BRITISH STANDARD

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12648:2003

Graphic technology — Safety requirements for printing press systems

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British Standards

National foreword

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Cross-references

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Summary of pages

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INTERNATIONAL STANDARD

ISO 12648

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Graphic technology — Safety requirements for printing press systems

Technologie graphique — Exigences de sécurité pour systèmes de presses d'impression

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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*.

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 *Safety standard — Printing press systems*, prEN 1010-1, *Technical safety requirements for the design and construction of printing and paper converting machines — Part 1: Common requirements*, and prEN 1010-2, *Technical safety requirements for the design and construction of printing and paper converting machines — Part 2: Printing and varnishing machines including pre-press machinery*.

Graphic technology — Safety requirements for printing press systems

1 Scope

This International Standard applies to 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 will apply.

This International Standard provides safety requirements for the design and construction of the classes of machines listed in Clause 2. 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.

This International Standard applies to new machines (see Clause 2) manufactured after December 31 of the year following the year of publication of this International Standard.

2 Classifications

2.1 Machines for producing printing by various processes

— relief (letterpress, flexographic);

— offset (lithographic);

— gravure (rotogravure, intaglio);

— screen printing;

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

2.2 Auxiliary equipment

— 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.

3 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, *Safety of machinery — Laser processing machines — Safety requirements*

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

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

ISO 12100-2, *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 13850:1996, *Safety of machinery — Emergency stop — Principles for design*

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

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

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

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

ISO 13856-1, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for 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 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 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*

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

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

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

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

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

IEC 60079-11, *Electrical apparatus for explosive gas atmospheres — Part 11: Intrinsic safety “i”*

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

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

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

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

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

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

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

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

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

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

ANSI/NFPA 86, *Standard for Ovens and Furnaces*

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 — 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*

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

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
actuator
part of the actuating system to which an external actuating force is applied

[IEV 441-15-22]

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

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

NOTE 3 See also **machine actuator** (4.32).

4.2
alcohol dosing equipment
equipment for dosing the amount of alcohol in the dampening water of offset printing presses

4.3
armed condition
machine condition in which machine motion can be automatically initiated

NOTE **Zero speed** (4.88) may be considered to be an armed condition.

4.4
audible alarm
horn, bell or other distinctive audible warning device which, when sounded, indicates impending machine motion

4.5
authorized person
person designated as such by plant management as having been trained in the following:

a) the task to be performed;

b) the function of the adjustments in the work zone;

c) proper operation of adjustments and controls;

d) all types of hazards in the area where the task is to be performed;

e) the application of equivalent, alternative protection to perform the task;

f) improper actions that can cause injury; and

g) the consequences of those improper actions

4.6
automatic plate clamping device
device for automatic or semi-automatic changing of printing plates

4.7
auxiliary devices for printing presses
devices used for the production process which are either built in or attached to the printing press

4.8
barrier guard
guard closing off access to an area containing one or more hazards

4.9
category 0 stop
stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop)

[IEC 60204-1]

4.10
category 1 stop
controlled stop with power to the machine actuators available to achieve the stop and then removal of power when the stop is achieved

[IEC 60204-1]

4.11
category 2 stop
controlled stop with power to the drive elements of the machines being maintained

[IEC 60204-1]

4.12
coating unit
coater
type of finishing machine for applying liquid substances (for example glue, varnish, ink) on substances made of paper or similar material in a predetermined thickness; the thickness of the layer is determined by a doctor blade (scraper) or by the gap between two rollers (metering gap)

4.13
continuous flow drying and curing device
device built into printing presses for drying and curing substrates after the printing process (for example by hot air, IR or UV radiation)

4.14
crawl speed
continuous motion at a steady slow speed, and initiated by a momentary contact control

4.15
cylinder screen printing press
sheet-fed printing press where the substrate (sheet) is guided along the screen by a printing cylinder

4.16
digital printing press
printing press where the printing image is produced from data stored in digital form

EXAMPLE Exposing a photo-sensitive drum or film in the machine.

4.17
electrical hazard
source of potential injury or death from electric shock or burn

4.18
emergency stop device
manually actuated control device used to initiate an emergency stop function

[ISO 13850:1996]

4.19
emergency stop function
function initiated by a single human action that is intended to avoid injury to persons, damage to machinery or damage to work in progress

4.20
enabling device
actuating device that needs to be operated in addition to at least one more actuator or device in order to start a machine under hold-to-run control; machine movement is stopped as soon as one of the hold-to-run controls or enabling devices is released

4.21
exposing equipment
machinery used for taking images by exposing photo-sensitive material such as printing plates or printing forms

4.22
fixed guard
guard that is securely affixed by fasteners that require a tool(s) to gain access to a significant hazard

4.23
forms printing press
leporello printing press
machine for the production of continuous forms where paper webs printed with one or multiple colours are leporello folded or wound onto a reel

NOTE In addition to the printing section, the machine consists of devices for punching, rema liners, cross perforation, longitudinal perforation and leporello folding.

4.24
gravure press
machine consisting of a printing cylinder, an impression cylinder and 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; the impression cylinder, covered with a rubber composition, presses the substrate into contact with the ink in the cells of the printing surface

4.25
guard
physical barrier that restricts access to a significant hazard

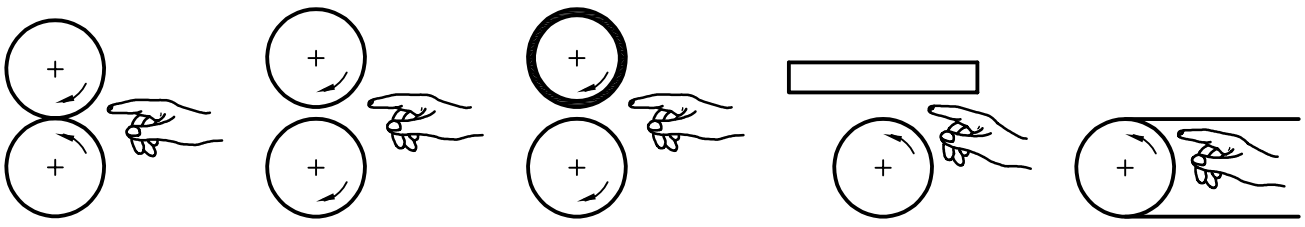
4.26
hazard zone
any area within and/or around machinery in which a person is exposed to risk of injury or damage to health

NOTE Adapted from ISO 12100-1.

