INTERNATIONAL STANDARD

ISO 12648

Second edition
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Graphic technology — Safety requirements for printing press systems

Technologie graphique — Exigences de sécurité pour systèmes de presses à imprimer

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Foreword

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

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 12648 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 12648:2003), the following subclauses of which have been technically revised.

— 5.1: A requirement has been added to enable needed observation and adjustment with guards closed.

— 5.2.2.1: The use of risk assessment has been added to requirements, as appropriate.

— 5.5.6.3: A requirement to protect against malfunction of the interlock circuit as a result of short circuits has been added.

— 5.9.2.11: The exception to the requirements for protection of hazard zones on the unwinding unit of automatic reel-loading systems has been removed.

— 5.9.7 – 5.9.9: Requirements relating to guarding of the gripper area have been added.

— 6.5.2.4: For access platforms, a maximum handle diameter has been added.

— 9.2: A requirement for the use of symbology defined in ISO 15847 has been added.

— 9.2.3: A requirement for the colour of manual control devices in accordance with IEC 60204-1 has been added.

— 9.2.4.1.2: The location of emergency control devices has been clarified.

— 13.2.2: The timing of the audible alarm during the warning period has been changed.

— 13.2.6: Requirements for optional personnel warning lights for auxiliary equipment having armed status have been added.

— 15.2: Additional requirements for the contents of the instruction handbook have been defined.

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 has taken into consideration material contained in ANSI B65.1-1995 [55] , EN 1010-1 [11] and EN 1010-2 [12].

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of one or more patents concerning the use of ESPDs in the delivery area. The patents identified are:

— German Patent DE 103 10 236 B3

— PCT patent application WO 2004/078626 A1

ISO takes no position concerning the evidence, validity and scope of this patent right.

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Graphic technology — Safety requirements for printing press systems

1 Scope

This International Standard provides safety requirements for the design and construction of machines used in printing press systems, including auxiliary equipment and finishing machines, in which all the machine actuators (e.g. drives) of the equipment in the system are controlled by the same control system.

It is applicable only to systems in which a printing press is part of the system. In cases where a binding/finishing system is not integrated with a printing press, ISO 12649 [32] will apply.

It addresses recognized hazards specific to printing press systems in the following areas:

— mechanical;

— electrical;

— slipping, tripping, falling;

— ergonomics;

— noise;

— radiation;

— fire and explosion;

— thermal;

— emissions.

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.

This International Standard applies to machines manufactured one year or more after the date of publication of this International Standard.

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 plastics hoses and hose assemblies — Determination of electrical resistance*

ISO 11553:1996, *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 12100-1:2003, *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 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 13851:2002, *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 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 walkways*

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

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

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"*

1) To be published.

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: Construction, test and marking of type of protection encapsulation 'm' electrical apparatus*

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 61496-1:2004, *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 378-1, *Refrigerating systems and heat pumps. Safety and environmental requirements — Part 1: Basic requirements, definitions, classification and selection criteria*

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

EN 1127-1, *Explosive atmospheres — 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*

NFPA 86, *Ovens and furnaces*. Available from Internet <http://www.nfpa.org/>

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13849-1and the following apply.

3.1
access height in the sheet-fed press delivery zone
dimension of the maximum opening into the area below the sheet gripper, measured between the access level (floor, fixed platform or footboard) and the lower edge of fixed machine parts (e.g. fixed guard, fixed cover, fixed parts such as a sheet stop) (see Figure 18)

3.2
actuator
part of the actuating system to which an external actuating force is applied

[IEV 441-15-22][54]

NOTE 1 The actuator can 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** (3.39).

3.3
alcohol dosing equipment
device(s) used to regulate the amount of alcohol in the dampening water of offset printing presses

3.4
armed condition
machine status in which machine motion can be automatically initiated

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

3.5
audible alarm
horn, bell or other distinctive audible warning device that sounds to indicate impending machine motion

3.6
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; the consequences of those improper actions.

3.7
automatic plate clamping device
mechanism used to secure a printing plate during the automatic or semi-automatic changing of the plates

3.8
auxiliary devices for printing presses
mechanisms or machines, either built-in or attached, used for the production process

3.9
barrier guard
guard (3.32) that reduces or prevents access to a hazard zone by closing off access to an area containing one or more hazards

3.10
bypass function
bypass sequence
temporary, time-limited suppression of one or more safety functions through the use of safety-relevant parts of a control system

3.11
category 0 stop
uncontrolled stop
stopping by immediate removal of power to the **machine actuators** (3.39)

[IEC 60204-1:2000]

3.12
category 1 stop
controlled stop with power available to the **machine actuators** (3.39) to achieve the stop and then removal of power when the stop is achieved

[IEC 60204-1:2000]

3.13
category 2 stop
controlled stop with power to the **machine actuators** (3.39) being maintained

[IEC 60204-1:2000]

3.14
coating unit
coater
machine that applies a predetermined thickness of a liquid substance (e.g. glue, varnish, ink, etc.) on substrates made of paper or a similar material

NOTE The thickness of the layer is determined by a doctor blade (scraper) or by the gap between two rollers (metering gap).

3.15
continuous-flow drying and curing device
mechanism built into printing presses to dry and cure inks and coatings that have been applied to substrates after the printing process (e.g. by hot air, IR or UV radiation)

3.16
continuous run
machine motion at a steady speed initiated by a momentary contact control

3.17
control station
defined location containing one or more controls

3.18
control zone
control configuration of single or multiple machine motions using the same control devices (see Clause 8)

3.19
crawl speed
continuous movement at a steady slow speed, and initiated by a momentary contact control

3.20
cylinder
smooth roller
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 1)

Dimensions in millimetres

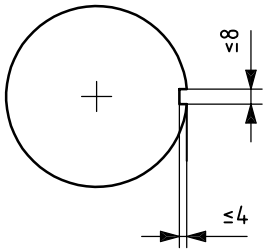


Figure 1 — Smooth roller/cylinder

3.21
cylinder screen printing press
sheet-fed machine in which the substrate (sheet) to be printed is guided along the screen by a printing **cylinder** (3.20)

3.22
digital printing press
machine in which the printed image is produced from data stored in digital form (e.g. exposing a photo-sensitive drum or film in the machine)

3.23
electrical hazard
source of potential injury or death from electric shock or burn

3.24
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.

3.25
emergency stop device
manually actuated control used to initiate an **emergency stop function** (3.26)

[ISO 13850:1996]

3.26
emergency stop function
mechanism initiated 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

3.27
enabling device
mechanism that must be in a specified state or condition in order for a second actuator or device to start a machine under **hold-to-run control** (3.34), and which will stop machine movement as soon as one of the hold-to-run controls is released or the status of the mechanism changes

3.28
exposing devices
machinery used for creating images by exposing photo-sensitive material such as printing plates or printing formes

3.29
fixed guard
guard (3.32) that is securely affixed by fasteners that require a tool(s) to gain access to an area with a significant hazard

3.30
forms printing press
leporello printing press
machine for the production of continuous forms where paper webs printed with one or more colours are accordian-folded or wound on to a reel

NOTE In addition to the printing section, the machine consists of devices for punching, remaliners (sprocket punching), cross perforation, longitudinal perforation and leporello (zig-zag) folding.

3.31
gravure press
machine consisting of a printing cylinder, an inking system in which ink is applied to the printing cylinder by an ink roll or spray and the excess is removed by a doctor blade and an impression cylinder covered with a rubber composition, which presses the substrate into contact with the ink in the cells of the printing cylinder

3.32
guard
physical barrier that restricts access to a **significant hazard** (3.80)

3.33
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)]

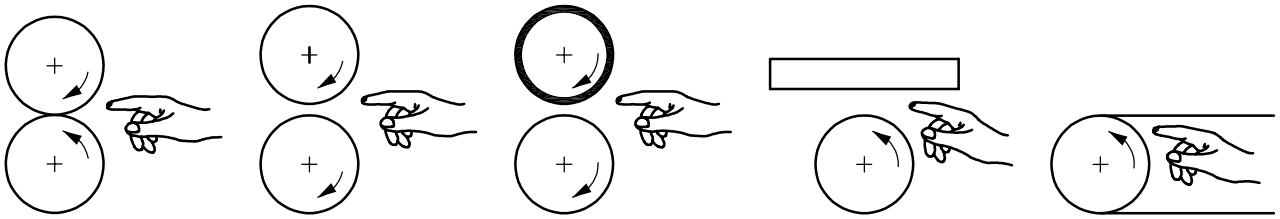
3.34
hold-to-run control
control that starts and maintains machine motion only as long as the control is activated

3.35
inch
jog
〈operation of machinery〉 machine motion requiring maintained activation engagement of a **hold-to-run control** (3.34) and which will continue until the control is released or until a pre-determined displacement (limited inch) has been reached

3.36
inch speed
how fast the press is operating while in **inch** (3.35) mode

3.37
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

3.38
in-running nip
area created either by two rotating components that are rotating inward, or by one rotating component rotating toward an adjacent surface (see Figure 2)



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 2 — In-running nips

3.39
machine actuator
power mechanism used to effect motion of a machine

[ISO 13850:1996]

3.40
maintained-contact control
control that remains in an opened or closed state after its activation

3.41
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 (e.g., 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.

3.42
make-ready
tasks preceding a production run, such as adjusting ink controls for proper colour, plate alignment for proper registration, adjusting pressures, measurement with quality control devices, etc.

3.43
manual control device
mechanism comprising part of the actuating system to which a manual action is applied

[Adapted from IEV 441-15-22][54]

3.44
mechanical hazard
source of potential injury to a person, created by motion of machinery, components or material (e.g. 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.

3.45
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 (knife blades, etc.) of machines, or parts thereof; work pieces or parts thereof, or materials being processed.

3.46
momentary contact control
control that is opened or closed only during its actuation

3.47
motion control
control that initiates machine movement or movement at **zero speed** (3.92), or places the machine in the **armed condition** (3.4)

3.48
motion control station
station that contains a **motion control** (3.47)

3.49
motion zone
area defined by any press component, or group of press components, that is driven directly by the press system drive motor(s) or **machine actuator**(s) (3.39), or indirectly by the web

3.50
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

3.51
movable guard
guard (3.32) that does not require a tool to move or remove it to gain access to a significant hazard

3.52
newspaper printing presses
machines that are designed and built mainly for printing newspapers

3.53
nip guard
guard (3.32) located at an in-going nip

EXAMPLES Nip bar, finger bar, finger guard.

3.54
non-motion zone
area defined by any press component, or group of press components, which, due to system configuration, is not driven by the press system drive motor(s) or by the web

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

3.55
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** (3.41) operations

3.56
operating position
location where normal functions (make-ready and other routine, repetitive tasks) requiring control of main drive motor(s) are performed

3.57
permissive period
time interval during which machine motion can be initiated (see 13.2.3)

3.58
personnel warning lights
red and green lights used to indicate the ready, running and safe conditions of the printing press relative to personnel safety

NOTE These lights are not the same as machine **status lights** (3.81).

3.59
pile turner
device attached to sheet-fed printing presses and used to turn piles of printed paper for further processing, such as back-printing on a second run

3.60
portable control station
control station that can be disconnected from one location, moved to another location and be reconnected

3.61
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.

3.62
positive opening
contact separation as the direct result of a specified movement of the **actuator** (3.2) through non-resilient members, e.g. those not dependent on springs

3.63
powder spraying devices
equipment used to spray powder onto the printed material on the delivery side of sheet-fed printing presses

3.64
press system
printing press and a series of machines that supply substrate into and through the printing press and guide or direct the substrate to a cutting, folding or delivery device that delivers the product to the last working station integrated with the printing press control system

3.65
printing forme
printing plate
base material that stores the image to be printed (pictures and/or text) and transfers ink on to a substrate, thus printing the image

3.66
printing table
supportive surface to hold the substrate to be printed during the printing process (as on certain types of screen printing presses)

3.67
proofing press
machine with manual feeding and delivery used for printing a small number of copies, and generally used for assessing print quality before the printing forme is mounted in the machine

3.68
raised workplace
areas where functions are regularly performed, and are at least 0,5 m above access level

3.69
ready condition
status of a machine in which motion can be initiated by the operator

3.70
reel rewinding device
part of a machine used for rewinding the processed web-type material

3.71
reel turner
device used to turn reels (webs) of substrate for easier handling, e.g. for correct positioning of the reel when feeding webs to printing presses

3.72
reel unwinding device
part of a machine used for unrolling web-type material for processing

3.73
remote control
connection to the control station of a machine by use of an external communication link

3.74
routine and regular access
repetitive access to a hazard point that is required for manual feeding of a machine during normal production activity

3.75
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

3.76
screen frame
device for taking up the printing screen

3.77
screen printing press
machine using printing formes with woven material (screens) that partially allow ink to penetrate through the material

3.78
separating elements
parts on feeders of sheets, blanks or similar materials that separate the individual sheets, blanks, etc.

3.79
sheet-fed press
machine for printing sheet-size substrates, including proofing presses, in which sheets may be fed by feeders (automatic or manual), or from sheeters attached to unwinding units

3.80
significant hazard
potential source of severe or disabling injury, or death

3.81
status lights
lights that indicate machine status or machine process condition

NOTE These are not the same as **personnel warning lights** (3.58).

3.82
tool
implement, such as a key or spanner, designed to operate a fastener

NOTE An item such as a coin or nail file is not considered a tool.

3.83
trip bar
protective bar that, when pushed, activates the interlocked safety system of the machine

3.84
trip nip bar
movable protective bar located at an **in-running nip** (3.38) that, when pushed, activates the interlocked safety system of the machine

3.85
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

3.86
warning period
time interval during which machine motion is prevented and a warning is given to personnel that machine motion is about to occur

3.87
washing device for roller/cylinder
equipment integrated into the printing press for washing cylinders and rollers such as ink rollers, blanket cylinders, printing cylinders, plate cylinders

3.88
washing equipment for printing formes
machines for washing printing formes outside the printing press

EXAMPLE Screen washing equipment.

3.89
web-fed press
press in which a substrate passes through the printing couple, or couples, in a continuous form, as fed from a roll

3.90
web-type material
web of paper, board, foil or similar material that is to be handled or processed

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** (3.4).

4 Classification of machines covered by this International Standard

4.1 Machines for producing printing by various processes

The following categories of printing press are covered by this International Standard:

— relief (letterpress, flexographic);

— offset (lithographic);

— gravure (rotogravure, intaglio);

— screen printing;

— digital (electrostatic, ink jet, thermal, etc.).

New technologies should incorporate the safety principles set forth in this International Standard, in their design.

4.2 Auxiliary equipment

Auxiliary equipment that is part of a printing press system is covered by this International Standard.

EXAMPLE The following are examples of auxiliary equipment often part of a printing press system, depending on the process:

— washing equipment for cylinders and rollers;

— powder spraying devices;

— alcohol dosing devices;

— imprinting/addressing/numbering equipment;

— automatic plate clamping devices, automatic pile handling equipment;

— washing equipment;

— inserting machines;

— pile turners, reel turners, elevators;

— dryers/pollution control;

— radiation equipment;

— in-line processing and finishing equipment;

— stackers;

— palletizers;

— bundlers;

— coaters;

— chilling systems;

— electrostatic equipment;

— humidifiers;

— accumulating or piling-off devices;

— conveyors;

— unwinding, rewinding, reel transport devices.

5 Guarding against 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. Machinery shall be designed according to the principles of ISO 12100-1 and ISO 12100-2 for hazards that are relevant, but not significant, and which are not covered by this International Standard.

Significant hazards (e.g. 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 shall be guarded against.

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 5.4.2, 5.4.3 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 Guard types and travel

5.2.1.1 Types of guard

For the purpose of this International Standard there are two types of guard, 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 (see 3.82), such as a key or a spanner, designed to operate a fastener.

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, removed 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 A typical shift is 8 h.

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

— 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.

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

5.2.1.2 Automatic travel of movable guards

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

This can be achieved 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 an 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 so that there is no risk of a crushing injury.

Higher values may be chosen based upon risk analysis.

5.2.1.3 Protection against gravity falls of guards

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

— devices for balancing the mass;

— pneumatic springs;

— devices that 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 positioning

5.2.2.1 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.

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

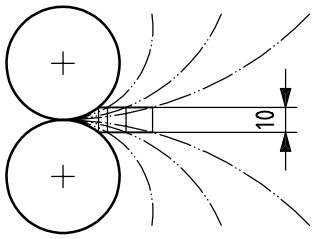


Figure 3 — Measuring safety distances at in-running nips

5.2.2.2 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. Otherwise,

a) either the height of the danger 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[37].

5.2.2.3 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 value. 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 (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 value. 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 (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. For guarding in-running nips that are accessible while a movable guard is open, see 5.4

On sheet-fed flexographic printing presses, the feed opening between the side lays and the sides of the machine shall be guarded by means of adjustable or self-adjustable guards.

EXCEPTION: On sheet-fed printing presses that are also used for printing on board, sheet metal or other inflexible materials, it is possible that for production reasons ISO 13852 cannot be applied in the feeding area. In this case, the height of the material feeding aperture shall be as small as possible, but shall not exceed 20 mm. The existence of residual risk shall be identified in the instruction handbook.

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;

NOTE For non-powered surfaces, this hazard will depend on a number of factors; e.g. type of material, wrapping angle, web speed, inertia.

— 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;

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

Examples of in-running nips are shown in Figure 2.

5.4 Guarding in-running nips

5.4.1 General

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 ISO 13852:1996, Table 4.

b) nip guard (allowed) on smooth surface rollers/cylinders only, 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, in accordance with 9.7.

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.

