378-1, *Specification for refrigerating systems and heat pumps. Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria*

[5] EN 614-1, *Safety of machinery. Ergonomic design principles. Terminology and general principles*

[6] EN 614-2, *Safety of machinery. Ergonomic design principles. Interactions between the design of machinery and work tasks*

[7] EN 746-1, *Industrial thermoprocessing equipment. Common safety requirements for industrial thermoprocessing equipment*

[8] EN 894-1, *Safety of machinery. Ergonomics requirements for the design of displays and control actuators. General principles for human interactions with displays and control actuators*

[9] EN 894-2, *Safety of machinery. Ergonomics requirements for the design of displays and control actuators. Displays*

[10] EN 894-3, *Safety of machinery. Ergonomics requirements for the design of displays and control actuators. Control actuators*

[11] prEN 1010-1, *Safety of machinery. Safety requirements for the design and construction of printing and paper converting machines. Common requirements*

[12] prEN 1010-3, *Safety of machinery. Safety requirements for the design and construction of printing and paper converting machines. Cutting machines*

[13] prEN 1010-4, *Safety of machinery. Safety requirements for the design and construction of printing and paper converting machines. Bookbinding, paper converting, and paper finishing machines*

[14] EN 1760-1, *Safety of machinery. Pressure sensitive protective devices. General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*

[15] EN 1760-3, *Safety of machinery. Pressure sensitive protective devices. General principles for the design and testing of pressure sensitive bumpers, plates, wires and similar devices*

[16] prEN 12753, *Thermal cleaning plants (incinerators) for exhaust gas from surface treatment plants. Safety requirements*

[17] EN 50081-2, *Electromagnetic compatibility. Generic emission standard. Industrial environment*

[18] *European Council Directive 92/58/EEC of 24 June 1992*

[19] IEC 60073, *Basic and safety principles for man-machine interface, marking and identification — Coding principles for indication devices and actuators*

[20] IEC 60079-0, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements*

[21] IEC 60079-4, *Electrical apparatus for explosive gas atmospheres — Part 4: Method of test for ignition temperature*

[22] IEC 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas*

[23] IEC 60204-32, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines*

[24] IEC 60447, *Man-machine-interface (MMI) — Actuating principles*

[25] IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

[26] EC 61310-3, *Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators*

[27] IEC 61491, *Electrical equipment of industrial machines — Serial data link for real-time communication between controls and drives*

[28] ISO 9355-1, *Ergonomic requirements for the design of displays and control actuators — Part 1: Human interactions with displays and control actuators*

[29] ISO 9355-2, *Ergonomic requirements for the design of displays and control actuators — Part 2: Displays*

[30] ISO 11228-1, *Ergonomics — Manual handling — Part 1: Lifting and carrying*

[31] ISO/TS 13732-2, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 2: Human contact with surfaces at moderate temperature*

[32] ISO/TR 13849-100, *Safety of machinery — Safety-related parts of control systems — Part 100: Guidelines for the use and application of ISO 13849-100*

[33] ISO 13853, *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs*

[34] ISO 14118, *Safety of machinery — Prevention of unexpected start-up*

[35] ISO 14121, *Safety of machinery — Principles of risk assessment*

[36] ISO 15534-1, *Ergonomic design for the safety of machinery — Part 1: Principles for determining the dimensions required for openings for whole-body access into machinery*

[37] ISO 15534-2, *Ergonomic design for the safety of machinery — Part 2: Principles for determining the dimensions required for access openings*

[38] ISO 15534-3, *Ergonomic design for the safety of machinery — Part 3: Anthropometric data*

[39] *International Electrotechnical Vocabulary (IEV)* <http://domino.iec.ch/iev/iev.nsf>

[40] NFPA 79 *Electrical Standard for Industrial Machinery*

[41] NFPA 86, *Ovens and Furnaces*

[42] *OSHA 29CFR1910.147, Control of Hazardous Energy Sources (Lockout/Tagout)*

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