4.27
hold-to-run control
control that starts and maintains machine motion only as long as the control is activated (see 5.5)

4.28
in-running nip
in-going nip
area created by either two rotating components that are rotating inward, or one rotating component rotating toward an adjacent surface

See Figure 1.



a) Two counter-rotating rolls | **b) Two rolls rotating 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, and possibly a web driving or being driven by a roll**

Figure 1 — In-running nips

4.29
inch
jog
motion condition requiring maintained activation of a hold-to-run control; motion will continue until the control is released or until a pre-determined displacement has been reached (limited inch)

4.30
inch speed
speed at which the press is operating while in inch mode

4.31
infrequently used workplace
area where a function that is routine, repetitive, and integral to (but not necessarily during) production, but done on an infrequent basis, is conducted

NOTE Examples of such activities include observation, refill of the ink pan, blanket change and plate change, access to elevated sheet-fed presses, make-ready, minor servicing, jam clearing, etc.

4.32
machine actuator
power mechanism used to effect motion of a machine

[ISO 13850:1996]

4.33
maintained contact control
control that remains opened/closed after activation of the control

4.34
maintenance
operation that is usually performed when the machine is not available for production

EXAMPLE Examples of maintenance operations are repairing or replacing broken, worn or damaged parts; performing lubrication; preventive servicing, etc. Maintenance 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. When possible, this should be performed with energy isolated.

4.35
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.

4.36
manual control device
part of the actuating system to which a manual action is applied

NOTE Adapted from IEV 441-15-22.

4.37
mechanical hazard
source of potential injury to a person that is created by motion of machinery, components or material

4.38
mechanical hazard points
locations in the machines where persons can be injured by parts of machines or machine movement, such as

— tools of machines, or parts thereof;

— work pieces, or parts thereof; or

— materials being processed

4.39
momentary contact control
control that is opened/closed only during actuation of the control

4.40
motion control
control that initiates machine motion

4.41
motion control station
operator control station containing both an emergency stop and a motion initiation control

4.42
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 indirectly by the web

4.43
movable control station
control station that is permanently wired to the equipment, but can be moved within the confines of the attached cable

4.44
movable guard
guard that does not require a tool to gain access to a significant hazard

4.45
newspaper printing presses
presses that are designed and built mainly for printing newspapers

4.46
nip guard
guard (nip bar, finger bar, finger guard) located at an in-going nip

4.47
non-motion zone
area defined by any press component, or group of press components that, due to press configuration, is not driven by the press system drive motor(s) or the web

NOTE When the console is freestanding (not press-mounted), it is a non-motion zone.

4.48
non-operational press
press configured for functions other than delivering products, such as make-ready or wash-up

4.49
normal operation
condition that exists during set-up, make-ready, production and minor servicing/adjusting and cleaning performed by operators; this does not include maintenance operations (see 4.34)

4.50
operating position
the location where normal operations (make-ready and other routine, repetitive tasks) requiring control of main drive motor(s) are performed

4.51
operational press
press that is configured to deliver product, is composed of at least one motion zone, and may include non-motion zones

4.52
operator control station
panel containing at least an emergency stop control

4.53
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.

4.54
pile turner
device for turning substrates and attached to sheet-fed printing presses in order to turn piles of printed paper for further processing

NOTE An example of further process may be back printing in a second run.

4.55
portable control station
control station that can be disconnected from one location, moved to another location and be reconnected

4.56
positive mechanical action
⟨of a component on another component⟩ action in which the moving mechanical component inevitably moves another component along with it, either by direct contact or by rigid elements

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

NOTE 2 When a mechanical component moves and thus allows another component to move freely (e.g. by gravity, spring force, etc.), there is no positive mechanical action of the first component on the other component.

4.57
positive opening
achievement of contact separation as the direct result of a specified movement of the actuator through non-resilient members

NOTE For example, not dependent upon springs.

4.58
powder spraying devices
devices for spraying powder onto the printed material on the delivery side of sheet-fed printing presses

4.59
pre-press machinery
machines and equipment for the production of master copies and/or printing plates

4.60
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

4.61
printing form
printing plate
base material that stores the image to be printed (pictures and/or text) and transfers ink on a substrate (such as printing plates, printing cylinders, screen), thus printing the image

4.62
printing plate bending machine
machine for bending or folding printing plates before they are clamped in the printing press

4.63
printing table
table to hold the substrate to be printed during the printing process (as on certain types of screen printing presses)

4.64
proofing press
machine for printing a small number of copies, generally used for assessing print quality before the printing form is mounted in the machine, with manual feeding and delivery

4.65
raised workplace
workplace that is at least 0,5 m above access level

4.66
ready condition
condition in which machine motion can be operator initiated

4.67
reel rewinding device
that part of a machine used for rewinding the processed web-type material

4.68
reel turner
device for turning webs wound onto reels for easier handling, for example, for correct positioning of the reel when feeding webs to printing presses

4.69
reel unwinding device
that part of a machine used for unwinding web-type material for processing

4.70
remote control
connection to the control station of a machine by use of an external communication link

4.71
routine and regular access
repetitive access to a hazard point that is required for manual feeding of a machine during normal production activity

4.72
safe condition
condition in which movement of the main drive motor(s) (prime mover) of the motion zone is prevented

NOTE This condition may apply to the entire press system or to one or more motion zones. The safe condition exists only when one or more stop/safe or emergency stop pushbuttons are latched in the depressed position.