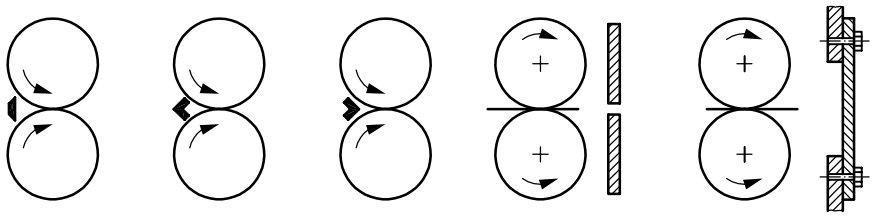
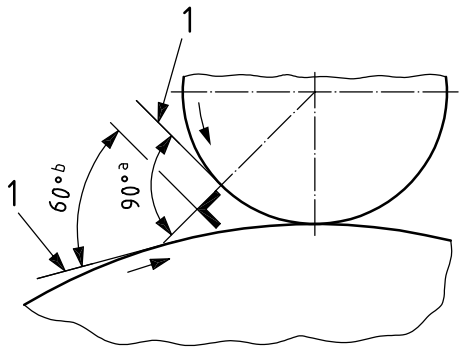


Figure 4 — Examples of nip guards

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 tangent

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 presses, such as business form presses, the clearance should be smaller, if possible, considering both safety and production concerns.

Dimensions in millimetres

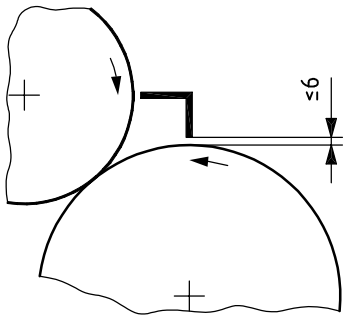
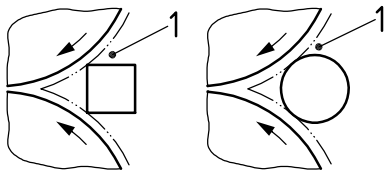


Figure 6 — Safeguarding an in-running nip by means of a fixed nip guard

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 9.7.



Key

1 wedge pocket

Figure 7 — Shapes creating wedge pockets

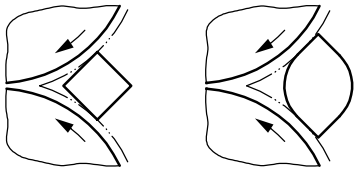


Figure 8 — Shapes not creating wedge pockets

5.4.2 Guarding in-running nips on sheet-fed presses

If technically feasible, trip nip bars in accordance with 9.7 shall be used where frequent access is required to the area during machine motion, and cylinders are directly accessible after the interlocked guard has been opened.

If it is not possible to use trip nip bars as described above, hold-to-run control speed limitations defined in 5.6.1 a) shall apply.

NOTE Use of trip nip bars is not possible on small-size offset presses where trip nip bars would impede access to the cylinder for activities such as plate changing.

Where cylinders have gaps that exceed those defined for smooth cylinders (see 3.79), trip nip bars, in accordance with 9.7, should be used. Nip guards shall not be used with these cylinders. For such trip guards, the requirements of category 3 of ISO 13849-1:1999 shall be satisfied and the interlocking system shall be designed such that the requirements for stopping paths defined in 9.7 are satisfied. Trip nip bars and cylinder gaps shall be designed such that cylinder nips cannot be accessed behind trip nip bars, thus causing a hazard.

To comply with the requirements of 5.5, the interlocking systems will normally have to be designed such that, after opening the interlocked guard, a predetermined number of revolutions, depending on the functional characteristics of the trip guard, is not exceeded.

5.4.3 Guarding in-running nips on web-fed presses

In-running nips that are not, in the operator's view, from the position where the hold-to-run control or enabling device is operated shall be safeguarded by additional measures.

Such measures include:

— guarding in accordance with this clause;

— an electrically interlocked, movable nip bar on the outgoing side between the two blanket cylinders of a rotary offset printing press, that ensures that the bar is in position prior to reverse movement.

On machines with varying web paths where such measures for safeguarding the in-running nip existing between blanket cylinders during the reverse movement are not feasible, the following procedure using a hold-to-run with limited inch control is permitted, providing all of the following conditions are met:

— speed shall not exceed 3 m/min;

— movement shall not exceed 1,2 cylinder revolutions;

— a stop control element with mechanical latch (such as a stop/safe pushbutton) or an emergency stopping device shall be in the immediate vicinity of the in-running nip;

— a modified audible warning signal shall be used;

— a red flashing light shall be provided that can be seen during the warning and permissive periods, and a red warning light (steady burn, not flashing) shall be provided during operating time of the hold-to-run control in the immediate vicinity of any unguarded in-running nip that cannot be observed.

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).

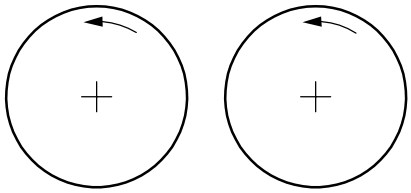


Figure 9 — Non-hazardous rollers rotating in the same direction

5.4.4 Guarding in-running cylinder nips on newspaper presses

In deviation from 5.4.1 b), nip guards may be used for web-fed newspaper printing presses on cylinder gaps of up to 19 mm circumferential slots (see 3.20). For new machines, however, efforts should be made to limit cylinder gaps to 12 mm circumferential.

NOTE Some press cylinder lock-up devices, such as on newspaper presses, require gaps up to 19 mm, measured without the blanket. With the blanket in place, the gap is reduced significantly.

5.4.5 Guarding in-running nips on flatbed offset proofing presses

On flatbed offset proofing presses, the in-running nip between the movable upper unit and the fixed lower unit or printing table shall be safeguarded. This can be achieved by the provision of trip nip bars or electro-sensitive protective devices.

Trip nip bars shall satisfy the requirements of 9.7, and category 3 of ISO 13849-1:1999. Electro-sensitive protective devices shall comply with 9.6. The safety device shall cause the upper unit in time to prevent any risk of injury. The hand-approach speed specified in ISO 13855 does not need to be met.

5.4.6 Guarding in-running nips on cylinder screen printing presses

On cylinder screen printing presses, the in-running nip on the printing cylinder shall be safeguarded.

This can be achieved by interlocked guards, or guarding by the printing forme (screen).

Where the printing forme is used as a means of guarding, additional protective measures are required for lifting and removal of the printing forme.

Such additional measures can be electrical interlocking, which allows cylinder rotations only under hold-to-run control according to 5.6.1 as long as the printing forme is lifted.

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, using the maximum braking action established for that press system without creating an additional hazard. Machine motion shall not be able to be initiated without the operator going through the normal starting sequence.

If a machine is operating at inching speed and under conditions defined in 5.6.1, motion may continue.

5.5.2 Continuous run with an interlocked guard open

When any interlocked guard is open, continuous run shall not be permitted.

EXCEPTION: If the only hazard being protected by the interlocked guard is an in-running nip, continuous machine motion at crawl speed may be permitted with a guard open provided the condition specified in 9.3.3 is met.

5.5.3 Closing an interlocked guard

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

Closing the interlocked guard on dampening, coating or inking devices may initiate the rotation of dampening or coating ductor rollers or metering rollers if it is ensured that at this time no hazard points can be accessed.

NOTE Restarting any independently driven dampening, coating, metering, or ink fountain rollers may be required in order to prevent malfunctions due to dried up coating or dampening agents.

5.5.4 More than one interlocked guard open

Where more than one interlocked guard is open and there are any unguarded hazard zones that cannot be observed from a single point of operation, an inch function or reverse function (as specified in 9.2.4.5.2 – 9.2.4.5.3), or a plate position function (as specified in 9.2.4.11) shall be permitted if

a) all in-running cylinder nips behind interlocked guards are additionally guarded by nip guards and all other hazards are guarded or

b) 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.

5.5.5 Remote control with interlocked guard open

When any interlocked guard is open, initiation of motion of the press system by remote control shall be prohibited (see 11.1).

5.5.6 Interlock design

5.5.6.1 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.

5.5.6.2 Personnel safety switches for interlocked guards

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

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

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

For manually fed devices where interlocked guards are used to safeguard routine and regular access to hazard points (see 3.74), control systems for safety position switches shall satisfy category 4 of ISO 13849-1:1999.

5.5.6.3 Short circuits of interlock circuits

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

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

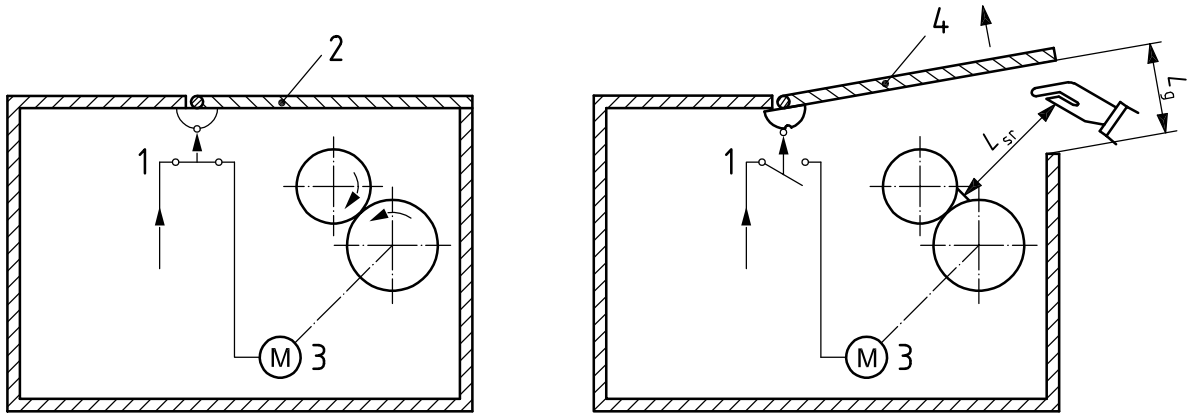
5.5.7 Interlocking with guard locking

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 EN 1010-2[12] in that the latter requires guard locking where hazardous movement cannot be stopped within at least 10 s of actuation of the personnel safety switch.

Table 1 — 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	$\leqslant 30$
$\geqslant 80$ and < 500	$\leqslant 40$
$\geqslant 500$ and < 850	$\leqslant 80$
$\geqslant 850$	$\leqslant 160$
[a] See Figure 10 for location of the measurements.	



a) motor running **b) motor stopped**

Key

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

Figure 10 — Distances related to requirements for guard locking

5.6 Hold-to-run controls

5.6.1 General

If all hazard points are safeguarded by nip guards in accordance with 5.4.1 to 5.4.6, 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 interlocked 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 interlocked guard open and hazardous points unprotected, machine motion 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 be category 3 of ISO 13849-1:1999. Control circuitry (including selector switch relays and PLC circuits) that 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.

NOTE This International Standards differs from EN 1010-1[11] in that the latter permits motion at speeds between 5 m/min and 10 m/min only with the use of a two-hand control.

Any two-hand control device shall meet the requirements defined in 9.5.1 tol 9.5.3. The stopping path shall be as short as technically feasible.

See 11.1 for general requirements for control systems.

5.6.2 Specific requirements for sheet-fed presses

When interlocked guards are opened and any exposed hazard point is not safeguarded, sheet-fed printing press systems shall only be allowed to be started under hold-to-run according to 5.6.1 a).

When interlocked guards are opened and all hazards are protected, crawl speed is permitted under the provisions of 9.3.3.

When interlocked guards are opened and direct access to unprotected in-running nips on cylinders or unprotected hazard points on the sheet transport system is not possible, the machine may be started under hold-to-run control according to 5.6 b). In this case, continuous run while an interlocked guard is open shall not be possible.

NOTE 1 “Cylinders” includes plate cylinders, blanket cylinders, impression cylinders, etc. Ink rollers and dampening water rollers, for example, are not considered to be cylinders within the meaning of this International Standard.

NOTE 2 “Sheet transport systems”, e.g. gripping systems, transport drums.

NOTE 3 “Direct access” is possible where in-running nips can be reached after falling in or where nips are located in the immediate vicinity of places where setting-up or cleaning operations need to be carried out.

NOTE 4 On small-size sheet-fed presses, movements can be non-powered.

5.6.3 Specific requirements for forms presses

In deviation from the requirements of 5.6.1, on forms printing presses, starting the machine by two-hand control with guards open shall be possible with a speed higher than 10 m/min where this is required for production reasons and all of the following requirements are met:

— other interlocked guards outside the area that can be observed shall be closed;

— a selector switch shall be used for this kind of operation;

— warning shall be provided in the instruction handbook (including a statement of the operator's responsibility and a description of safe working practices);

— hold-to-run speed shall be as low as possible under production conditions.

5.7 Automatic format setting operations

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

EXAMPLES Automatic format setting devices include sheet side lays, suction heads, turner bars, compensators, slitters, etc.

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

a) provision of trip devices or

b) a separate stop device that is not included in the emergency stop circuit of the printing press or

c) zone control using the emergency stop circuit.

5.8 Other safeguarding measures

5.8.1 General

Where safeguarded accessible hazard zones cannot be observed from positions from which hazardous movements can be started, the requirements of 5.8.2 to 5.8.5 shall apply.

5.8.2 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.

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.

5.8.3 Electro-sensitive protective devices

Where accessible hazard zones are safeguarded by means of electro-sensitive protective devices (ESPDs), an additional control element 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, e.g. 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 9.6.

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

Pressure-sensitive mats, pressure-sensitive bumpers and trip nip bars shall function in accordance with 9.7.

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

EXAMPLE 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.

5.8.5 Auxiliary devices that act as guards on printing and coating units

Auxiliary devices that are built into printing and coating units and act as fixed guards to prevent access to hazard points in the built-in position shall be fitted so that they can be removed only by means of tools. Auxiliary devices that prevent access to hazardous areas, and that need to be removed frequently or accessed for set-up, act as movable guards and shall be interlocked with any hazardous movement (see 5.5).

EXAMPLE A continuous-flow drying device on the delivery side of sheet offset printing presses where drying modules are inserted into the printing press from the side that, when removed, allows access to hazard points on the sheet gripper system.

NOTE Auxiliary devices are listed in 4.2 and defined in 3.8.

When the machine is operated with the auxiliary device removed, thus exposing a hazard, alternative guards shall be used to protect the user from the hazard point(s).

5.9 Guarding of machine devices and components

5.9.1 Feeding units, delivery units (pile lifting and lowering devices) on sheet-fed printing presses and coating units

5.9.1.1 Load take-up equipment

Load take-up equipment shall be designed such that it can stand a static load test with a load of $\times$ 1,25 the maximum load capacity without showing permanent deformation or apparent defects. It shall stand a dynamic load test with a load of $\times$ 1,1 the maximum load capacity under normal operating conditions.

5.9.1.2 Breaking strength of components

On lifting and lowering devices with production format sizes greater than 2,5 m^2, the breaking strength of the steel link chains shall be at least six ($\times$ 6) times the permissible static load; on pile lifting and lowering devices with production format sizes less than 2,5 m^2, the breaking strength of the steel link chains shall be at least three ($\times$ 3) times the permissible static load.

Calculations shall be based on a minimum specific density of 1 400 kg/m^3 for paper and a minimum specific gravity of 200 kg/m^3 for corrugated board.

5.9.1.3 Lifting height of pile lifting and lowering devices

5.9.1.3.1 Pile carrier

On pile lifting and lowering devices with production format sizes greater than 2,5 m^2, and a lifting height greater than 1,5 m, provisions shall be made to prevent the pile carrier from moving more than 100 mm in case of failure of a rope, chain, supporting nut or gear drive in areas where such a failure may cause injury.

This requirement is satisfied for worm drives, by providing an additional nut of the same type as the supporting nut in order to back up the supporting nut in the event of a breakage or thread wear. The requirement is satisfied for chains (or ropes), for example, by providing one or more unloaded double chains that, in the event of a chain breakage, take over the load and function of the operating chain.

EXCEPTION: This requirement does not apply to gears that are rated for double load. This requirement also does not apply to lifting and lowering devices with a hydraulic or pneumatic drive if, in case of leakage in the pipe system, the lowering speed of the pile carrier does not accelerate to more than × 1,5 the speed under normal operating conditions.

See also 5.9.1.4.1.

5.9.1.3.2 Pile carrier plate

On pile lifting and lowering devices with production format sizes greater than 2,5 m^2, the area below the pile carrier plate shall be safeguarded by guards or by electro-sensitive protective devices. ISO 13855 need not be considered.

On pile carrier plates, the hazard points between the edges of the pile carrier plate and the place where the operator may stand shall be safeguarded by one of the following means, in order to prevent injury to the operator.

a) On feeders with production format sizes of up to and including 1 m^2, and on deliveries with format production sizes of up to and including 0,175 m^2, the pile carrier plate shall be allowed to lower automatically down to a height of 120 mm above the floor, and further down to the base only in the hold-to-run control mode.

b) On feeders with production format sizes of greater than 1 m^2, and on deliveries with format production sizes of greater than 0,175 m^2, one of the following protective measures shall be provided in order to safeguard the exposed edges of the pile carrier plates.

   — Resilient, non-switching, overhanging shields with their forward edges protruding over the hazardous edges by at least 250 mm shall be used (see Figure 11).

   — Electro-sensitive protective devices located in front of the pile carrier plate edges shall be used. ISO 13855 need not be considered. The movement of the pile carrier plate may be automatically initiated when the electro-sensitive protection device is no longer actuated.

   — A horizontal distance of 300 mm between the vertical projection of the machine frame and the pile carrier plate shall be used. The protruding parts of the machine frame shall not be higher than 1,5 m above the base. Carrier arms reaching into the safety distance (300 mm) shall be at least 120 mm above the floor (see Figure 12). To lower the pile carrier plate below 120 mm, hold-to-run control shall be used.

   — Pressure-sensitive bumpers or trip devices shall be used.

   — Hold-to-run control shall be used on feeders at a horizontal distance of at least 850 mm from the hazard point and at a position from where the hazard point is in the operator's view.

c) On feeders and deliveries with production format sizes greater than 2,5 m^2, the hazard point shall be safeguarded by one or more of the following safety devices:

   — guard;

   — photoelectric device in front of the edge of the pile carrier plate, or on board feeding and delivery units by a photoelectric device fitted at a distance of 300 mm minimum from the edge of the pile carrier plate;

   — other presence-sensing devices as defined in 9.6 and 9.7.