4.73
screen frame
frame for taking up the printing screen

4.74
screen printing press
printing press using printing forms with woven material (screens) that partially allow ink to penetrate through the material

4.75
separating elements
elements on feeders of sheets or blanks or similar materials that separate the individual sheets, blanks, etc.

4.76
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

4.77
significant hazard
potential source of severe or disabling injury, or death

NOTE This International Standard only addresses significant mechanical hazards.

4.78
smooth roller
cylinder
rotationally symmetric solid body with smooth surface; i.e. with grooves or elevations of a maximum of 4 mm deep and with circumferential slots of a maximum of 8 mm in width with no sharp or cutting edges

See Figure 2.

Dimensions in millimetres

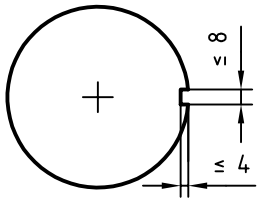


Figure 2 — Smooth roller/cylinder

4.79
status lights
lights that indicate machine process condition

NOTE These are not the same as personnel warning lights.

4.80
trip nip bar
a movable protective bar located at an in-going nip that when pushed activates the interlocked safety system of the machine

4.81
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

4.82
warning period
period during which machine motion is prevented, and a warning is given to personnel that machine motion is about to occur

4.83
washing device for roller/cylinder
device integrated into the printing press for washing cylinders and rollers such as ink rollers, blanket cylinders, printing cylinders, plate cylinders

4.84
washing equipment for printing forms
machines for washing printing forms outside the printing press

EXAMPLE An example would be screen washing equipment.

4.85
web-fed press
press in which a substrate passes through the printing couple, or couples, in a continuous form, as fed from a roll

4.86
web-type material
web of paper, board, foil or similar material that is to be handled or processed

4.87
wireless control
using means other than physical connection for transmitting commands and signals between a machine control system and the operator control station(s)

4.88
zero speed
condition of machine motion in which the drive control system is actively holding the machine at a position

NOTE 1 In this condition, machine movement is not discernible; however, machine movement can be initiated without warning.

NOTE 2 Zero speed may be considered to be an **armed condition** (see 4.3).

5 Guarding of significant hazards

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

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 or these operations shall be carried out using a hold-to-run device as specified in 5.5.

5.1 Guards

5.1.1 Types of guards

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

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

NOTE 1 An improvised tool, such as a coin or nail file, does not meet the requirements of this International Standard.

All movable guards shall be interlocked.

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

NOTE 2 A typical shift is 8 h.

NOTE 3 An example of setting-up and other purposes for which guards and doors may be removed include:

— to supply the material to be processed;

— to change the format;

— to change tools;

— for make-ready; or

— for washing-up.

The interlock system shall operate as described in 5.4.1.

When the interlocked guard is open, one of the measures set out in 5.5 shall become effective.

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

5.1.1.1 Automatic travel of movable guards

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

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

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

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.

5.1.1.2 Protection against gravity falls of guards

Guards that can be opened shall be safeguarded against gravity falls if this creates a risk of injury.

NOTE Examples of means that may be used include:

— devices for balancing the weight;

— 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; or

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

Springs used for balancing the weight 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.

5.1.2 Guard distances and gaps

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

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

On guide rollers the safety distance shall be 120 mm, as specified is ISO 13854.

Dimensions in millimetres

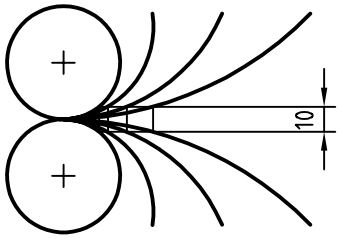


Figure 3 — Measuring safety distance at in-running nips

5.1.2.1 Reaching upwards

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

If there is a high risk from the danger zone when reaching upward, then either the height of the danger zone shall be 2 700 mm or more, or other safety measures shall be used.

5.1.2.2 Reaching over protective structures

If there is a low risk from a hazard zone when reaching over a protective structure, the values given in Table 1 of ISO 13852:1996 shall be used as minimum values. There shall be no interpolation of the values given in that table. Therefore, when the known values of a, b or c are between two values in Table 1 of ISO 13852:1996, values to be used are those that provide the higher level of safety.

If there is a high risk from a hazard zone when reaching over a protective structure, the values given in Table 2 of ISO 13852:1996 shall be used as minimum values. There shall be no interpolation of the values given in that table. Therefore, when the known values of a, b or c are between two values in Table 2 of ISO 13852:1996, values to be used are those that provide the higher level of safety.

5.1.3 Guard openings

Guard openings shall comply with the requirements of ISO 13852:1996. For guarding in-running nips that are accessible while a movable guard is open, see 5.3.

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 13852:1996 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.

5.2 In-running (in-going) nips

Hazards from in-running nips may exist between

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

NOTE For non-powered surfaces, this hazard will depend on a number of factors; for example, 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) which are driven by the movement of the web.

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

5.3 Guarding in-running nips

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

a) barrier guard/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 Table 4 of ISO 13852:1996.

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

c) trip nip bars, which shall be in accordance with 9.6.

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

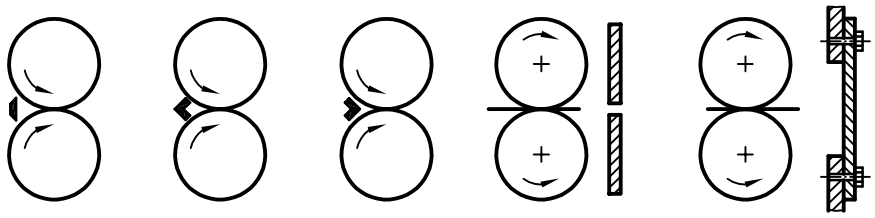
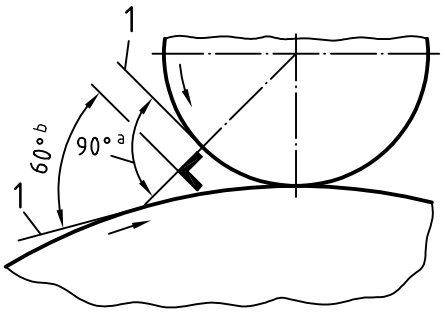


Figure 4 — Examples of nip guards

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 forms presses, the clearance should be smaller, if possible, considering both safety and production concerns.