Where platforms or gangways are fitted to the feeding or delivery unit, the hazard point between platform or gangway and the edge of the pile carrier plate shall be safeguarded.

This can be achieved by one of the following measures:

— minimum distance of 120 mm between pile carrier edge and edge of platform;

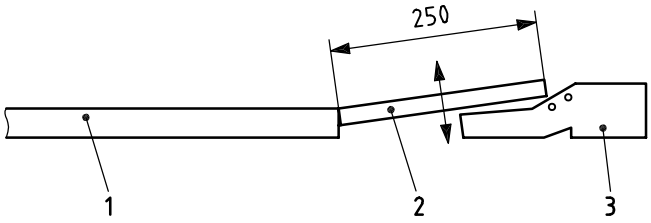
— electro-sensitive protective devices in front of the pile carrier edge (ISO 13855 need not be considered);

— horizontal distance of 300 mm between the vertical projection of the outer edge of the machine frame and pile carrier edge, with protruding parts of the machine frame arranged at a maximum distance of 1,5 m above platform or gangway;

— trip device.

See also 5.9.1.4.1.

Dimensions in millimetres



Key

1 pile carrier plate
2 overhanging shield
3 foot

Figure 11 — Overhanging shield

Dimensions in millimetres

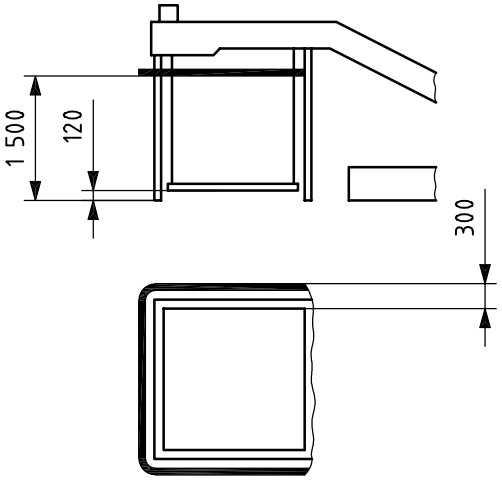


Figure 12 — Safeguarding by deflecting parts of the machine frame

5.9.1.3.3 Pile changing device

Where the movement of pile changing devices causes a crushing hazard between the pile changing device, the pile lifting and lowering device, the paper pile and fixed machine parts, safeguarding shall be provided. This can be achieved by means that include, but are not limited to:

— fixed or interlocked guards in accordance with 5.2;

— electro-sensitive protective devices in accordance with 5.8.3;

— safety distances and gaps in accordance with ISO 13852 and ISO 13854;

— hold-to-run control in accordance with 5.6;

— trip devices in accordance with 9.7.

For trip devices, the requirements of category 3 of ISO 13849-1:1999 shall be satisfied.

5.9.1.3.4 Pile turners and reel turners

On pile turners and reel turners, the crushing point between the floor and load-lifting member (lifting fork, pile carrier plate, pallet) or paper pile shall be safeguarded.

The following are examples of safeguarding.

a) Where hold-to-run control is being adopted as a safety measure, pile descent shall only be done in the hold-to-run control mode with a maximum speed of 5 m/min. Unintended access to the hazard zone shall be prevented by providing a sufficient distance between the location of the hold-to-run control and load-lifting member, or by providing a foot guard. The hazard point shall be in the operator's view from the location of the hold-to-run control. Hazard points on the far side of the paper pile are considered to be in the operator's view if the pile height, including load lifting member, does not exceed 1,4 m in the lowest position.

b) Electro-sensitive devices used for safeguarding a hazard zone with crushing points between the floor and the load-lifting member shall satisfy the requirements of 9.6.1 and 9.6.4. Hand-approach speeds in accordance with ISO 13855 need not be taken into account where the descent speed is not more than 5 m/min.

On hydraulic and pneumatic lifting equipment of pile turners and reel turners, an unblockable check valve shall be provided directly on the lifting cylinder if there is the possibility of uncontrolled gravity falling of the lifting device in the event of hose breakage or leakages.

The load-lifting device shall be designed and constructed such that it can stand a static load of $\times$ 1,25 the maximum load capacity without permanent deformation or apparent defects. It shall be able to stand a dynamic test with $\times$ 1,1 the maximum load under normal operating conditions. On pile lifting and lowering devices, the breaking strength of steel sprocket chains shall be at least four ($\times$ 4) times the admissible static load.

On pile turners and reel turners that are not exclusively operated in the hold-to-run control mode, an emergency stop button shall be provided on each motion control station.

5.9.1.4 Guarding crushing and shearing points

5.9.1.4.1 Guarding sheet feeding and delivery units

On sheet feeding and delivery units, the crushing and shearing points caused by the upward movement of the pile or pile carrier plate shall be safeguarded.

Safeguarding may be done by one of the following measures:

— safety distances in accordance with ISO 13854;

— trip devices;

— guards;

— hold-to-run operation.

On the delivery of sheet-fed printing presses and coating units with a pile carrier, where a pile weight of 500 kg is not exceeded and safeguarding in accordance with 5.9.1.3.2 is not practical for operational reasons, crushing of the toes shall be prevented as defined in ISO 13854 by providing a clearance of 50 mm between the lower edge of the pile carrier and the floor. In addition, the lowering movement shall be permitted only in the normal operating mode of the printing press or under hold-to-run control. Pile carrier wheels shall be fitted as far to the centre of the carrier plate as possible without decreasing stability.

5.9.1.4.2 Control and measuring devices

Crushing and shearing points between movable and fixed parts of control and measuring devices on printing press systems shall be safeguarded.

This can be achieved, for example, by:

— safety distances in accordance with ISO 13854;

— limiting the operating force to a non-hazardous level;

— electro-sensitive protective devices in accordance with 9.6;

— guards in accordance with 5.2.

5.9.1.4.3 Screen printing presses

5.9.1.4.3.1 Guarding screen printing presses

The crushing point between the screen printing frame (upper unit) and the machine frame (table) shall be safeguarded. This may be accomplished by one of the following methods.

a) Using trip devices, which shall be arranged such that their operation is positively ensured each time the gap between screen printing frame and machine table is accessed. Hazardous reaching over the device shall be prevented. The force to operate the device shall be a maximum of 300 N (dynamic). Where the material is manually fed directly between the screen printing frame and the machine table, and the stopping function of the device is being tripped by personnel safety switches, a trip device shall be arranged with redundant personnel safety switches to ensure initiation of the stopping operation, even in the event of a single switch failure.

b) Using electro-sensitive protective devices (ESPDs), the arrangement of which shall take account of the hand-approach speed as defined in ISO 13855. Such devices shall be arranged such that it is not possible to access the machine between two adjacent beams or to defeat them.

c) Limiting the closing force of the screen printing frame to a non-hazardous low level. A non-hazardous level is a maximum of 300 N, if there are no crushing hazards due to sharp edges.

d) Using fixed guards in accordance with ISO 13852, that can be provided on that side of the machine where access for feeding and ink replenishment is not required.

5.9.1.4.3.2 Crushing point between doctor blade and screen printing frame

The crushing point between the doctor blade and screen printing frame shall be safeguarded.

This can be done by adjusting the stop gauge such that the minimum distance of 25 mm between the doctor blade and the screen frame is ensured.

Where various sizes of screen frames are used, the instruction handbook shall give advice on the proper adjustment of stop gauges.

5.9.1.4.3.3 Crushing hazards caused by the movement of the doctor blade

Crushing hazards caused by the movement of the doctor blade shall be safeguarded.

This can be done by using the safety distances defined in ISO 13852 between the doctor blade and fixed parts of the printing press.

Where the descending doctor blade causes crushing points between the doctor blade and the printing table or printing cylinder, and where such crushing points cannot be safeguarded for operational reasons, the instruction handbook shall contain a warning of the residual risk existing. The lifting path of the doctor blade shall be as short as possible.

NOTE The crushing point between the doctor blade and the printing table or printing cylinder on screen printing presses can generally not be safeguarded because ink replenishing must be done manually.

5.9.1.4.3.4 Protection during access between screen printing frame and machine frame

Where access between the screen printing frame and the machine frame is required (e.g. for cleaning the screen), a control element shall be provided in addition to the measures described under 5.9.1.4.3.1, that, when actuated, prevents unintended start-up of the machine.

5.9.1.4.3.5 Protection between movable screen frame and fixed machine parts

On cylinder screen printing presses, safeguarding shall be provided for the crushing point between the movable screen frame and fixed machine parts. This can be achieved by the use of safety distances in accordance with ISO 13854, or interlocked guards.

5.9.1.5 Separating elements on feeders

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

Where blanks are fed from the top of the pile, the requirement is satisfied if safety distances between suction heads are used or if suction heads touch down only under spring force.

5.9.1.6 Suction heads on sheet feeders

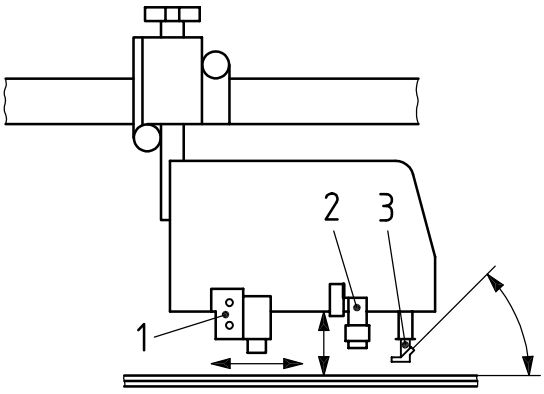
Hazard points on suction head drive gears that can be accessed during the production process shall be safeguarded by guards completely enclosing the head, leaving only the bottom open (see Figure 13). Hazard points caused by moving parts outside the suction head (such as a forwarding sucker or lifting sucker) shall be safeguarded by one of the following measures:

a) a distance of at least 25 mm is maintained between the moving parts, such as a forwarding sucker, that are accessible during production or

b) parts are moved only by springs with a non-hazardous low force (e.g. pressure foot, lifting sucker) or

c) hazard points (shearing and crushing hazards) are protected by guards.

The drive shaft of the suction head shall be completely enclosed.



Key

1 forwarding sucker
2 lifting sucker
3 pressure foot

Figure 13 — Movement of the suction head

5.9.1.7 Pull-in and forwarding wheels

In-running nips on the pull-in and forwarding wheels on the sheet feeding system shall be safeguarded.

This can be achieved, for example, by

— using a deflection of 25 mm (obtained with a force that would not cause injury);

— using a deflection of 15 mm (obtained with a force that would not cause injury) with roller widths limited to 25 mm;

— providing guards in accordance with Clause 5.

5.9.2 Reel unwinding, rewinding and transport devices

5.9.2.1 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 14), any accessible hazard point between the reel and the belt shall be safeguarded if the pressure 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 15).

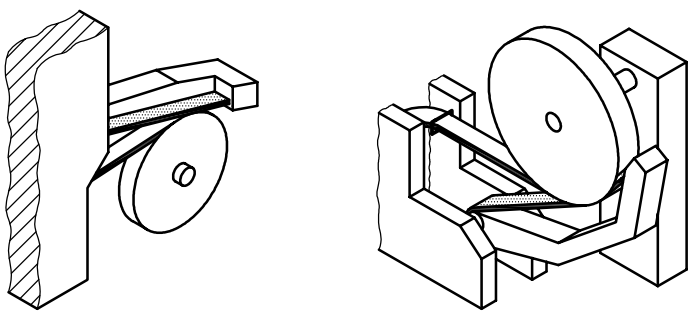


Figure 14 — Belt drives

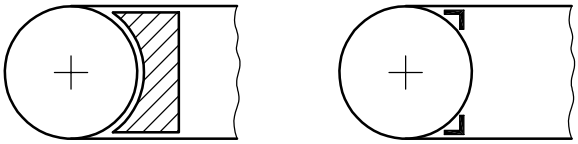


Figure 15 — Safeguarding of belt in-running nips on belt drives

5.9.2.2 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 having approach reaction (trip nip bars, pressure-sensitive mats, electro-sensitive devices). The safety device selected shall be effective at all operating reel diameters and operating speeds. 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 9.7. For electro-sensitive protective devices, see 5.8.3.

5.9.2.3 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 5.9.2.11.

5.9.2.4 Separation of chucking cones

Provision shall be made to prevent unintentional separation of the chucking cones after the 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.

5.9.2.5 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 using of a pressure-sensing monitor.

On shaftless unwinding and rewinding devices, hazards caused by small diameter reels being ejected shall be prevented. This can be done, for example, by

— changing reels at a lower speed;

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

— fitting an adequate safety device to the unwinding unit.

5.9.2.6 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 heavy, long roll is stuck on 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.

5.9.2.7 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.

5.9.2.8 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.

5.9.2.9 Protection against crushing hazard

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

5.9.2.10 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 with 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.

5.9.2.11 Protection of hazard zones on unwinding unit of automatic reel-loading systems

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

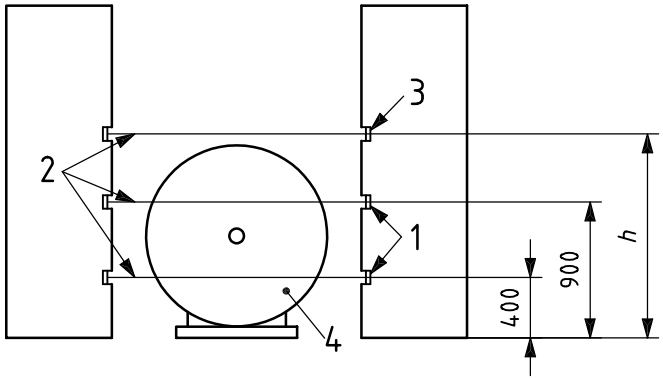
Where ESPDs in accordance with 5.8.3 are used for safeguarding the automatic reel-loading area on unwinding units, the device may be muted while material reels or unwound cores are transported through the area safeguarded by the electro-sensitive device on the following conditions:

— 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 16);

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

For safeguarding the hazard zone by electro-sensitive protective devices, see 5.8.3.

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 16 — Use of ESPDs to guard automatic reel loading on unwinding unit on automatic reel loading systems

5.9.3 Transport carriages

Where transport carriages are driven automatically and cylinders are handled automatically, the hazard points between fixed and movable parts shall be safeguarded by one of the following measures:

— trip devices and/or photoelectric curtains;

— hold-to-run control as defined in 5.6 where hazard points are within operator's view from the location of the hold-to-run control;

— safeguarding the hazard zone as described in 5.2.

When removing printing cylinders, hazardous over-travelling on the transport carriage shall be safely prevented by the use of mechanical stops.

5.9.4 Folders for web presses

5.9.4.1 Exception for folder set-up

Where access to the folder is required for folder set-up (for example, for removing waste sheets), speeds up to 8 m/min are permitted with the guard(s) open in accordance with the requirements of 5.6.

5.9.4.2 Exception for folder delivery guarding

In contrast to 5.2.3, the distance between the guard and the delivery surface shall be no more than 75 mm, regardless of the distance between the unguarded access area and the hazard (see Figure 17).

Dimensions in millimetres

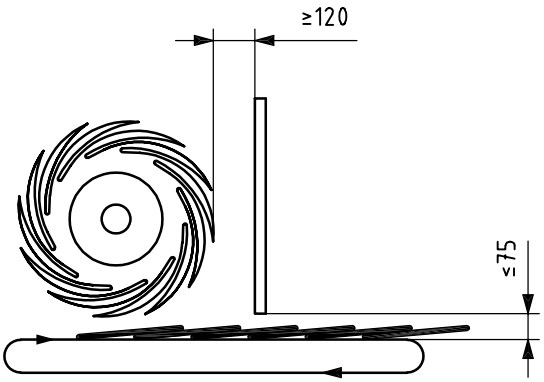


Figure 17 — Openings for folder guards

The distance between the delivery fly (fan) and the enclosure that forms an in-running nip shall be a minimum of 120 mm.

Folders shall be designed to allow observation of moving components or product flow, and to allow adjustments to folder operation with the guards closed.

NOTE 1 A transparent guard or remote viewing system, by which the necessary observation of moving components or product could be made, shall be provided.

However, it is recognized there may be areas in the folder delivery that cannot be observed with the guard closed, and it may be necessary for an authorized person to observe moving components or product flow at production speed 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, keeping in mind that this exception does not comply with current European Standards or the Machinery Directive:

— 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.

— The key lock shall be interlocked with a timer that has a maximum capability of 4 min.

NOTE 2 It may be desirable to have an alerting mechanism that will warn the operator that the allotted period is about to elapse.

— When the key is inserted in the lock, the interlock on the guard is overridden and the authorized person can access the area for a maximum of 4 min.

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

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

— When the key is removed from the lock, the timer shall automatically stop and the interlock on the guard shall be automatically reactivated.

— If the guard remains open longer than the allotted time, the interlock on the guard shall be automatically reactivated and the press safety system shall stop machine motion.

A danger label warning of 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.

Under no circumstances shall the guards in the cutting area of the folder be designed in such a manner that allows them to be open during machine motion at production speed.

5.9.5 Web feed on web-fed rotary presses

5.9.5.1 Safety distances

On web-fed rotary presses in the areas where the web is fed through a webbing slot, if it is impossible to apply the safety distances specified in ISO 13852:1996, a safety distance of 200 mm shall be observed for gaps with a width of more than 20 mm and less than 30 mm.

Where web material runs over passageways, the height of the passage shall be at least 2 m. If this is not possible for constructional reasons, and if there is a risk of injury to face and neck, web edges shall be safeguarded. Safeguarding may be by use of a guard with black and yellow markings.

5.9.5.2 Exception to 5.6.1 b) for newspaper presses not equipped with an automatic web-up device

As an exception to 5.6.1 b), for newspaper presses a maximum operating speed of 10 m/min is permitted for web-up. Under this exception, to initiate machine motion at 10 m/min, a special web-up mode shall be added to the control system. However, this exception does not comply with current European Standards or the Machinery Directive.