Nip guards shall not be shaped or oriented such that a “wedge pocket” is created. See Figures 7 and 8. If the shapes shown in Figure 7 are used as trip nip bars, such shapes are permitted, since activation of the trip nip bar stops hazardous motion, as specified in 9.6.

Dimensions in millimetres

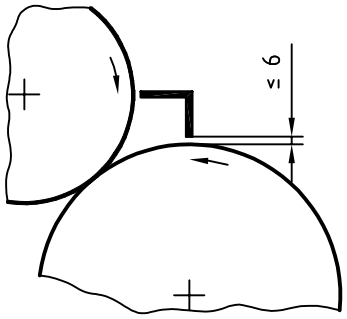
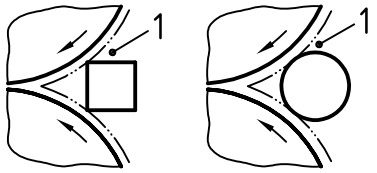


Figure 6 — Safeguarding an in-running nip by means of a fixed nip guard



Key

1 wedge pocket

Figure 7 — Shapes creating wedge pockets

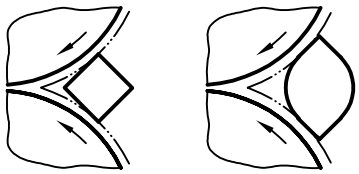


Figure 8 — Shapes not creating wedge pockets

5.3.1 Guarding in-running nips on sheet-fed presses

If technically feasible, trip nip bars in accordance with 9.6 shall be used where:

— frequent access is required to the area during machine motion; and

— cylinders are directly accessible after the interlocking 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 5.5 a) shall apply.

Where cylinders have gaps which exceed those defined for smooth cylinders (see 4.78), trip nip bars, in accordance with 9.6, 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 9.6 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.

NOTE 1 Use of trip nip bars is not possible, for example, on small-size offset presses where trip nip bars would impede access to the cylinder for, for example, plate changing.

NOTE 2 To comply with the requirements of 5.4, the interlocking systems will normally have to be designed such that, after opening the interlocking guard, a predetermined number of revolutions, depending on the functional characteristics of the trip guard, is not exceeded.

5.3.2 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.

NOTE Such measures include, for example:

— guarding in accordance with this clause; or

— 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.

Where on machines with varying web paths, 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:

— speed shall not exceed 3 m/min; and

— movement shall not exceed 1,2 cylinder revolutions; and

— 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; and

— a modified audible warning signal shall be used; and

— 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.

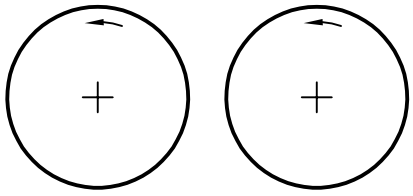


Figure 9 — Non-hazardous rollers rotating in the same direction

5.3.3 Guarding in-running cylinder nips on newspaper presses

In deviation from 5.3 b), nip guards may be used for web-fed newspaper printing presses with cylinder gaps of up to 19 mm. For new machines, however, efforts should be made to limit cylinder gaps to 12 mm.

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.

5.3.4 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 is achieved, for example, by the provision of trip nip bars or electro-sensitive protective devices.

Trip nip bars shall satisfy the requirements of 9.6 and category 3 of ISO 13849-1:1999. Electro-sensitive protective devices shall comply with 9.5. The safety device shall cause stopping of the upper unit in time not to cause any risk of injury. The hand approach speed specified in ISO 13855 need not be complied with.

5.3.5 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.

NOTE 1 This can be achieved, for example, by

— interlocking guards; or

— guarding by the printing form (screen).

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

NOTE 2 Such additional measures can, for example, be electrical interlocking which allows cylinder rotations only under hold-to-run control according to 5.3 as long as the printing form is lifted.

5.4 Interlocks

5.4.1 Machine response to interlock operation

System operation involving an interlock guard shall be as follows.

5.4.1.1 Opening an interlocked guard

When an interlocked guard is opened/moved/removed while the machine is in continuous motion the machine shall stop, utilizing the maximum braking action established for that press. 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 5.5, motion may continue.

5.4.1.2 Continuous run with a guard open

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

Exception: If the only hazard being protected by the interlocking guard is an in-running nip, continuous machine motion at crawl speed may be permitted with a guard open provided the condition specified in 9.2.3 is met.

5.4.1.3 Closing an interlocking guard

When the guard is re-closed, the machine shall not automatically start. Closing the interlocking 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. Closing the interlocking guard shall not cause the machine to restart its operation. The machine shall go through the normal starting sequence.

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.

5.4.1.4 More than one interlocking guard open

Where more than one interlocking guard is open and any unguarded hazard zones cannot be observed from a single point of operation, only an inch function or reverse function (as defined in 9.1.3.5) or a plate position function (as defined in 9.1.3.11) shall be permitted

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

b) if multiple operators depress and maintain a hold-to-run control at each unguarded area during the same permissive period. Releasing any hold-to-run control shall stop machine motion.

5.4.1.5 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.

5.4.2 Interlock design for personnel safety

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

NOTE While all interlocking schemes are capable of being defeated, the interlocking arrangement should not be able to be defeated by commonly available items such as tape, paper, a single common magnet, etc.

5.4.2.1 Compliance with ISO 14119

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

5.4.2.2 Personnel safety switches for interlocking guards

For personnel safety switches built in accordance with IEC 60947-5-1 and installed in accordance with IEC 60204-1:2000 it may be assumed that no malfunctions occur. For machines where routine and regular access is not required, it is therefore sufficient to provide only one personnel safety switch for each interlocking guard.

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

For manually fed devices where interlocking guards are used to safeguard routine and regular access to hazard points (see 4.71), control systems for safety position switches shall satisfy category 4 of ISO 13849-1:1999.

5.4.2.3 Short circuits

Short circuits between two electric wires outside the switch cabinet due to physical impacts can be prevented by mechanical protection of the cable.

NOTE For example, wires may be protected by locating them within ducts or within the machine frame to protect them from impact.

5.4.3 Interlocking with guard locking

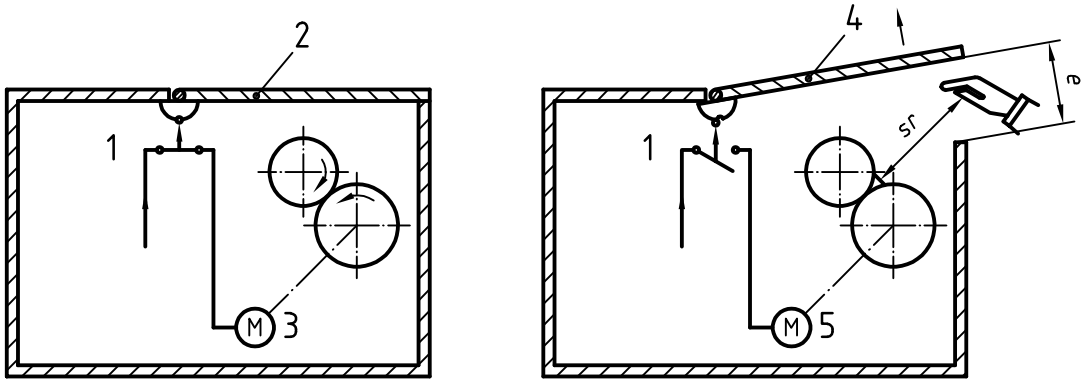
Guard locking is required only when the guard opening distance does not comply with Table 1.

NOTE EN 1010-2 also requires guard locking where hazardous movement cannot be stopped within at least 10 s after actuation of the personnel safety switch.

Table 1 — Requirements for interlocked guards without guard locking (see Figure 10)

Dimensions in millimetres

Safety distance, *sr*, between guard opening and hazard point	Maximum opening, *e*, of the guard while the detector changes its state
< 80	⩽ 30
⩾ 80 and < 500	⩽ 40
⩾ 500 and < 850	⩽ 80
⩾ 850	⩽ 160



Key

1 failsafe limit switch
2 guard closed
3 motor run
4 guard open
5 motor stop

Figure 10 — Distances related to requirements for guard locking

5.5 Hold-to-run controls

If all hazard points are safeguarded by nip guards in accordance with 5.3, the requirements for hold-to-run controls and speed limitations do not apply.

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

In cases in which the hazardous area can be viewed from the operating position, with an interlocking guard open and hazardous points unprotected, machine motion can only be initiated by means of a hold-to-run device 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 a) above would reduce the ability of the machine to perform its function and where there would be no substantial increase in hazard.

When using a hold-to-run control with a guard open, the hold-to-run control shall be located so that the hazard can be monitored from the control position.

Guard circuitry for the hold-to-run condition shall be category 3 of ISO 13849-1. 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.

Where a particular type of machine needs to run with a speed greater than 5 m/min, the maximum speed shall be as low as possible, and in no case more 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 EN 1010-1 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 9.4. The stopping path shall be as short as technically feasible.

See 11.1 for general requirements for control systems.

5.5.1 Specific requirements for sheet-fed presses

When interlocking 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 5.5 a).

When interlocking guards are opened and all hazards are protected, continuous machine motion at crawl speed is permitted. The provisions of 9.2.3 shall apply.

When interlocking 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 5.5 b). In this case, starting for continuous run while an interlocking guard is open shall not be possible.

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

NOTE 2 “Sheet transport systems” are, for example, gripping systems, transport drums.

NOTE 3 “Direct access” is, for example, 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 “Continuous run” is starting the machine with a self-holding actuating element (other than hold-to-run), for example, for running the machine at a reduced speed or for cylinder positioning where the cylinder stops at a predetermined position.

NOTE 5 On small-size sheet-fed presses, movements can be non-powered.

5.5.2 Specific requirements for forms presses

In deviation from the requirements of 5.5, 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 the following requirements are fulfilled:

— other interlocking guards outside the area that can be observed are closed;

— a selector switch is used for this kind of operation;

— warning is provided in the instruction handbook (operator's responsibility and description of safe working practices); and

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

5.6 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.

NOTE Examples of 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;

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.

5.7 Other safeguarding measures

Where safeguarded accessible hazard zones cannot be observed from positions from which hazardous movements can be started, one of the following requirements shall be satisfied.

5.7.1 Fence-type enclosures

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

a) it shall not be possible for the 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 hold-to-run, shall be permitted only after the access door has been closed and the additional control device has been actuated.

NOTE 1 Examples of such additional control devices are reset buttons, captured keys, trapped keys, etc.

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

NOTE 2 For example, 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 5.5.

5.7.2 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 able to be reached 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 safeguarded by means of, for example, guards or electro-sensitive protective devices and allowing whole-body access. The objective is to prevent anyone from starting the machine while persons are within the hazard zone.

Electro-sensitive protective devices shall comply with 9.5.

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

Pressure-sensitive mats, pressure-sensitive bumpers and trip nip bars shall function in accordance with 9.6.

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.

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

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

5.7.4 Auxiliary devices which 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 Clause 5 and applicable subclauses for fixed and movable guards.

NOTE 1 Auxiliary devices are listed in 2.2 and defined in 4.7.

NOTE 2 Auxiliary devices preventing access to hazard points in their built-in position can, for example, be continuous flow drying devices on the delivery side of sheet offset printing presses where drying modules are inserted into the printing press from the side that, when removed, allow access to hazard points on the sheet gripper system.