5.9.6 Threading of web material

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

On power-driven threading devices for web-type material, access to hazard points shall be prevented by 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 of a fixed disc on the outside of the pulleys, the radius of which is at least 120 mm larger than the radius of the pulley;

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

5.9.7 Guarding sheet gripper from unintentional hand access

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

Any residual risk caused by reaching underneath protective devices (e.g. in order to remove sample sheets or to place wedges in the pile) must be indicated in the instruction handbook (see 15.2.7.3).

5.9.8 Guarding rotating sheet gripper systems from whole-body access

5.9.8.1 General

In the area of rotating sheet gripper systems on sheet deliveries, measures for safeguarding the whole-body access of persons shall be in place on all access sides if the access height, h, is 800 mm or more (see Figure 18) or whole-body access is necessary more than once a week.

NOTE Whole-body access more than once a week is generally only necessary when make-ready and cleaning work can be carried out only by accessing the area with the whole body.

5.9.8.2 Safeguarding whole-body access by ESPDs

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

The light beams of the ESPD on machines having a single access level shall be arranged as specified in Table 2 (see Figure 18). For the arrangement of light beams of the ESPD on multi-level machines, see 5.9.8.2.4. The requirements of ISO 13855 relating to the horizontal distance between the light beams and the rotating gripper systems need not be met.

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

For information on the residual hazards in instruction handbooks see 15.2.7.3.

Table 2 — Arrangement of the ESPD in relation to the access height, h

Dimensions in millimetres

h	Arrangement of the ESPD in relation to the access level(s)		
	Light beam 1[a]	**Light beam 2**[b]	**Light beam 3**[c]
$h \leqslant 1\,200$	300	not required	400 below h $(h - 400)$[d]
$1\,200 < h \leqslant 1\,500$	300	in the centre between light beam 1 and 3 [d]	400 below h $(h - 400)$[d]
$h > 1500$	300	700	1 100

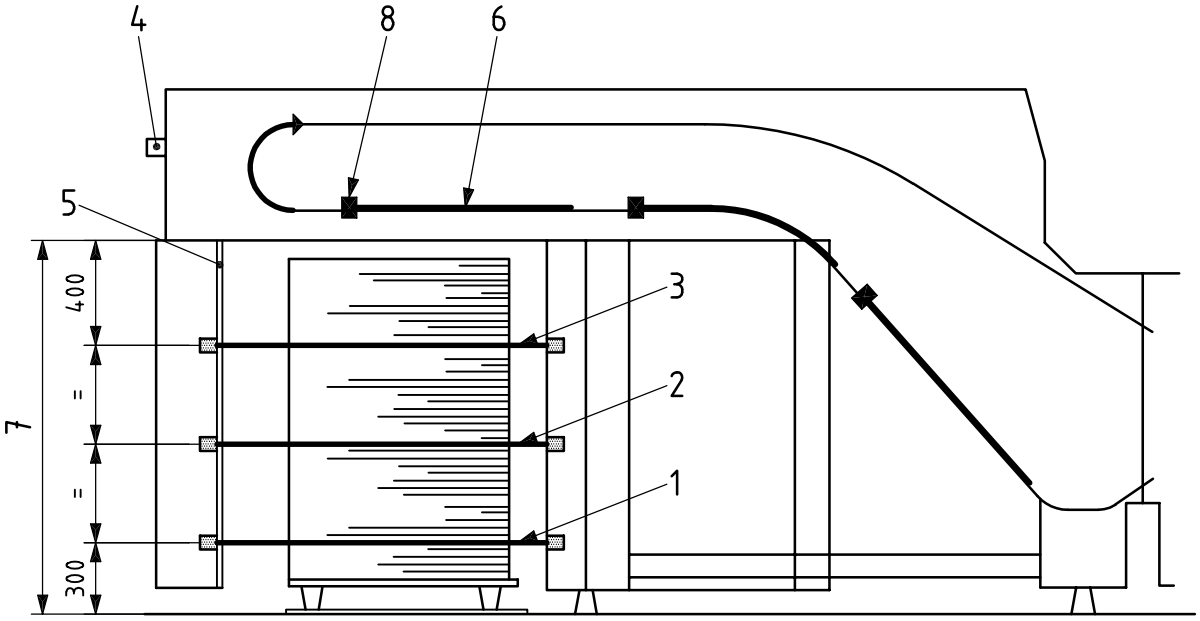
[a] Arrangement measured from the access level or from a fixed or swinging platform; due to the structural tolerances at the location of installation, the permissible tolerance for the arrangement is $\pm$ 35 mm.

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

[c] A maximum of 1 100 mm in height.

[d] See Figure 18.

Dimensions in millimetres



Key

1	light beam 1	5	sample sheet removal
2	light beam 2	6	sheet
3	light beam 3	7	access height h
4	reset button	8	sheet gripper system

Figure 18 — Access height in the delivery zone

5.9.8.2.2 Bypassing light beams

5.9.8.2.2.1 General

For the functions of sample sheet removal, insertion of wedges into the pile, correction of pile formation, exit of the pile, complete pile removal (including insertion of empty pallets and moving in equipment, such as a. hand forklift truck), a time-limited bypass of individual or several light beams is permissible only if the respective requirements for the individual functions are met under the conditions defined in 5.9.8.2.2.

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

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

5.9.8.2.2.2 Bypass function for removing sample sheets

Bypassing only the top light beam (see Figure 18) in the area where sample sheets are removed by the sample sheet removal equipment shall be permitted only if:

— the machine is in paper run mode (sheets are being delivered);

— the light beams are active on all other access sides of the delivery.

As an exception to the requirements of 11.1.1, the detection of the paper run mode, the sample sheet removal equipment and its individual signal processing shall meet the requirements of at least category B of ISO 13849-1:1999.

5.9.8.2.2.3 Bypass function for inserting wedges and correcting the pile formation

Bypassing the top light beam on any single side (see Figure 18) shall be possible only if:

— the bypass control is a pushbutton positioned on the side being accessed;

— 3 light beams are installed for safeguarding the access side;

— all light beams are active on all other access sides.

Bypassing the top beam on more than one side at the same time shall not be permitted.

When a bypass function is active and the main drive is at a standstill, start-up shall be prevented.

5.9.8.2.2.4 Bypass function for inserting empty pallets and moving in equipment

Bypassing the bottom light beam (see Figure 18) on the side being accessed, shall be possible only if:

— the bypass control is a pushbutton positioned on the side being accessed;

— 3 light beams are installed to safeguard the access side;

— the auxiliary pile support (e.g. rake, wooden pile board, roller blind) or an equivalent device prevents access to the hazard zone;

— all top and middle light beams on all access sides and all bottom light beams on all other access sides are active;

— the pile support plate is raised no more than 120 mm.

Detection to determine correct positioning of the auxiliary pile support (preventing access to the hazard zone) may be done by means of a personnel safety switch, which is activated when the plate is in the correct position. In this case, the personnel safety switch does not require a separate actuating element. The switch control system shall comply with category 3 of ISO 13849-1:1999.

NOTE Since metal rods and wooden boards, which need to be removed from the press and can be used for several presses, are used as auxiliary pile supports, it is not possible to use encoded personnel safety switches with separate actuating elements.

5.9.8.2.2.5 Automatic bypass function for pile removal

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

Pile removal may be detected by the use of a sensor (e.g. ultra sound, light beam, etc.), which is arranged inside the delivery zone, behind the ESPD. Easy manipulation of the sensor shall be prevented. Manipulation of the sensor could be prevented through the arrangement of sensors, a plausibility check of signals, etc.

As an exception to the requirements of 11.1.1, the sensor and the related control system shall meet the requirements of at least category B of ISO 13849-1:1999.

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

Bypassing the light beams on the side where the pile is moved out by pressing the pile removal control located on the side from which the pile is being removed shall be possible only if:

— the machine is in press run mode;

— the pile support plate is no more than 120 mm above the floor;

— paper run has been present and detected since the last pile removal and the last tripping/malfunction;

— 3 light beams are arranged to safeguard the access side;

— all top, middle and bottom light beams on all other access sides are active during the entire process.

The bypass sequence shall meet the following requirements:

— bypass only the bottom light beam (see Figure 18) on the removal side for not more than 20 s;

— during this time a sensor is to be triggered, which detects the exit of the pile and switches off the light beams on the exit side for a maximum of 20 s;

— light beams 2 and 3 (see Figure 18) shall be reactivated automatically after this time (maximum of 20 s) has elapsed;

— light beam 1 (see Figure 18) remains switched off for a further duration of maximum 20 s for inserting the empty pallet;

— during this period (maximum 20 s) it is possible to bypass the bottom light beam (see Figure 18) for only one additional period of 20 s by activating the remove pile control again;

— the bottom light beam (see Figure 18) is automatically activated again after the expiration of its bypass time.

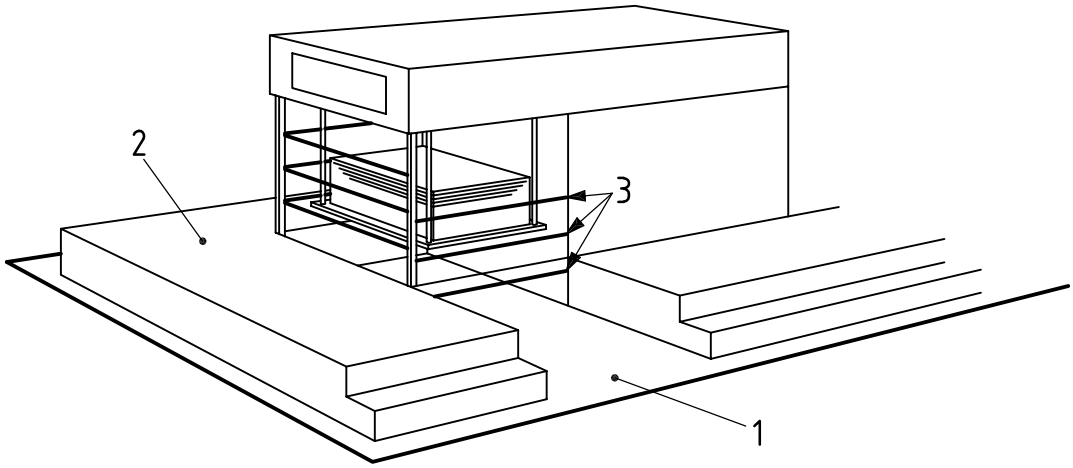
5.9.8.2.3 Status lights for bypass function

A yellow status light shall be used to indicate that the bypass function is activated (released automatically or at the push of a button). The end of the bypass duration may be indicated by the yellow status light flashing. A green status light shall be used to indicate that all light beams are activated and uninterrupted. The interruption of a light beam shall be indicated by a red status light. The status lights shall be placed on all access sides that are protected by light beams. The integration of the status lights into the control system may be single-channel, e.g. via an electronic control system. Status lights shall be positioned in such a way as to ensure that they cannot be confused with the optional personnel warning lights defined in 13.2.4, if used.

5.9.8.2.4 Machines with multiple access levels

On machines with several access levels (e.g. with movable platforms), the protective measures described in 5.9.8.2.1 to 5.9.8.2.3 shall be provided on every access level (see Figures 19 and 20).

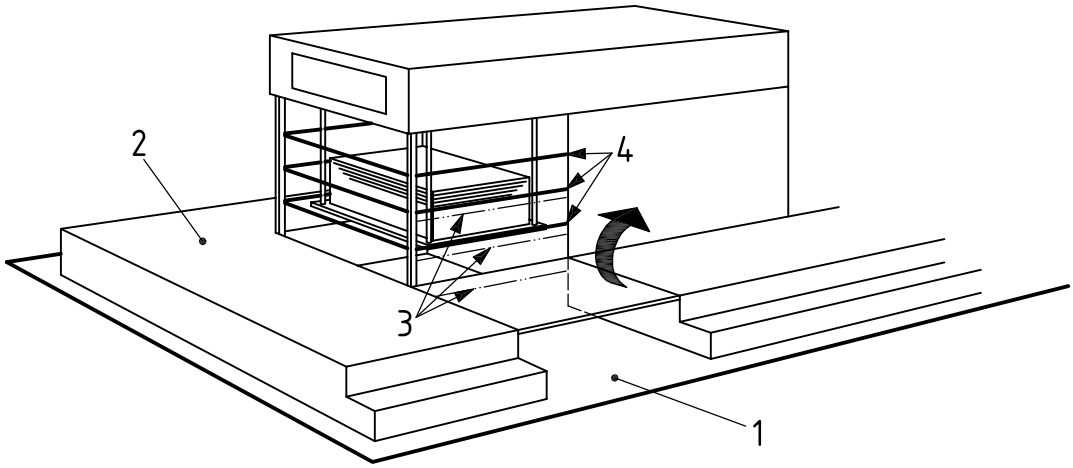
NOTE Figure 19 shows two reference levels, one for the ground and one for the platform. This requires a set of light beams on each side positioned at a height appropriate for that reference level. Figure 20 shows a situation in which a movable ramp may create an additional reference level on that side, and necessitates additional light beams to ensure that all reference levels are considered.



Key

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

Figure 19 — Multiple access levels without movable platform



Key

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

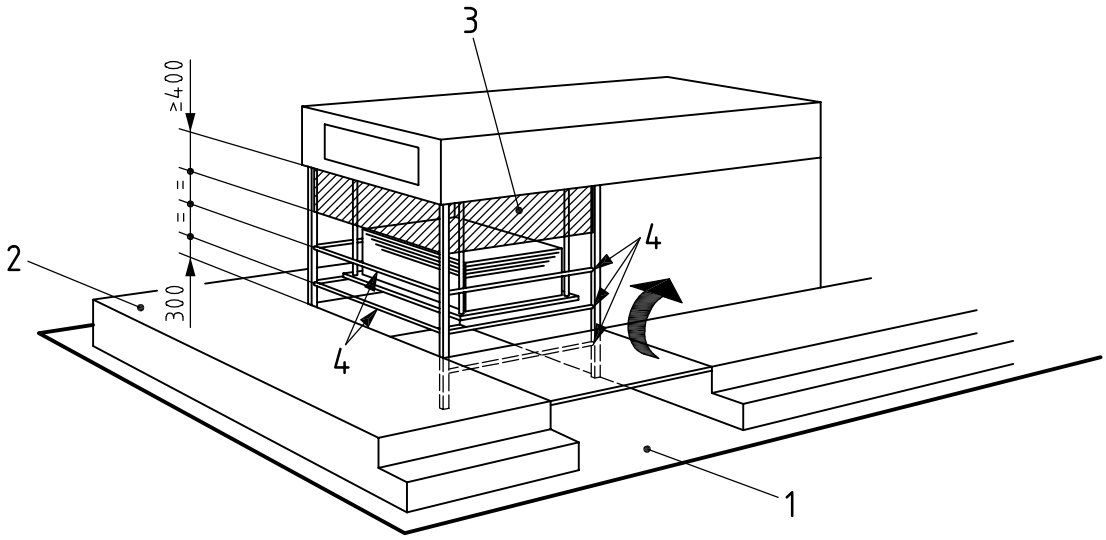
Figure 20 — Multiple access levels with movable platforms

5.9.8.3 Other methods of whole-body access safeguarding

As an alternative to safeguarding in accordance with 5.9.8.2, whole-body access safeguarding can be achieved using one or more of the following methods, providing an equivalent level of safety is met:

— fixed and interlocked guards (see Clause 5);
— pressure-sensitive mats (see 9.7);
— laser scanners;
— trip bars (3.83) (see 5.9.8 and Figure 21);
— light curtains (see Figure 22).

Dimensions in millimetres

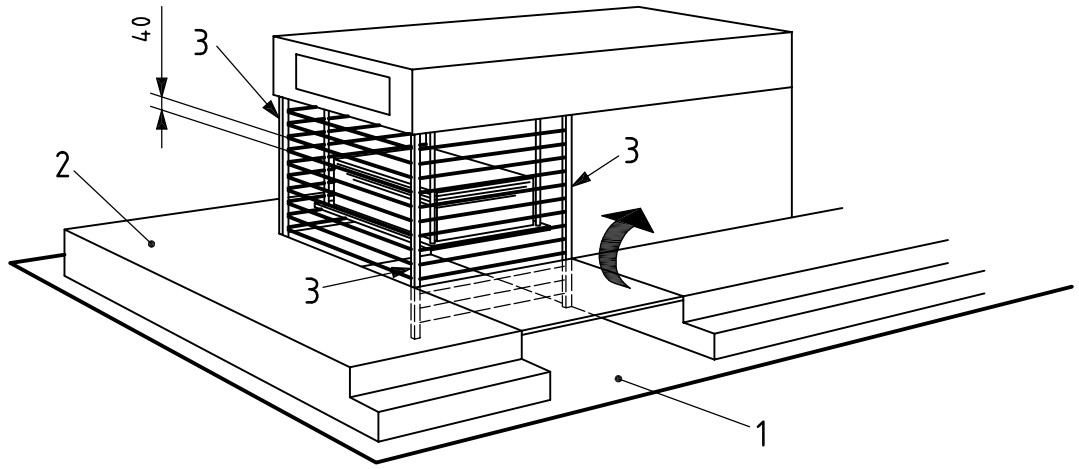


Key

1 access level 1
2 access level 2
3 area to be protected by a movable, electronically interlocked guard
4 trip bars

Figure 21 — Whole-body access safeguarding using a combination of trip bars and a movable guard

Dimensions in millimetres



Key

1 access level 1
2 access level 2
3 outer boundary of light curtain

Figure 22 — Whole-body access safeguarding using light curtains

5.9.8.4 Safeguarding the sheet gripper system

The delivery is considered to be sufficiently safeguarded against whole-body access to the hazard zone of the sheet gripper system under the following operating states.

— While the delivery is separated from the drive train using couplings; the coupling action and restart shall not cause any hazardous movements.

— The opening above the pile carrier or the moved-in auxiliary pile support (e.g. rake, wooden pile board, roller blind) or equivalent device, is no greater than 160 mm.