When the machine is operated with the auxiliary device removed, exposing a hazard, alternative guards shall be used to protect the hazard point.

5.8 Guarding of machine devices and components

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

5.8.1.1 Load take-up equipment

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

5.8.1.2 Breaking strength of components

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

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

5.8.1.3 Lifting height of pile lifting and lowering devices

5.8.1.3.1 Pile carrier

On pile lifting and lowering devices with production format sizes over 2,5 m^2, and a lifting height over 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 failure may cause injury.

NOTE This requirement is satisfied for worm drives, for example, 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 which in the event of a chain breakage take over the load and function of the operating chain.

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 times the speed under normal operating conditions.

See also 5.8.1.4.1.

5.8.1.3.2 Pile carrier plate

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

To prevent injury to the operator, 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 as follows:

a) On feeders with production format sizes of up to 1,0 m^2 and on deliveries with format production sizes of up to 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.

   Hazard points may alternatively be safeguarded by one of the measures listed under b).

b) On feeders with production format sizes of over 1,0 m^2 and on deliveries with format production sizes of over 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 over 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, 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 9.5 and 9.6.

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.

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

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

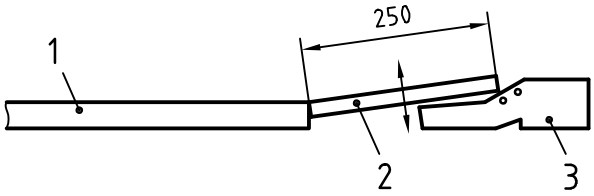
— electro-sensitive protective devices in front of the pile carrier edge (ISO 13855 need not be followed);

— 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 distance of 1,5 m maximum above platform or gangway; or

— trip device.

See also 5.8.1.4.1.

Dimensions in millimetres



Key

1 pile carrier plate
2 overhanging shield
3 foot

Figure 11 — Overhanging shield

Dimensions in millimetres

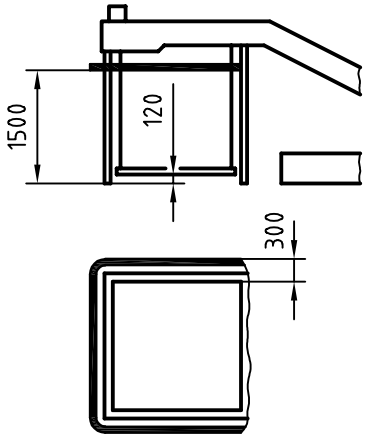


Figure 12 — Safeguarding by deflecting parts of the machine frame

5.8.1.3.3 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 used. This can be achieved by means which include, but are not limited to:

— fixed or interlocking guards in accordance with 5.1;

— electro-sensitive protective devices in accordance with 5.7.2;

— safety distances and gaps in accordance with ISO 13852:1996 and ISO 13854;

— hold-to-run control in accordance with 5.5;

— trip devices in accordance with 9.6.

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

5.8.1.3.4 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 speed of 5 m/min maximum. 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 9.5.1 and 9.5.4. Hand approach speeds according to 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 1,25 times the maximum load capacity without permanent deformations or apparent defects. It shall be able to stand a dynamic test with 1,1 times 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 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 operator control station.

5.8.1.4 Guarding crushing and shearing points

5.8.1.4.1 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.

NOTE Safeguarding may, for example, be done by one of the following measures:

— safety distances in accordance with ISO 13854;

— trip devices;

— guards;

— hold-to-run operation.

Where on the delivery of sheet-fed printing presses and coating units with a pile carrier, a pile weight of 500 kg is not exceeded and safeguarding in accordance with 5.8.1.3.2 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.

5.8.1.4.2 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.

NOTE 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 9.5;

— guards in accordance with 5.1.

5.8.1.4.3 Screen printing presses

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

a) 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 300 N maximum (dynamic). Where the material is fed manually 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) 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 300 N maximum, if there are no crushing hazards due to sharp edges.

d) Fixed guards (complying with ISO 13852:1996), that can be provided, for example, on that side of the machine where access for feeding and ink replenishment is not required.

5.8.1.4.3.1 Crushing point between doctor blade and screen printing frame

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

NOTE This can be done, for example, 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.

5.8.1.4.3.2 Crushing hazards caused by the movement of the doctor blade

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

NOTE 1 This can be done, for example, by using the safety distances defined in ISO 13852:1996 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 2 For example, the crushing point between the doctor blade and the printing table or printing cylinder on screen printing presses can generally not be safeguarded as ink replenishing must be done manually.

5.8.1.4.3.3 Protection during access between screen printing frame and machine frame

Where access between the screen printing frame and the machine frame is required, for example, for cleaning the screen, a control element shall be provided in addition to the measures described under 5.8.1.4.3 which, when actuated, prevents unintended start-up of the machine.

5.8.1.4.3.4 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.

NOTE This can be achieved, for example, by safety distances in accordance with ISO 13854, or interlocking guards.

5.8.1.5 Separating elements on feeders

Separating elements on feeders shall be so designed 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.

5.8.1.6 Suction heads on sheet feeders

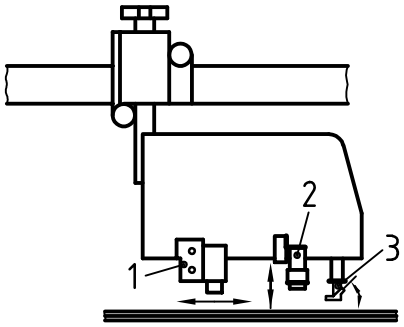
Hazard points on suction head drive gears that can be accessed during the production process shall be safeguarded by guards completely enclosing the head, leaving only the bottom open. See Figure 13. Hazard points caused by moving parts (such as forwarding sucker, lifting sucker) outside the suction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

— distance of at least 25 mm between moving parts (for example, forwarding sucker) that are accessible during production;

— parts are moved only by springs with a non-hazardous low force (for example, pressure foot, lifting sucker); or

— 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

5.8.1.7 Pull-in and forwarding wheels

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

NOTE This can be achieved, for example, by

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

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

— providing guards in accordance with Clause 5.