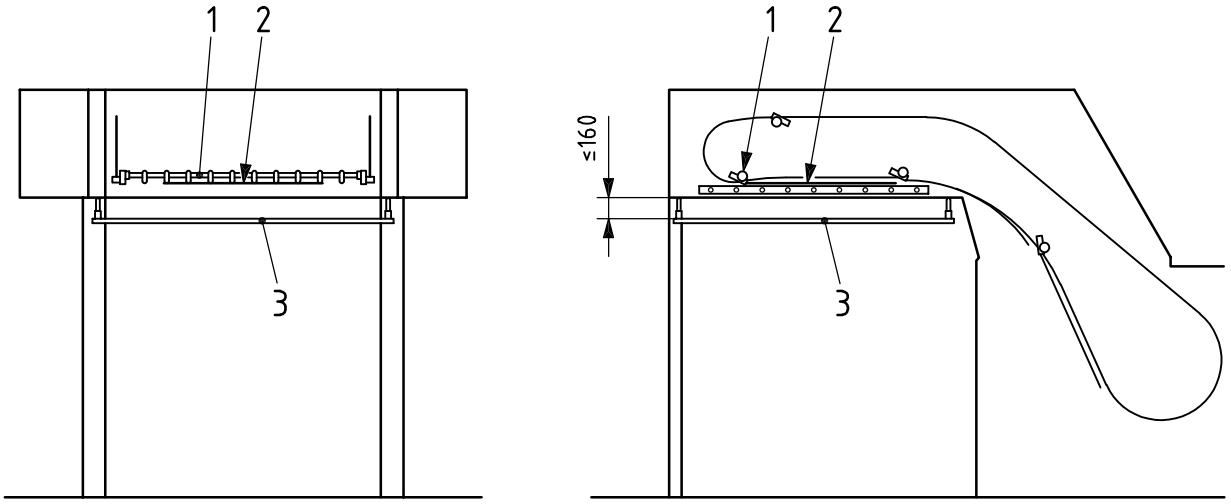
— While the press is delivering material to a raised pile support plate or to an auxiliary pile support (e.g. rake, wooden pile board, roller blind) or equivalent device; and the presence of the pile support in use is detected either at insertion or by the time it has reached 160 mm below the access to the hazard; and the opening above the uppermost pile carrier is no greater than 300 mm; and no change of state of the main drive has occurred.

— While the machine is at a standstill, the use of horizontal light beams, arranged underneath the gripper system in accordance with ISO 13855 shall prevent the start of the machine (see Figure 23). If the existing light curtains do not meet the requirements of the ISO 13855, other protective devices shall be provided in accordance with 5.9.8. The distance between the individual light beams underneath the gripper system shall not exceed 40 mm (see Figure 22)

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

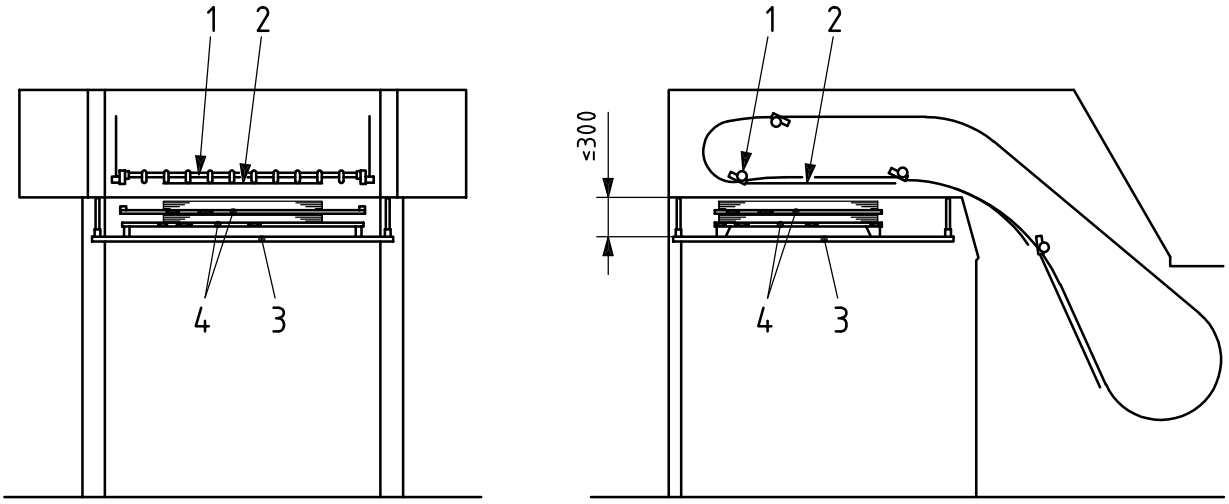
NOTE If the pile support has not been detected by the time it has descended to a distance of 160 mm below the access to the hazard, the machine shall either shut down, or the hazardous area shall be protected by additional safeguarding, such as light beams, guards, etc.

Dimensions in millimetres

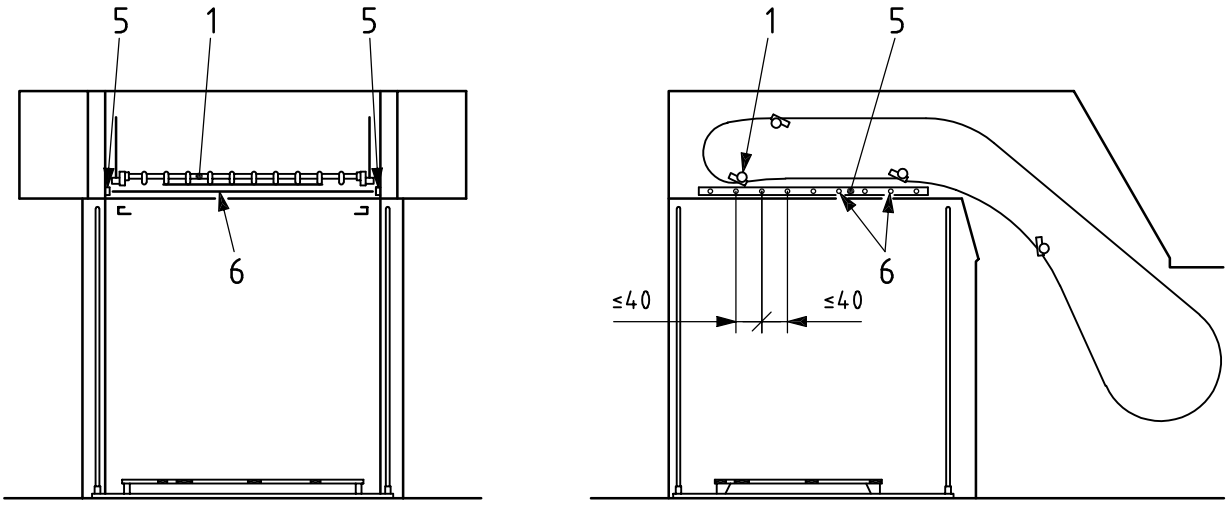


a) front and side views with pile carrier support in place (⩽ 160)

Dimensions in millimetres



b) front and side views with pile and pile carrier support in place (⩽ 300)



c) front and side view with light beams (⩽ 40)

Key

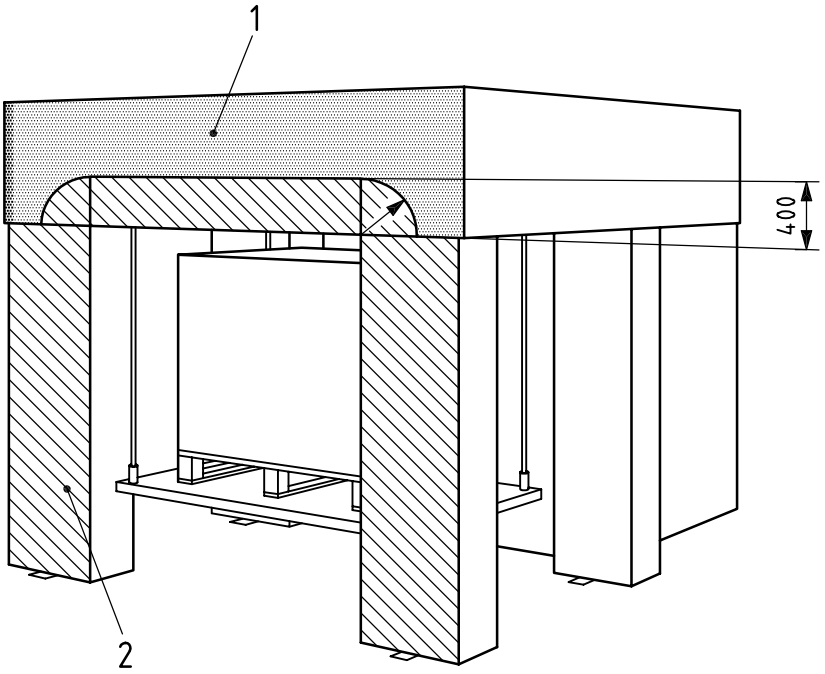
1 sheet gripper system
2 sheet
3 pile carrier
4 pile support
5 sensor parts
6 light beams

Figure 23 — Guarding of sheet gripper system

5.9.8.5 Reset pushbutton for ESPDs

The reset pushbutton for ESPDs shall be placed in a location from which the hazard area can be fully viewed and reaching the reset pushbutton from inside the hazard area is prevented. This requirement is met if the reset button is inside the permissible area at least 400 mm away from, but not lower than, the bottom edge of the press contour (see Figure 24).

Dimensions in millimetres



Key

1 permissible area

2 non-permissible area

Figure 24 — Permissible area for reset button location

On presses having several access areas where all hazard zones cannot be fully viewed from a single location (e.g. elevated presses or presses with dual deliveries), additional reset buttons shall be provided. This is to ensure that the hazardous area affected by each of the reset pushbuttons can be viewed from the position of that pushbutton.

It shall be necessary to press the reset pushbutton before movement in the delivery area can be initiated using a separate control:

— after switching on the press at the main switch;

— after activating the ESPDs;

— when the protective device that safeguards whole-body access to hazard areas has been tripped.

EXCEPTION: It is not necessary to press the reset pushbutton if persons inside the hazard area are safely detected due to the construction of the protective devices (e.g. laser scanners).

Pressing the reset pushbutton shall not lead to an automatic start-up of the hazardous motion.

EXCEPTION: Pressing a reset pushbutton may initiate motion of the main pile and auxiliary pile system.

5.9.8.6 Guarding the area beneath the pile carrier on presses having an access height of 800 mm or more

On presses having an access height to the delivery of 800 mm or more (see 5.9.8), access to the area beneath the pile carrier plate and the lowerable auxiliary pile device shall be safeguarded in addition to safeguarding the edge of the pile carrier plate in accordance with 5.9.1.3.2. This safeguarding shall be achieved using area protection devices with ESPDs or other protective devices in accordance with 5.9.8.2 and 5.9.8.3. The bypass functions as defined in 5.9.8.2.2 also include safeguarding of the area beneath the pile support systems.

As an alternative, the provisions of 9.6.4 may be applied for the arrangement of the beams.

Independent movement of the pile carrier without the use of additional guarding defined in 5.9.8.2 or 5.9.8.3 is also permitted by hold-to-run control if the hazardous area can be viewed from the position of the hold-to-run control.

5.9.8.7 Information on ESPDs in the instruction handbook

When using ESPDs to safeguard the delivery, all residual risks that still exist shall be indicated in the instruction handbook in accordance with 15.2.7.3.

5.9.9 Guarding plate clamping devices

Movements of automatic plate clamping devices shall be safeguarded. This can be achieved by:

— fixed or interlocked guards in accordance with 5.2;

— trip nip bars in accordance with 9.7 (satisfying the requirements of category 3 of ISO 13849-1:1999);

— electro-sensitive protective devices in accordance with 5.8.3;

— limiting the operating force to a non-hazardous level;

— limiting the maximum clearance between movable and fixed parts to 4 mm.

5.9.10 Continuous-flow drying devices on web presses

For continuous-flow drying devices, when guards cannot be used to protect against heat hazards, a warning shall be provided in accordance with Clause 15. See also 6.7.

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 Explosion zones

For a list of explosion zones for electrical apparatus, 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, detonating or explosive materials, or for impregnating material, shall be conductive and electrostatically earthed (resistance less than 10^6 Ω over the total length of the hose).

EXAMPLES These include, but are not limited to, paper, paper dust, plastic shavings, inks, coatings, glues, etc.

Hoses and pipes used for exhausting solvent vapours shall be conductive and electrostatically earthed (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.

Respective reference shall be made in the instruction handbook (see 15.2).

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.

Solvents evaporating from the agitator shaft shall be prevented from reaching the motor. This can be achieved by mounting a disc on the shaft. The distance between the electric drive motor for viscosity control and the outer flange of the agitating device shall be at least 50 mm.

6.2.5 Continuous-flow drying devices

6.2.5.1 General

Continuous-flow drying devices built into printing and coating units where inflammable substances are set free during the drying and/or curing processes of the ink or coating shall satisfy the requirements of EN 1539 or NFPA 86.

EXCEPTION: In Europe, the requirements of EN 1539 shall be satisfied.

Evaporation of inflammable substances are generally not expected where inks and/or coatings are used for which the safety data sheet indicates that the explosion limit is “not applicable” at the operating temperature of the drying device. Where the use of such inks and/or coatings is required in order to comply with the requirements stated, this shall be indicated in the instruction handbook.

NOTE Evaporation of inflammable substances during the drying process may be expected on gravure, screen printing and rotary web presses. This may, however, not be the case when using commercial offset printing inks (e.g. cold set inks instead of heat set inks) that are absorbed by the substrate.

6.2.5.2 Interface with automatic cylinder- and roller-washing devices

6.2.5.2.1 Substrate transporting solvents

On continuous-flow drying devices, any hazards from emission of inflammable substances caused by the substrate transporting solvents out of the automatic cylinder- and roller-washing device shall be avoided.

This requirement is fulfilled, for example:

a) on a sheet-fed printing press,

   1) where the design of the continuous-flow drying unit takes account of the solvent transported by the substrate in accordance with EN 1539 (required in Europe) or NPFA 86;

2) where the cylinder- and/or roller-washing device is electrically interlocked with the paper transport system, so the paper transport during the washing process is prevented and can be restarted only after the cylinders are sufficiently dry.

b) on a web-fed rotary printing press, where the design of the continuous-flow drying unit takes account of the solvent in accordance with EN 1539 (required in Europe) and/or NFPA 86, including a combination of

1) design-stage calculations of maximum solvent flow;

2) commissioning-stage testing of the blanket wash system, usually done by qualified personnel or an agent of the wash system manufacturer, to verify the calculations and to determine the safety of the washer system (part of the testing procedure is the measurement of solvent concentrations inside the dryer and exhaust duct using a total hydrocarbon analyser equipped with a flame ionization detector at worse-case conditions of solvent flow).

6.2.5.2.2 Vapours and mists

On printing presses, where continuous-flow drying devices are fitted on one press together with automatic cylinder- and roller-washing devices, any risk of ignition when solvent vapours and mists set free during the washing process are heated up by the drying unit shall be prevented.

This requirement is fulfilled, for example,

a) by designing the continuous-flow drying unit to take into account the solvent vapours and mists in accordance with EN 1539 (required in Europe) or NFPA 86;

b) by providing an exhaust unit between the washing and the drying unit, thus reducing the risk of ignition;

c) by interlocking the washing and the drying devices so as to allow starting of the washing operation only if the dryer temperature is at a non-hazardous level, and to prevent starting of the drying device until there is no risk of ignition of the inflammable solvent vapours if the control system satisfies category 3 of ISO 13849-1:1999 (one means of accomplishing this is by the use of an inflammable vapour sensor that monitors the level of solvent vapours and prevents heating of the drying device until there are no inflammable solvent vapours present in the zone or area of the drying device).

6.2.5.2.3 Leakage and spillage of solvents

The risk of ignition due to leaks of the solvent from the washing device shall be prevented.

EXAMPLE Solvent leaking on to the substrate running into the drying device; on sheet-fed presses, solvent leaking on to the drying device, or spillage during the filling process.

This requirement is fulfilled by one or more of the following:

— when the solvent reservoir and washing device are fixed and sealed, by providing hose and connections of highest leak-proof quality, permanently fitted, adequately dimensioned and of materials that are suitable for the solvent used;

— by positioning the washing devices and hoses so that, in case of leakage, neither the liquid solvent nor its vapours can reach the continuous-flow drying device;

— by monitoring the area surrounding the continuous-flow drying device so that the device is disabled in the event of spillage/leakage.

6.2.5.3 Ignition of substrate

Ignition of the substrate by the continuous-flow drying device shall be prevented. This can be achieved, for example, by

— reducing the dryer temperature when the printing process is stopped;

— separating the substrate from the radiation source by use of air knives (air curtain) or deflectors.

6.2.5.4 Exhaust systems of drying devices

When exhaust systems are provided as a safety ventilation system to prevent hazards of fire and explosion, their function shall be monitored. Failures in the exhaust system shall cause automatic stopping of the substrate feeding system. For example, on sheet-fed printing presses, failures in the dryer exhaust system cause both the feeders and the drying system to stop automatically. On rotary web presses, failures in the dryer exhaust system cause automatic stopping of the solvent dispensing areas (e.g. ink forme rollers on units, or automatic blanket washing devices).

The control system for monitoring the function of the exhaust system shall satisfy category 3 of ISO 13849-1:1999.

6.2.6 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 60079-1 or 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 temperatures.

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).

6.2.7 Explosion protection exceptions

6.2.7.1 General

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 11271 are satisfied where the build-up of explosive atmospheres is prevented by adequate ventilation systems. This is the case where 25 % of the lower explosion limit is not exceeded even if the system fails.

For washing units on printing presses, see 6.16.

EXAMPLE A breakdown of the ventilation system.

NOTE Heating of a combustible liquid occurs under operational conditions; for example, in film and printing plate development units with bath heating.

6.2.7.2 Exceptions for screen printing presses

Explosion protection measures on screen printing presses need not be provided, even when using screen printing inks with a flashpoint of 40° C to 55° C, if adequate air ventilation in the working area is ensured. The need for adequate air ventilation shall be indicated in the instruction handbook.

Where the intended use of a machine allows the use of screen printing inks with a flashpoint below 40° C, see 6.2.2, 6.2.3 and 6.2.7.

6.2.7.3 Exceptions for automatic washing devices

Where automatic cylinder-washing (e.g. impression or blanket) and roller-washing devices are attached to printing presses, explosion protection measures otherwise required due to the washing solvent being used are not required if all of the following conditions are met:

— the flash point of the washing solvent is at least 55 °C or the flash point of the washing solvent is at least 40 °C, and the amount of washing solvent used does not exceed 0,08 l per printing unit and washing cycle;

— the solvent does not heat up to a temperature in excess of the flash point (e.g. due to heating equipment, waste heat from motors or the sun's rays);

— explosive concentrations cannot build up when applying the solvent.

6.3 Spillage from washing devices

Safe replenishing of the washing agent shall be ensured.

The following are examples of ways to satisfy this requirement:

— designing washing agent tanks to allow one person handling the equipment to replenish the washing agent without the hazard of spilling or overflowing;

— avoiding tank overflow when replenishing the washing agent by use of devices that check the filling level (tank full indicators, inspection glasses, adequate openings for filling, etc.).

When the washing device is disconnected by the user, provision shall be made to prevent leakage of washing agents from the lines.

EXAMPLE The use of self-locking hose couplings.

6.4 Electrical equipment

6.4.1 General

All electrical equipment shall be designed in accordance with IEC 60204-1, such that electrical hazards (e.g. electric shock, burns) are prevented. The requirements of IEC 60204-1 shall be fulfilled, taking into account the additional requirements specified in 6.4.1 to 6.4.5.

6.4.2 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 of being locked in the OFF position.

If actuation of a stopping device causes 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 for printing and coating units may be equipped with supply-disconnecting devices in accordance with IEC 60204-1:2000, 5.3.2 d) or 5.3.2 e).

6.4.3 Installation

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

6.4.4 Insulated single-core conductors

For insulated single-core conductors laid between two terminals inside an enclosure (e.g. 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.

6.4.5 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 to 19.6. Voltage tests as specified in IEC 60204-1:2000, 19.4, are not required for electronic control circuits.

6.4.6 Measuring devices

Measuring devices shall comply with IEC 61010-1.

6.5 Working platforms, access stairs, passageways and raised workplaces

6.5.1 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 3.37), the exceptions specified in 6.5.2 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.

See also 5.9.1.3.2 for guarding when platforms and gangways are fitted to the feeding or delivery unit.

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

6.5.2 Infrequently used platforms and access steps

6.5.2.1 General

As an exception to the requirements of 6.5.1, infrequently used platforms and access steps shall comply with the requirements of 6.5.2.2 to 6.5.2.6.

6.5.2.2 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.

6.5.2.3 Footstep dimensions

6.5.2.3.1 General

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

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.

6.5.2.3.2 Single footsteps

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

a) normal step height: ⩽ 300 mm

b) maximum step height: 500 mm

c) minimum width (for 1 foot): 200 mm

d) minimum width (for 2 feet): 300 mm

e) minimum depth: 300 mm

EXCEPTION FOR SHEET-FED PRESSES: On sheet-fed offset printing presses with a format width of no more than 750 mm it is acceptable to provide a single footstep for access to the platform fitted between units (printing units, coating units, delivery units) if all the following conditions are met:

— the difference in height between floor or gangway and platform is not more than 750 mm;

— the depth of the footstep is at least 250 mm, and the width at least 300 mm;

— the footstep is fitted halfway between the floor or gangway and the platform;

— suitable handles are provided.

6.5.2.3.3 Multiple steps

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:

a) maximum height of upper footstep: 1 200 mm

b) maximum height of intermediate steps: 300 mm

c) minimum depth of footstep: 200 mm

d) maximum height without a railing: 1 200 mm

6.5.2.4 Handle dimensions

Where handles are required, the following dimensions shall apply (see Figure 25):

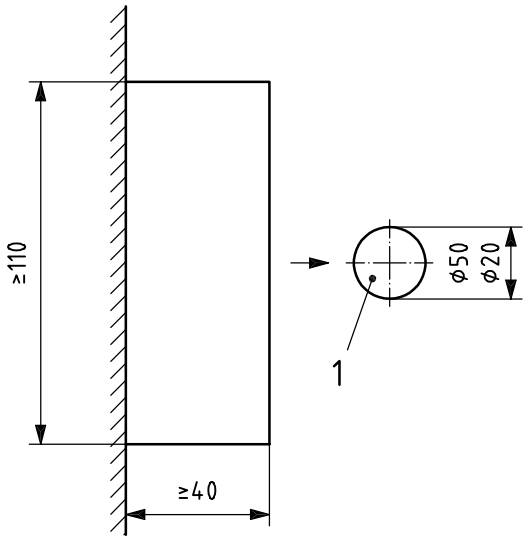
a) minimum handle clearance: 40 mm

b) minimum handle length: 110 mm

c) minimum handle diameter: 20 mm

d) maximum handle diameter: 50 mm

Dimensions in millimetres



Key

1 diameter of handle

Figure 25 — Handles for infrequently used access platforms

6.5.2.5 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 6.5.1 shall apply.

Hinged platforms are generally provided in areas where space limitations preclude 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.

6.5.2.6 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 26). 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

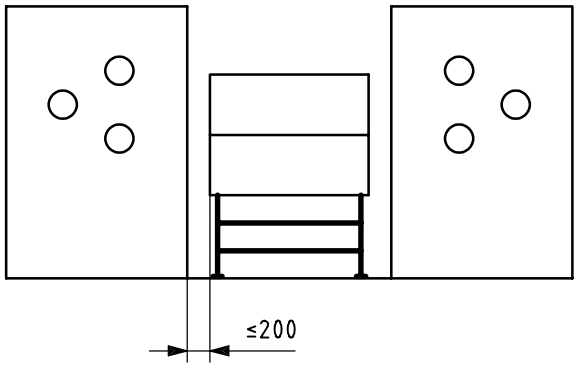


Figure 26 — Mobile platform

6.5.3 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.

As an exception to the design load requirements of ISO 14122-2, calculations or tests for plates of such material shall 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. The area being tested shall not include the metal frame surrounding the glass or other transparent area.

6.5.4 Access stairs and passageways

Access stairs and passageways shall have a clear height for passage of at least 2 m. If, for constructional 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 space 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 Imperial units. Requirements stated by the U.S. Occupations Health and Safety Administration (OSHA) may supersede the resulting conversions in the U.S.

6.5.5 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).

6.5.6 Infrequently used workplaces

For infrequently used workplaces (see 3.37) that cannot be accessed by stairs, secured ladders may be used if the access height does not exceed 2 m. Toe plates and intermediate rails on railings are not required if the falling height is less than 2 m.

6.5.7 Railings, toe plates and self-closing gates

Railings with handrails, intermediate rails, toe plates and self-closing gates shall satisfy the requirements specified in 6.5.1.

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.

6.6 Stability

6.6.1 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 (inertia forces, electrodynamic forces, etc.).

Means for preventing unforeseeable 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.

6.6.2 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;

— combined machines (in-line).

EXAMPLE Self-locking gears.

6.7 High contact temperatures

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

NOTE The limit values in EN 563 are expected to be retained in the ISO 13732-1[56].

Means of safeguarding 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.

6.8 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 of reducing 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.

EXAMPLES (of significant sources of noise) Gears, hydraulic devices, compressors, pumps, exhaust fans, blast air nozzles, suction devices (for paper dust, trimmings), paper embossing, cutting, diecutting, creasing of paper, board, paper grinders, cylinder rolling motion, paper stops, separation of paper or board from printing forme, power transmission systems, pneumatic systems, etc.

6.9 Electrostatic toner dust

Where electrostatic toners are used as printing substances (such as in digital printing presses), it shall be ensured that persons are not endangered by toner dust.

This can be achieved by

— using non-hazardous toners;

— providing totally enclosed systems;

— providing adequate dust separation equipment and filters.

6.10 Radiation hazards

6.10.1 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 interlocked 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 interlocked 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.

EXAMPLES Laser exposing devices, laser gravure equipment, laser cutting devices, etc.

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

NOTE For user information see Clause 15.

6.10.2 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 driers.

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 defined 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).

6.10.3 Ozone hazards caused by UV radiation

Every attempt shall be made at the design state to eliminate hazards due to ozone creation by UV radiation or electron radiation. If the design cannot completely eliminate ozone creation, exposure to air containing ozone shall be prevented.

Measures for reducing ozone emission include low-ozone UV dryers, provision of exhaust equipment, or provision of adequate purification systems to filter out the ozone.

On UV continuous-flow drying devices, any hazards caused by the build-up of ozone shall be prevented, for example, by using devices with low ozone radiation or by providing exhaust systems that are designed such that they act as much as possible on the source of radiation.

Radiators shall be operated only when the exhaust system is switched on. The function of the exhaust system shall be monitored.

Failures in the exhaust system shall cause automatic stopping of the substrate feeding system (such as feeders on sheet-fed printing presses) or printing shall be stopped (such as on web-fed rotary printing presses). It shall be ensured that the drying device stops automatically after the drying of the substrate (such as the last sheet) is finished. The control system for monitoring the function of the exhaust system shall satisfy category 1 of ISO 13849-1:1999.

6.11 Stationary knives

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

EXCEPTION: This does not apply to bed knives in sheet cutters.

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

6.12 Rotary tools

On rotary tools, the in-running nips and that part of the peripheral area that 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. The requirements of Clause 5 shall be satisfied.

EXAMPLES 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.

6.13 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 that forms part of an assembly.

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

6.14 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.

6.15 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 during the production run.

6.16 Washing equipment for printing formes, rollers and doctor blades

6.16.1 Hazards due to emission of washing agents

Personnel shall be protected from hazards from emissions of washing agents used in external washing devices for printing formes, rollers and doctor blades.

This can be achieved by one or more of the following measures:

— using non-hazardous solvents when possible (respective warnings shall be given in the instruction handbook);

— using closed-type washing equipment;

— providing interlocking with guard locking for the charging doors so that the doors can be opened only after the drying process is finished;

— exhausting solvent vapours.

NOTE Hazards for operating personnel are caused by the use of hazardous substances and by the existence of potentially explosive atmospheres.

6.16.2 Grounding of washing equipment

Where solvents with a flash point below 55° C are used on external washing equipment for printing formes, rollers and doctor blades, and where explosion hazards exist due to spraying of the washing agent, all parts inside the washing device shall be conductive and electrostatically earthed (resistance less than 10^6 Ω).

6.16.3 Unintended escape of solvents

Where solvents with a flash point below 55 °C are used on external washing equipment for printing formes, rollers and doctor blades, hazards from unintended escape of solvents, e.g. leakage or during pumping, shall be prevented.

Penetration into non-explosion-proof areas can be prevented, for example, by using catch tanks of adequate size.

NOTE For further information on fire and explosion protection, see 6.2.

6.17 Alcohol dosing devices

6.17.1 Concentration

Alcohol dosing devices as auxiliary devices on dampening units shall be equipped with a means of allowing the user to limit the concentration of alcohol in the dampening water to the percentage required for the printing process.

Additional explosion protection measures in the dosing equipment and printing press area are not required if the dosing device is equipped such that maximum 15 % by volume of alcohol in the dampening water for normal operation cannot be exceeded.

In addition, if an electric/electronic control system is used to control the alcohol concentration in the dampening water, this system shall satisfy the requirements of 11.1.1, to ensure that a failure of the primary control system shall not allow the volume of alcohol in the dampening water to exceed 20 %.

6.17.2 Prevention of leakage and overflow

Adequate measures for alcohol dosing devices shall be provided to prevent leakage and overflow of concentrated alcohol into non-explosion-proof areas. Adequate measures include the use of collecting tanks or means of draining the alcohol into the dampening recirculator.

When setting up alcohol tanks, it shall be ensured that the tank cannot fall, and that the tank and the hoses connecting the tank to the dosing device are safeguarded against damage. Where appropriate facilities for setting up the tank cannot be supplied because of user-specific tanks being used on site, the instruction handbook shall contain instructions for the proper setting up of the tanks.

Alcohol tanks are safeguarded against falling, for example, by placing them in closed cabinets.

6.18 Refrigerating devices in ink and dampening units

Refrigerating devices of auxiliary devices in ink and dampening units shall comply with EN 378-1.

6.19 Powder spraying devices

Safe replenishing of print powder used during the printing process shall be ensured.

6.20 Routine handling of heavy machine parts

Appropriate load lifting devices shall be supplied where heavy machine parts with a lifting load of 25 kg or more per person need to be installed and removed routinely. The instruction handbook shall indicate the need to use adequate means of lifting and transport (see 15.2.4).

EXAMPLES (of machine parts that need to be installed and removed routinely) Screen rolls, gravure cylinders, some rubber rolls and flexo forme cylinders.

The 25 kg requirement shall apply when ideal lifting conditions exist. Under conditions that are less than ideal, making lifting more difficult (such as positioning resulting in 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, 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 Imperial units. In the U.S., requirements stated by the U.S. Occupational Safety and Health Administration (OSHA) may supersede the resulting conversions.

6.21 Oxidizers, incinerators or thermal cleaning plants

Hazards associated with oxidizers, incinerators and thermal cleaning plants shall be reduced or, where possible, prevented.

NOTE For guidance, see EN 12753[15], NFPA 86[50] and EN 746-1[7].

Information on methods for reducing residual risks associated with these hazards shall be provided in the instruction handbook.

7 Release from a hazardous situation

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

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.

8 Control zones

A press 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 press 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 press 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 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 splicers and stackers/palletizers.

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 10.1.3. Wireless motion-control shall function in accordance with 11.2.3.

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 of 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 actuating 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 9.2.4.1.2).

Each control zone shall have a safety signalling system as specified in Clause 13, 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 10.

9 Controls

9.1 General

This clause addresses specific controls that shall meet the criteria put forth in this International Standard. The press 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.

9.2 Manual control devices

9.2.1 General

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

Unless otherwise specified in this International Standard, the manual controls specified shall be flush. An exception to this requirement is the controls on touch-pads, 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 operated safely 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.

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

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

9.2.2 Types of manual control

9.2.2.1 Flush controls

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

9.2.2.2 Guarded controls

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

9.2.2.3 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 27).

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

a) Mushroom-head pushbuttons **b) Palm-type pushbuttons**

Figure 27 — Types of emergency stop pushbutton

9.2.3 Colours for manual control devices

Colours used for control devices shall be as specified in Table 3.

Although Table 3 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 3.

The colour of the controls, illuminated or non-illuminated, shall be as specified in IEC 60204-1, and shall be uniform throughout the press 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 3 — 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	—
Speed limit	green, black, white or grey	green	used primarily on newspaper presses
Plate position (or comparable control)	black, white or grey	grey	
Other motion-initiating controls	black, white or grey	—	—

9.2.4 Functions, operations and mechanical specifications of manual control devices

9.2.4.1 Emergency stop

9.2.4.1.1 General

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

9.2.4.1.2 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 7. It shall not be possible for any start command (intended, unintended or unexpected) to take effect 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.

9.2.4.1.3 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.

Currently, NFPA 79[49] 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 control 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 10.1.2).

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 using 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 cause 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.

A pushbutton used for emergency stop shall meet the criteria of a stop/safe pushbutton, including integration with the safety signalling system, if required. The use of an emergency stop control other than a pushbutton does not meet the requirements for the stop/safe 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 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.

9.2.4.1.4 Emergency stop and auxiliary devices

For auxiliary devices built into a press system, which require an emergency stop device according to this International Standard, the emergency stop buttons on the printing press shall function in accordance with the requirements of Clause 8.

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;

— 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.

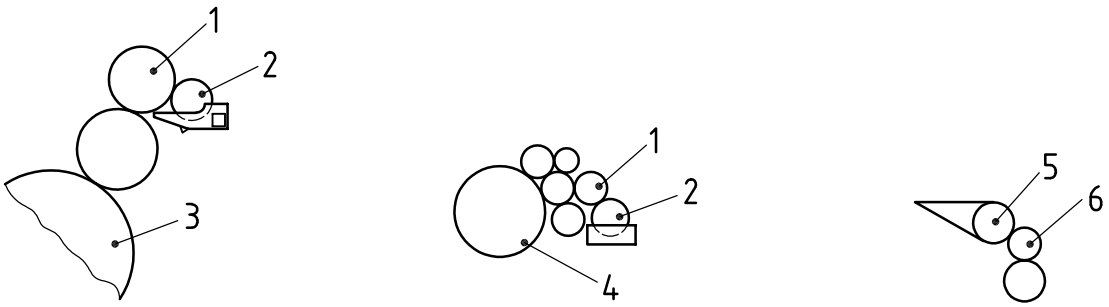
9.2.4.1.5 Emergency stop and ink, dampening, metering, coating or fountain rollers

Actuation of an emergency stop or stop/safe button need not cause stopping of auxiliary motion of the ink, dampening and coating roller where this is required for operational reasons and all hazard points are safeguarded; that is,

— in-running nips between the ink fountain roller and the ductor roller are not accessible, even when the ink fountain is in the open position;

— all in-running nips on the dampening and the coating fountain roller and metering roller are safeguarded by fixed guards.

If interlocked guards are used, motion protected by the guard must stop when the guard is opened. Figure 28 shows potential in-running nips that may need to be guarded on the coating unit, dampening unit and ink pan.



a) Coating unit **b) Dampening unit** **c) Ink pan**

Key

1	metering roller	4	plate cylinder
2	fountain roller	5	ink fountain roller
3	printing cylinder	6	ink doctor

Figure 28 — Coating unit, dampening unit and ink pan

9.2.4.2 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 stop/safe pushbuttons 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 pushbutton shall be clearly distinguishable from an emergency stop pushbutton, if separate pushbuttons 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 also used 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, and shall be a mushroom-head or palm-type pushbutton.

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.

9.2.4.3 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. A stop control need not stop motion in the entire control zone. 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.

9.2.4.4 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 9.3.2.