5.8.2 Unwinding and rewinding and reel transport devices

5.8.2.1 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).

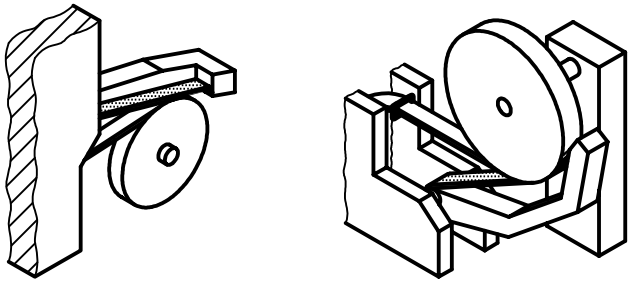


Figure 14 — Belt drives

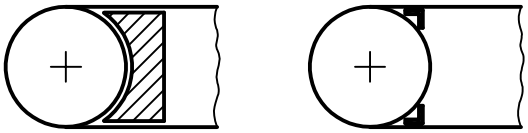


Figure 15 — Safeguarding of belt in-running nips on belt drives

5.8.2.2 In-running nips

On unwinding and rewinding devices, the accessible in-running nips at reels, pressure rollers or support rollers shall be safeguarded by means of guards or safety devices with approach reaction (trip nip bars, pressure-sensitive mats, electro-sensitive devices). The safety device selected shall be effective at all operating reel diameters. Access to the in-running nip from the side shall not be possible.

Included in this requirement is the safeguarding of the in-running nip facing the machine, if drawing-in hazards exist as long as the diameter of the reel is small (at the beginning of the rewinding process) or the diameter of the pressure roller is small.

For trip nip bars and pressure-sensitive mats, see 9.6. For electro-sensitive protective devices, see 5.7.2.

5.8.2.3 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 only be inserted 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 5.5.

For automatic reel loading, see 5.8.2.12.

5.8.2.4 Separation of chucking cones

Provision shall be made to prevent unintentional separation of the chucking cones after the reel has been lifted.

NOTE 1 This is prevented, for example, where separation can only be done in the hold-to-run control mode with 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.

NOTE 2 For example, an interlocking system may be used to prevent separation of the chucking cones during roll movement.

5.8.2.5 Shaftless unwinding and rewinding units

On shaftless unwinding and rewinding devices, hazards caused by small diameter reels being ejected shall be prevented.

NOTE This can be prevented, for example, by

— changing of reels at lower speed;

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

— fitting an adequate safety device to the unwinding unit.

5.8.2.6 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.

NOTE 1 This is to help prevent possible damage to the chucking device that could possibly result in releasing the roll unexpectedly.

NOTE 2 Generally, this risk increases in proportion to the width and weight of the roll.

5.8.2.7 Small diameter reels on shaftless unwinding and rewinding devices

On shaftless unwinding and rewinding devices, hazards caused by small diameter reels being ejected shall be prevented.

NOTE This is prevented by, for example :

— changing of reels at lower speed;

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

— fitting an adequate safety device to the unwinding unit.

5.8.2.8 Lifting arm

If hazard points between lifting arm(s) and machine frame cannot be avoided by built-in design or be safeguarded, the lifting arm(s) shall only be movable 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 5.5.

5.8.2.9 Protection against drawing in hazard

On reel unwinding and rewinding devices, the risk of drawing in between the end surface of a rotating paper reel and fixed parts or lifting arms shall be guarded if the distance is less than 25 mm.

5.8.2.10 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 13852:1996 and ISO 13854.

NOTE Risk of crushing exists between movable parts 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.

5.8.2.11 Transport of material reel to reel stand

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

5.8.2.12 Protection of hazard zone on unwinding unit of automatic reel loading systems

On automatic reel loading systems, the hazard zone existing on the unwinding unit shall be completely safeguarded by electro-sensitive devices or by guards.

Where ESPDs in accordance with 5.7.2 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 of not more than 50 mm of the largest reel diameter 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); and

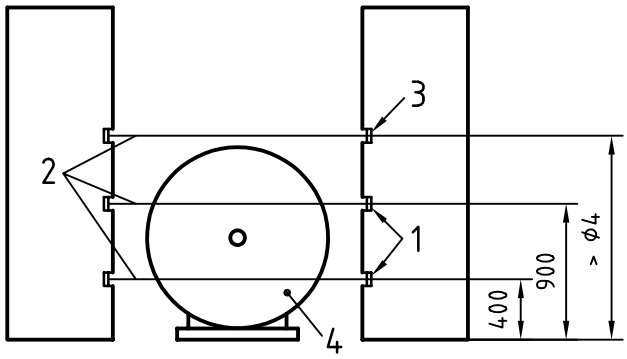
— emergency stop devices shall be provided within easy reach on the unwinding unit that will also stop the automatic loading operation.

For safeguarding the hazard zone by electro-sensitive protective devices see 5.7.2.

NOTE Hazard zones exist between material reel and fixed machine parts, between material reel and lifting arm and floor, between material reel and chucking cone.

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

Dimensions in millimetres



Key

1 photoelectric device
2 photoelectric beams
3 additional photoelectric device
4 reel

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

5.8.3 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 5.5 where hazard points are within operator's view from the location of the hold-to-run control;

— safeguarding the hazard zone as described in 5.1.

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

5.8.4 Folders for web presses

For folders, the exceptions defined in 5.8.4.1 and 5.8.4.2 shall apply.

5.8.4.1 Folder set-up

Where access to the folder is required in the start-up phase of a production run for operational reasons (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 5.4.1.4 and 5.5.

5.8.4.2 Folder delivery guarding

In deviation from 5.1.3, 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.

The distance between delivery fly (fan) and the enclosure which 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.