For printing presses, run at zero speed shall not be allowed. A printing press may contain smaller subsystem components that may run at zero speed even though the press is in the run condition, as long as these components do not pose a hazard. However, auxiliary equipment that is part of the press system may be running at zero speed and/or may be in the armed condition.

NOTE A press system might have any number of run controls, labelled differently, allowing the machine to run at different particular or set speeds, including speeds that are slower than production speed.

See Clause 13 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.

9.2.4.5 Inch control (jog)

9.2.4.5.1 Forward inch control

The forward inch device shall be a momentary-contact control that functions as described in 9.3.1, and moves the press 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 9.3.1.

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 5.6.1 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 and 5.6.

The inch-control device may also be used to activate the reset function, which shall reset the machine and initiate the warning period as specified in Clause 13 and Annex E.

9.2.4.5.2 Reverse inch control

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 press system motion at inch speed in a reverse direction as specified in 9.3.1.

9.2.4.5.3 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 press system motion as defined in 9.3.1.

With the selector switch in the forward position, the inch control shall function in accordance with 9.2.4.5.1. With the selector switch in the reverse position, the inch control shall function in accordance with 9.2.4.5.2.

9.2.4.6 Ready control

The ready control shall be a maintained-contact pushbutton, mechanically interlocked with the associated stop/safe pushbutton. When depressed, it shall release the associated stop/safe pushbutton and may place the machine in the ready condition.

For example, if all guards are closed and all stops are released, the machine will go to the ready condition.

9.2.4.7 Reset control

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 reset control shall conform to the colour requirements for the inch control.

Motion-initiation 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 9.2.4.5.1 for use of an inch control to accomplish the reset function.

9.2.4.8 Faster control

A faster control shall be a momentary-contact control.

Depressing the 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 9.3.2 at minimum continuous run speed.

9.2.4.9 Slower control

A slower control shall be a momentary-contact control that decreases the speed of the press system.

The slower control may also be used in conjunction with the inch control to initiate machine motion as defined in 9.3.2 at minimum continuous run speed.

9.2.4.10 Speed limit

While the speed limit control is depressed, a machine or machine element at standstill shall not move.

When the press is in continuous run, activating any speed limit control shall prevent acceleration until all speed limit controls are deactivated (speed limit function). Press speed can be reduced using the slower control.

Pressing a stop/safe pushbutton shall take precedence over the speed limit function.

9.2.4.11 Plate position control

When an interlocked guard is open and hazardous points are unprotected, press motion shall occur only according to hold-to-run conditions as defined in 5.5.4 and 5.6.

Alternatively, if all hazards are protected, a plate position control may be a momentary-contact control. Successive depressions of the control during the permissive period may initiate indexing to the next plate position.

NOTE This device is not used for registration purposes.

9.2.4.12 Other motion-initiating controls

Other controls used to initiate motion of the main drive shall be momentary-contact controls.

EXAMPLE A blanket cylinder positioning control.

9.3 Initiating machine motion

9.3.1 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 (double-push) activation of the same inch or reverse inch control.

Regardless of which implementation is chosen, it shall be uniform throughout the press system.

9.3.2 Initiating continuous machine motion (run)

Continuous machine motion may be initiated by 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 in 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 control;

c) activation of the run, the slower or the faster control 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 control without going through an additional warning period if all hazards are protected.

Regardless of which implementation is chosen, it shall be uniform throughout the press system.

9.3.3 Initiating continuous machine motion at crawl speed with a guard open

Initiation of continuous machine motion at crawl speed with a guard open shall be permitted only if all in-running nips remain guarded by either a nip guard or a trip nip guard conforming to the requirements of 9.7. Maximum crawl speed is determined by the ability of the slowest acting trip nip guard to safeguard the hazard.

9.4 Hold-to-run controls

A hold-to-run control shall require continuous actuation of the control(s) to achieve operation.

9.5 Two-hand controls

9.5.1 General

Two-hand controls as safety devices are acceptable only if any hazardous movement stops when one manual control is released. The hazardous movement shall come to a stop in a time 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 5.6.1 for hold-to-run controls designed as two-hand controls).

9.5.2 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 shall be provided with tension-relief measures.

9.5.3 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 III A, and electric/electronic two-hand controls shall meet the requirements specified for type III B of ISO 13851:2002.

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 III B, and electric/electronic two-hand controls shall satisfy the requirements specified for type III C of ISO 13851:2002.

9.6 Electro-sensitive protective devices

9.6.1 General requirements

Electro-sensitive protective devices shall satisfy the requirements of type 2 of IEC 61496-1:2004 and IEC 61496-2.

9.6.2 ESPDs that safeguard routine/regular access

In deviation from 9.6.1, electro-sensitive protective devices that safeguard routine and regular access to the hazard zone shall satisfy the requirements of type 4 of IEC 61496-1:2004 and IEC 61496-2.

9.6.3 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.

9.6.4 Use of ESPDs to prevent whole-body access

Where electro-sensitive protective devices are used for preventing 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.

9.7 Pressure-sensitive mats, pressure-sensitive bumpers, trip devices

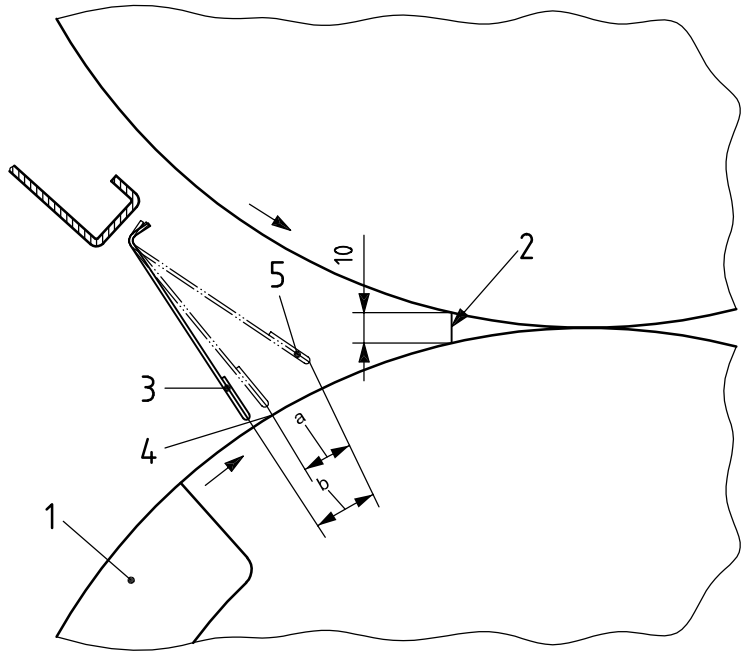
Pressure-sensitive mats and pressure-sensitive bumpers shall satisfy the requirements of ISO 13856-1.

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 that 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 in such a way that the hazardous movements that they are safeguarding shall be stopped before personnel can reach the hazard (see Figure 29).

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 29 — Tripping devices

9.8 Braking devices and clutches

9.8.1 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;

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.

9.8.2 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, and then pauses before the next cycle is initiated. For example, some platen presses, screen presses and bundling machines are single-stroke operation machines. A guillotine cutter is the most common example of a single-stroke machine.

10 Control stations

10.1 Motion-control stations

10.1.1 General

The use of a motion-control station is determined by the desired functions to be performed at its location

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 press system. When a motion-control station is located with another (non-motion-control) station or with other operator functions, the functions of the motion-control station shall be distinctly set apart from the other 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.

10.1.2 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 9.2.4.1.3.

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 pushbutton (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 control and a stop/safe pushbutton.

10.1.3 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) 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.

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 suitable means other than the electrical wiring.

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 permitted in 5.6.

10.2 Remote access

10.2.1 Remote control via data link

10.2.1.1 General

Press systems that utilize warning periods as defined in 13.2.2 and permissive periods as defined in 13.2.3 may use remote-control communications links for the purposes of performing diagnostic and calibration functions, including those functions requiring remote activation of machine motion.

10.2.1.2 Maintaining system and data integrity

The equipment manufacturer or service provider shall take into consideration the following measures, and shall comply with category 3 of 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 press system control computer. Identification of the press 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 be checked by means of the CRC mechanism or comparable measures.

— Guard against the possibility of the establishment of unauthorized data links to the press system control computer. Unauthorized entry to the press system control computer may be prevented, for example, by requiring the use of a password and a subscriber identification with so-called transaction numbers that 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.

10.2.1.3 Datalink line blocking

It shall be possible to disable (block) access to a local press system control computer via a remote-control data link by disconnecting the remote-control communications line connection to the press 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 5.5.5);

— a manually operated switch requiring a key or a password to close the connection.

10.2.1.4 Indication of enabled condition of remote-control datalink

Whenever the power supply to the local press system control computer is ON and the capability exists for the remote control communications link to be enabled (unblocked), there shall be a method to alert personnel at the local press system of the enabled condition.

This can be achieved, for example, by:

— indicator light(s) on one or more control stations;

— notification message on a display screen(s).

10.2.1.5 Indication of activated condition of remote control datalink

Whenever a remote-control communications link is established to the local press system control computer, there shall be a method of alerting personnel at the local press 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:

— a blinking notification message on a display screen(s).

10.2.1.6 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 13.2.2 and 13.2.3 and in effect during normal local operation of that press system.

10.2.1.7 Response to motion command from remote-contol datalink

The design of the press system controls shall require that every command initiated by the remote control datalink which causes the press 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.

Failure to receive the local ready signal shall cause the press system to stop under the same conditions, and with the same effects, as a trip of the press system safety-guard interlock system, including blocking of the datalink line.

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.

10.2.1.8 Remote-control datalink time-out

The press system shall be equipped with a time-out function which, when a remote control data link is established, will cause the press system to stop under the same conditions and with the same effects (including blocking of the datalink line), as a trip of the press 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.

10.2.1.9 Acceptance safety 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 safety 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 (e.g. 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 acceptance-test procedure and 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.

10.2.2 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 only allow sending a signal 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 meet the requirements specified in Clause 9.

f) The wireless control station shall contain a control which, when activated, shall generate an emergency stop command. As specified in 9.2.4.1.3, 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 a 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.

EXAMPLE 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.

11 Control systems

11.1 General requirements

11.1.1 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 may be used.

NOTE To meet the single-fault requirement of category 3 of ISO 13849-1:1999, redundancy can be achieved by redundant hard-wired circuits, a combination of a hard-wired circuit and an electronic circuit, or multiple electronic circuits with multiple PLCs or processors.

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 controllers (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 e.g. emergency stop circuits, electric interlocking circuits, limiters of displacement or operating speed on hold-to-run controls. (See also ISO 13849-1 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.

11.1.2 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 also will be switched off or any other appropriate measure will be taken.

EXAMPLES "Safety devices" include emergency stop devices, electro-sensitive protective devices, trip devices. "Other appropriate measures" include 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) that switches off after a preset time.

On electronic adjustable speed drives that 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 by shifting the supply voltage and/or frequency.

11.1.3 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 the power supply to the low-voltage tripping coil.

11.1.4 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.

11.1.5 Unobserved unguarded hazard zones

When more than one interlocked 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 5.8.1.

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 11.1

11.2 Additional requirements for hand-fed machines where the operator's hands enter the point of operation

11.2.1 General

For those hand-fed machines where the operator has routine and regular access to hazard points at which the operator's hands can come into contact with the tools or the path of tool movement, the additional requirements of 11.2.2 to 11.2.5 shall apply.

For example, this may apply to certain platen and screen presses.

11.2.2 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.

11.2.3 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.

11.2.4 Main contactors

Main contactors shall be redundant. Faults in the main contactors shall be detected and shall lead to shutdown.

11.2.5 Systems using electronic braking

Systems using electronic braking shall have, as back-up, an additional electro-mechanical or pneumatic-mechanical brake that 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.

11.3 Control systems for screen printing presses

The control system shall comply with 11.1. Trip devices shall comply with 9.7.

In addition, the following requirements shall be satisfied on screen printing presses where substrates are fed manually between the printing forme and the printing table:

— the safety-related parts of the control system that relate to the closing movement of the screen frame and the printing table shall comply with 11.2;

— trip devices shall satisfy category 4 of ISO 13849-1:1999 in addition to the requirements of 9.7;

— electro-sensitive protective devices shall comply with 9.6.2.

NOTE Manual feeding of the substrate between the printing forme and the printing table is used on several types of semi-automatic screen printing presses.

12 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 specified in IEC 61310-1 and IEC 61310-2.

13 Signals and warning devices

13.1 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 press systems if:

— the machine length is greater than 7 m;

— there is more than one printing unit and the height of the printing unit(s), measured from floor level, is greater than 1,6 m;

— the system includes machines on different floors;

— on automatic platen machines, the control panels are located such that waste discharge area cannot be observed from the control panels.

An audible warning system as defined in 13.2, 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 13.2.4 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 13.2.6.

Warning signals shall

— occur before the initiation of machine motion;

— be clearly recognized and differentiated from all other signals used.

When a press with multiple machine actuators is configured into multiple control zones, there shall be, at a minimum, a common warning system activated independently by each motion zone. Unique audible alarms (with different audible characteristics) for each control zone are optional, but are not required. If personnel warning lights are used, their independent operation is optional (see Clause 8).

13.2 Audible warning system

13.2.1 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.

13.2.2 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 occurs as a 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 occurs as a 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.

13.2.3 Permissive period

The permissive period shall be a period that shall be initiated after 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.

EXCEPTION: If, for operational reasons, it is necessary that the permissive period exceed 6 s, a permissive period of no more than 12 s is permitted with the addition of a flashing light or an audible signal (or both) in the hazardous area(s) (e.g. in the delivery area). The warning shall cycle throughout the entire permissive period.

If a single push to initiate motion at inch speed is used (e.g. an inch button is depressed and held through the warning period), 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.

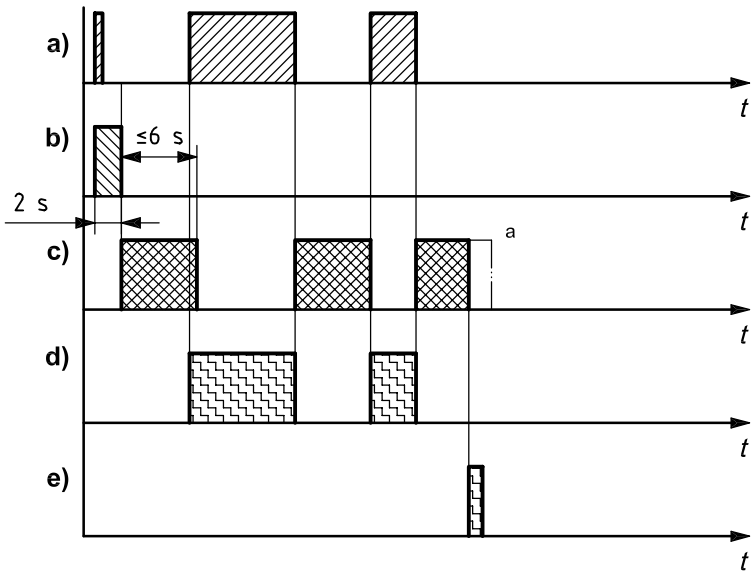
For example, for production reasons it may be preferable to use the double-push system to initiate inch, but a single-push system to initiate run.

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 Figures 30 and 31).

If the optional personnel warning light system is used, the warning lights shall operate as specified in Table 4.

NOTE The permissive period allows for successive inch or reverse operations without each being preceded by a warning period.

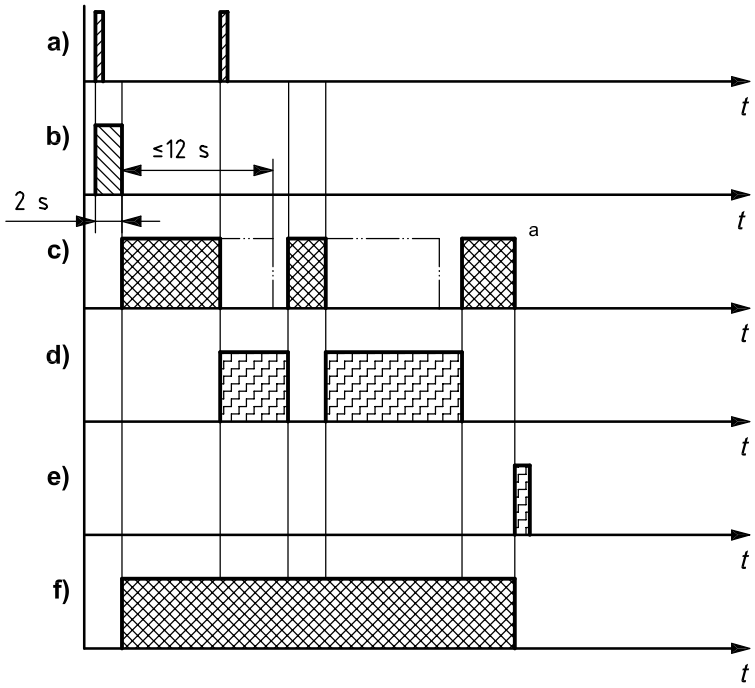


Key

a) inch-reverse
b) warning period and audible alarm
c) permissive period
d) machine motion
e) stop, stop/safe, breaking a safety circuit

[a] Cancellation of the permissive period.

Figure 30 — Audible warning system with double-push sequence



Key

a) automatic start button
b) warning period and audible alarm
c) permissive period
d) machine motion
e) stop, stop/safe, breaking a safety circuit
f) flashing light or audible signal in thehazardous area(s)

[a] Cancellation of the permissive period.

Figure 31 — Audible warning system for automatic machine mode with double-push sequence

13.2.4 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, 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 can 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 alarm shall comply with the requirements specified in Table 4.

Table 4 — 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[d]	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.

[d] See 13.2.3 for an exception.

13.2.5 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 printing press 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 distinctive from any machine-status lights.

13.2.6 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 specified in Clause 13 are not required.

13.3 Area-light warning system

An area-light warning system, as specified in Annex E, may be used instead of the audible warning system specified in 13.2. The use of the area-light warning system is not permitted in Europe.

14 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[18]

— ANSI Z535.3[2]

— ANSI Z535.4[3]

— IEC 61310-1

— IEC 61310-2

Warning signs and labels shall be provided to warn of the following hazards:

— exposed sharp edges on blanket sleeves;

— exposed sharp edges of slitter blades and cutting knives;

— crushing/sheering hazard on sheet-fed delivery gripper bars and chains;

— burn hazard on accessible hot surfaces of 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 to or posted as close as possible to the hazard.

15 Information for use

15.1 Minimum requirements for machine markings

15.1.1 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 EU market), or other relevant mark as appropriate to the market (e.g. UL, GS, etc.);

— year of manufacture (for machines and products to be launched on the EU market);

— designation of series or type, if any;

— serial number, if any;

— rating information (voltage, frequencies, power etc.).

15.1.2 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.

15.1.3 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.

15.1.4 Machinery with UV radiation

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 and the type of radiation shall be indicated.

15.1.5 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 hot surface(s) is (are) not protected against contact by insulation or additional guards.

15.2 Contents of instruction handbook

15.2.1 Each machine

Each machine shall be accompanied by an instruction handbook containing the minimum information listed in 15.1 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 values are based. See Annex D for examples of instruction handbook layout.

15.2.2 Machines using inflammable liquids

The instruction handbook for machines using inflammable 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 inflammable liquids.

15.2.3 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 regarding the removal of the knives using the tools and the knife covers supplied, and the subsequent storage in knife boxes.

15.2.4 Handling heavy machine parts

Where heavy machine parts need to be installed and removed regularly, necessitating the lifting of a load of at least 25 kg per person, the instruction handbook shall indicate the need for the user to provide adequate means of lifting and transport.

15.2.5 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.

15.2.6 Additional requirements

In addition to the requirements in 15.2.1 to 15.2.5, the instruction handbook(s) shall, where required:

a) describe the protective measure, if any in addition to 15.1.5, 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 (e.g. 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) provide a warning in the installation instructions to place the machines at sufficient distances from elements of the building (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) provide instructions for the proper handling and adjusting of guards;

h) provide 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.

15.2.7 Sheet-fed printing press systems

15.2.7.1 Residual risk from ink ducts

The instruction handbook shall warn the user of any residual risk existing when ink ducts are swung down.

NOTE There may be in-running nips between ink ducts and ductor roller.

15.2.7.2 Residual risks in sheet delivery area

The instruction handbook shall warn the user of residual risks existing when gaining access under the guards in the sheet delivery area.

NOTE Access may be for test sheet removal or for inserting pile wedges.

15.2.7.3 Residual risks using ESPDs

The instruction handbook shall warn the user of any residual risks that may exist when using one or more ESPDs to safeguard the delivery. The following conditions shall be covered by relevant notes:

a) risks occurring through intentionally defeating the bypass sequences;

b) movement of persons in areas where the view is obstructed by product or machinery;

c) intended use, and prohibited use, of the bypass function (top and bottom ESPD);

d) climbing over or crawling underneath the ESPD;

e) pressing a reset pushbutton and activating (or reactivating) the ESPD protection zone if a person is in the delivery.

The documentation shall contain information regarding maintenance intervals and separate inspection and test notes for this safety equipment.

15.2.7.4 Sheetfed presses used for printing on board or metal sheet

The instruction handbook shall warn the user of the residual risk existing where ISO 13852 cannot be applied in the feeding area for production reasons on sheetfed printing presses that are also used for printing on board or metal sheet.

15.2.7.5 Rollers

If activation of the emergency stop control does not stop ink, dampening, metering, coating or fountain rollers, the instruction handbook shall provide information on how these rollers shall be stopped. For example, an adequate measure for stopping is operation of the main supply switch.

15.2.7.6 Powders (anti-offset powders)

The instruction handbook shall specify the use of non-hazardous powders.

15.2.8 Web-fed printing press systems

15.2.8.1 Rollers

If activation of the emergency stop control does not stop ink, dampening, metering, coating or fountain rollers, instructions shall be provided in the handbook regarding how these rollers shall be stopped.

NOTE An adequate measure for stopping is, for example, operation of the main supply switch.

15.2.8.2 In-running nips

The instruction handbook shall identify hazards that exist when operations are carried out in the vicinity of areas where in-running nips could be generated under hold-to-run control and where such areas cannot be observed from the point of operation of the hold-to-run control. It shall also describe safe working practices, e.g. operation of a stop control with mechanical latch or emergency stop device before beginning operation in the hazardous area.

15.2.8.3 Operation by two-hand control with guard open

Where production reasons require the printing press to be started by two-hand control with guards open with a speed higher than 10 m/min, the instruction handbook shall contain a warning that the person operating the two-hand control shall make sure that there is no second person in the hazardous area before starting the hold-to-run operation.

15.2.9 Screen printing presses

15.2.9.1 Ventilation and admissible liquids

The instruction handbook shall indicate the admissible inks, coatings, washing liquids and solvents (admissible flash point), and shall provide instructions for adequate ventilation of the working area at the place of installation.

15.2.9.2 Access between screen printing frame and machine frame

The instruction handbook shall indicate that, before access between the screen printing frame and the machine frame (for example, for cleaning the screen) is allowed, unintended start-up of the machine shall be prevented, for example, by actuation of a selector switch.

15.2.9.3 Use of different size screens

Where screens of different sizes are being used, instruction handbooks shall contain instructions for adjusting stop gauges so that the distance between doctor blade and screen frame is no less than 25 mm.

15.2.9.4 Crushing point between doctor blade and screen or machine table

Where the crushing point between the doctor blade and the screen or machine table cannot be safeguarded for operational reasons, the instruction handbook shall warn the user of the residual risks existing, for example, when replenishing inks.

15.2.9.5 Residual risks related to doctor blade

The instruction handbook shall warn the user of residual risks caused by the doctor blade being used without a screen, or a screen of a smaller size being installed.

15.2.10 Automatic cylinder- and roller-washing device

The instruction handbook shall specify the requirement to set the washing parameters such that, depending on the washing agent used, solvent vapours will not be created.

Such parameters, for example, can be the pressure of the washing liquid, the speed of rotation of washing rollers and brushes, the length of the washing process, etc.

NOTE Solvent vapours can cause risks of explosion or damage to health.

15.2.11 Continuous-flow drying devices

15.2.11.1 Inks and coatings

Where the use of inks and coatings is restricted to certain types for avoidance of explosion risks in accordance with 6.2.2 to 6.2.7, the instruction handbook shall contain relevant information. The handbook should also include the suggested maximum flow rate, at a specific lower explosive limit, of ink, coating and wash solvents into the dryer.

15.2.11.2 Solvents

The instruction handbook shall contain a warning that to avoid an explosive hazard, solvents shall not be placed in the area of the continuous-flow drying device (e.g. during manual washing of cylinders or rollers).

15.2.11.3 Mist of UV inks and UV coatings

The instruction handbook for UV continuous-flow drying devices shall indicate that the build-up of mists of UV inks and UV coatings shall be avoided, and that exhaust equipment may be required to remove mists.

15.2.11.4 Solvents for manual washing

When washing cylinders and rollers by hand (manually), rather than with an automatic washing device, solvent ignition within the drying device should be avoided by one or more of the following means:

— removing the web from its operating position (threaded through the drying device) before starting the washing;
— using cleaning material (solvents) that has a safety data sheet indicating that the explosion limit is “not applicable” at the expected operating temperature of the drying device;
— using user-created "Standard Operating Procedures” for press operators so that the flow rate of solvents into the drying device is limited to that rate producing acceptable solvent concentration limit as defined by EN 1539 and NPFA 86.

15.2.12 Oxidizers, incinerators and thermal cleaning plants

The instruction handbook shall provide information on methods for reducing the following residual risks:

— inlet concentration of inflammable substances not limited to established maximum design concentration standards;

— inflammable condensate and deposits on internal duct surfaces;

— insufficient forced ventilation;

— insufficient oxygen, process space temperature, mixing, residence time and catalyst function (if applicable) for oxidation of inflammable substances;

— uncontrolled ignition sources such as electrical and mechanical sparks, static electricity and flashback;

— lack of explosion-resistant design and explosion relief devices;

— overheating caused by failure of temperature control, heater failures and insulation failure.

15.2.13 Alcohol dosing devices

Where appropriate facilities for setting up alcohol tanks are not supplied because of user-specific tanks being used on site, the instruction handbook shall contain instructions for the proper setting-up of tanks.

The instruction handbook shall also indicate that alcohol spillage needs to be removed immediately.

15.2.14 Washing equipment for printing plates

For washing equipment for printing formes, rollers and doctor blades where only washing solvents with a flash point above 55 °C may be used, this shall be noted in the instruction handbook.

15.2.15 Pile turners and reel turners

The instruction handbook shall clearly state the maximum load capacity of pile turners.

Annex A
(informative)

Hazards associated with printing press systems

Table A.1 lists many significant hazards that may be encountered in printing press systems. When performing risk assessment for an individual piece of equipment, the manufacturer may find that this list helps in identifying the risks on their piece of equipment. The manufacturer should be aware that there may be other hazards not included in this list that need to be identified during the risk assessment process.

NOTE Additional information on hazard analysis is given in ISO 14121[37].

Table A.1 — Significant hazards and hazard zones

Significant hazards	Hazard zone
Mechanical hazards — crushing — shearing — cutting or severing — entanglement — drawing-in — trapping — impacts	Production area — between rollers, cylinders, drums — short linear movements — wheels for floor travel — revolving handwheels — guards — make-ready, cleaning, maintenance operations and trouble-shooting (hold-to-run) — impact hazards in passageways, access ways — loss of stability — stationary knives — rotary tools — transport of hazardous tools — on feeding and delivery units (pile lifting and lowering devices) — unwinding and rewinding units for web material Sheet-fed printing presses and coating units — sheet gripping devices, rollers, cylinders, perforating tools, feed openings — in-running nips behind interlocked guards — dampening unit, coating unit — sheet delivery — automatic format setting — pile changing devices — offset proofing presses Web-fed rotary printing presses and coating units — in-running nips on rollers and cylinders, feed openings — in-running nips behind interlocked guards — dampening unit, coating unit — automatic format setting — automatic travel of transport carriages — folder — webs — automatic loading on unwinding unit — hold-to-run control for formes — printing rollers with equi-directional revolutions — digital printing presses

Table A.1 (*continued*)

Significant hazards	Hazard zone
Mechanical hazards (*continued*)	Screen printing presses — crushing points — screen frame/printing table — crushing points — doctor blade/screen frame — crushing points by doctor blade movement — unintentional start-up — danger points — cylinder screen printing presses Cylinder- and roller-washing devices — built into machines Continuous-flow drying devices — built into machines Powder spraying devices — built into machines — powder replenishment Auxiliary devices on inking and dampening units — built into machines — refrigerating devices Plate clamping devices — built into machines — hazardous movements Washing devices for printing plates, rollers and scrapers — installation in machine Pile turners and reel turners — crushing hazard — floor/lifting member — uncontrolled gravity falling in case of leakage or hose breakage — load lifting device — emergency stop device Measuring and control devices — crushing and shearing points in machines
Slipping, tripping, falling	Production area — work platforms, access stairs, passageways, steps
Thermal hazards — burns due to possible contact	All machinery — hot machine parts Continuous-flow drying devices — surface temperature
Electrical hazards — direct or indirect contact thermal radiation (burns)	All machinery — electrical equipment — equipment made live under electrical fault conditions
Hazards generated by radiation — laser — UV radiation	Sheet-fed printing presses, web-fed printing presses, coating units — laser exposing equipment Continuous-flow drying devices — emission of UV radiation

Table A.1 (*continued*)

Significant hazards	Hazard zone
Hazards generated by noise resulting in hearing loss	All printing machines and their ancillary equipment
Hazards from substances and material used for processing, machine operation or that are emitted during the process — hazards resulting from contact with or inhalation of harmful fluids, gases, fumes, dusts	Sheet-fed printing presses, web-fed printing presses, coating units — ozone build-up — toner dust — exhaust fans and suction devices Cylinder- and roller-washing devices — replenishing of washing agent — removal of washing device Continuous-flow drying devices — ozone build-up Auxiliary devices on inking and dampening units — leakage of washing agents
Hazards from fire and explosion	Web-fed printing presses and coating units — explosion hazards on exhaust fans Screen printing presses — explosion hazard Cylinder- and roller-washing devices — use of washing agent Continuous-flow drying devices — heating — leakages — emission of inflammable substances — ignition of inflammable substances Auxiliary devices on inking and dampening units — alcohol dosing devices Washing equipment for plates, rollers and doctor blades — explosive atmospheres, fire hazards
Hazards generated by neglect of ergonomic principles in machine design — unhealthy body postures	Production area — operating postures — lifting of heavy loads — design of actuators and displays, handles Sheet-fed printing presses and coating units — hold-to-run control — gangways — installation and removal of heavy machine parts Web-fed printing presses and coating units — hold-to-run control — installation and removal of heavy machine parts
Failure, malfunction of control system — faults or failures in safety circuits	Sheet-fed and web-fed printing presses, coating units — alcohol dosing equipment

Annex B
(informative)

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 is 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 dispersion of dust layers, different sets of zones have been defined for gases/vapours and dusts.

In view of this, avoiding the creation of effective ignition sources for combustible dusts requires different measures than for combustible gases/vapours to be required.

NOTE 2 Information on the control and classification of hazardous places for gases and vapours by the use of ventilation is given in EN 60079-10[22].

B.2 Zones for gases/vapours

The following zones are defined:

Zone 0: a place in which an explosive atmosphere consisting of a mixture with air of inflammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequents.

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 inflammable 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, e.g. on pumps and valves with stuffing-boxes.

Zone 2: a place in which an explosive atmosphere consisting of a mixture with air ofin 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 shows examples of explosion zones in which explosive atmospheres may exist.

Table B.1 — Examples of explosion zones

Equipment type	Zone	Zone description
Rotary web gravure printing machines	1	The area of the printing unit between the printing unit side frames. The service walkway between the printing units up to a height of 2 m including the area between the side frames. The area of the ink fountain, the area of the ink container of the printing unit, connected with the printing unit and the area of the storage tank and the surrounding area up to a distance of 500 mm on all sides. The area of the web material and the area surrounding it up to a distance of 250 mm on all sides, based on the maximum possible printing width, up to the point of entrance into the dryer, at a maximum, however, up to a length of 2 m of the freshly printed web-type material.
Sheet-fed rotary gravure printing machines	1	The area in between the side frames, in which the printing unit, for example with ink fountain, forme cylinder, intermediate roller and the freshly printed material are located. The area of the ink fountain, extending at right angles to the axis of the fountain roller in a radius of 1 m and to the sides a radius of 500 mm. The area of the ink container, connected to the machine and the area of the storage tank in a radius of 500 mm on all sides.
Rotary web flexographic printing machines, wallpaper printing machines	1	The area of the ink fountain defined by a radius corresponding to the length of the rollers, however, not more than 500 mm. The space below the printing units down to floor level in an area that results from the vertical projection of the danger area of the printing units. The area of the ink container of the printing units that is connected with the machine and the area of the storage tank defined by a 500 mm radius on all sides. The area of the web material established by a 250 mm radius on all sides, based on the maximum printing width, from the entrance of the web material into the first print unit to the entrance of the web material into the dryer tunnel including exhaust and ventilation ducts or up to 500 mm behind the point where the web material leaves the last printing unit, respectively.
Screen printing machines for printing on sheets, web or three-dimensional objects	1	The area around the screen printing frame or cylinder established by a 500 mm radius on all sides and the vertical projection of this area down to floor level. The area of the storage containers established by a 500 mm radius on all sides. The area of the freshly printed sheet or web material established by a 250 mm radius on all sides, based on the maximum printing format, including an area beginning at the exit and extending for 2 m from there or up to the entrance of the dryer tunnel, respectively.

Table B.1 *(continued)*

Equipment type	Zone	Zone description
Rotary and flatbed film printing machines	1	The area of the printing table, established by a 500 mm radius on all sides and the vertical projection of this area down to floor level. The area of the storage containers established by a 500 mm radius on all sides. The area of the freshly printed web material, established by a 250 mm radius on all sides, based on the maximum printing width, extended from the exit of the printing machine up to the entrance of the dryer tunnel.
Machines for printing imitation leather and film	1	The area of the printing unit between the printing unit side frames. The area of the ink fountain, the area of the ink container of the printing unit that is connected with the machine and the area of the storage tank, established by a 500 mm radius on all sides. The area of the web itself, established by a 250 mm radius on all sides, based on the maximum printing width, up to the entrance of the web-type material into the dryer tunnel, the maximum length, however, being a length of 2 m of the freshly printed material.
Wash-out machines and washing machines in which combustible liquids with flash points below 55 °C are used	0 1	The inside of the machine. The area of the machine established by a 5 m radius on all sides and the vertical projection of this area down to floor level and up to a height of 1,5 m above the machine.
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 that is connected with the roller coater unit and the area of the storage tank, established by a 500 mm radius on all sides. The area of the web-type material, established by a 250 mm radius on all sides, based on the maximum coating width, extending up to the entrance of the web-type material into the dryer tunnel, the maximum length, however, being a 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, established 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 established by the vertical projection of the danger areas of the roller coater units. The area of the container that is connected to the machine and the area of the storage tank, established by a 500 mm radius on all sides. The area of the web-type material itself, established by a 250 mm radius on all sides, based on the maximum coating width, from the entrance of the web material into the first roller coating unit up to the entrance 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, no stairs can 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 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):

$$E = E_1 + E_2 + F_1 + F_2 \tag{C.1}$$

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[a] 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 1,5 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	–
If the height to be covered 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;

— decommissioning;

— 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 warning lights

The area-light warning system 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 control zone(s). The status of area warning lights shall be as specified in Table E.1.

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[a]

[a] Either condition is permitted.

[b] If used.

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 press automatically reverts to a ready condition. The area warning lights shall be ON (bright).

At the end of the permissive period, the press 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 is in the forward direction shall have a period of 1 s or less with a duty cycle of 50 %.

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