Dimensions in millimetres

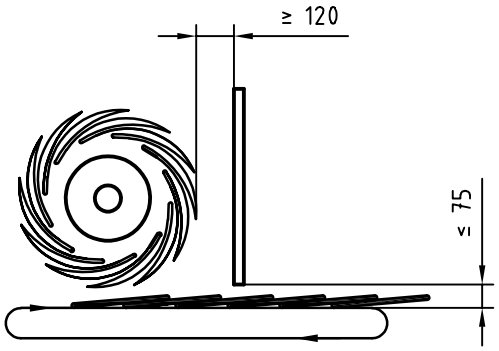


Figure 17 — Openings for folder guards

NOTE 1 An example would be the provision of a transparent guard or remote viewing system by which the necessary observation of moving components or product could be made.

Exception: 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 run 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:

— 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 into 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.

NOTE 3 This exception may not comply with current European standards or the Machinery Directive.

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.

5.8.5 Web feed on web-fed rotary presses

Where on web-fed rotary presses in the areas where the web is fed through a webbing slot, it is impossible to apply 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 there is a risk of injury to face and neck, web edges shall be safeguarded.

NOTE Safeguarding may be, for example, by use of a guard with black/yellow marking.

5.8.6 Threading of web material

On machines, safe threading of the web-type material shall be ensured.

NOTE 1 For certain types of machines, this may require auxiliary threading devices.

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

NOTE 2 Access to hazard points is considered prevented if, for example,

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

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

5.8.7 Guarding sheet gripper

In the sheet delivery area, access to the sheet gripper system from the top and from all sides shall be prevented by fixed or interlocking guards. On the sides as well as in the test sheet removal area, such guards shall reach down at least to the lower edge of the sheet gripper system. Residual risks due to the possibility of gaining access under the guards shall be mentioned in the instruction handbook (see 15.2).

NOTE Operators may seek access under the guards for test sheet removal or for inserting pile wedges.

5.8.8 Guarding plate clamping devices

Movements of automatic plate clamping devices shall be safeguarded.

NOTE This can be achieved, for example, by

— fixed or interlocking guards in accordance with 5.1;

— trip nip bars in accordance with 9.6 (satisfying the requirements of category 3 of ISO 13849-1:1999);

— electro-sensitive protective devices according to 5.7.2;

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

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

6 Requirements for protection against other hazards

See also Annex A for a list of hazards.

6.1 Fire and explosion

For a list of explosion zones for electrical apparatus, see Annex B.

6.1.1 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.

6.1.2 Hoses and pipes

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

NOTE 1 Examples of combustible or explosive materials 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 grounded (resistance less than $10^6\ \Omega$ over the total length of the hose) where the solvent concentration under any single failure may exceed 25 % LEL.

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

Respective reference shall be made in the instruction handbook.

NOTE 2 See 15.2, **Contents of instruction handbook**.

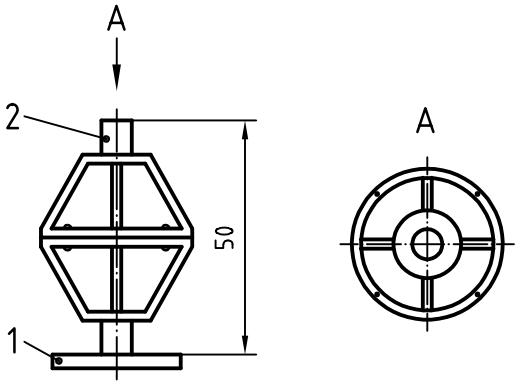
6.1.3 Electric motors on recirculating pumps

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

The distance between the electric drive motor for viscosity control and the outer flange of the agitating device shall be at least 50 mm using a lantern-type fixing as shown in Figure 18. It is also recommended to mount a disc on the shaft in order to increase the preventive effect.

NOTE This prevents solvents evaporating from the agitator shaft from reaching the motor.

Dimensions in millimetres



Key

1 drive motor
2 agitator
3 view from the top

Figure 18 — Lantern-type fixing

6.1.4 Continuous flow drying devices

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

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

Emissions of flammable substances may, for example not be 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 Emission of flammable substances during the drying process may, for example, be expected on gravure, screen printing and rotary web presses. This may, however, not be the case when using commercial offset printing inks (for example, cold set inks instead of heat set inks) which are absorbed by the substrate.

6.1.4.1 Interface with automatic cylinder and roller washing devices

6.1.4.1.1 Substrate transporting solvents

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

NOTE This requirement is fulfilled, for example:

a) On a sheet-fed printing press,

   — 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 ANSI/NPFA 86; or

   — where the cylinder and/or roller washing device is electrically interlocked with the paper transport system, so that 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 ANSI/NFPA 86, including a combination of:

   — design-stage calculations of maximum solvent flow; and

   — 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 ionisation detector at worse-case conditions of solvent flow.

6.1.4.1.2 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.

NOTE This requirement is fulfilled, for example,

a) where the design of the continuous flow drying unit takes account of the solvent vapours and mists in accordance with EN 1539 (required in Europe) or ANSI/NFPA 86; or

b) by sealing the feeding openings of the drying device in order to prevent solvent vapours from penetrating into the drying device; or

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

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

6.1.4.1.3 Leakage and spillage of solvents

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

NOTE 1 An example of such risks on web presses would be solvent leaking onto the substrate running into the drying device; on sheet-fed presses, solvent leaking onto the drying device, or spillage during the filling process.

NOTE 2 This requirement is fulfilled, for example,

— 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; or

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

6.1.4.2 Ignition of substrate

Ignition of the substrate by the continuous flow drying device shall be prevented.

NOTE This can be achieved, for example, by:

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

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

6.1.4.3 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.

NOTE For example, on sheet-fed printing presses, both feeders and the drying system are stopped automatically. On rotary web presses, failures in the dryer exhaust system cause automatic stopping of the solvent dispensing areas (for example, ink form 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.

6.1.5 Prevention of ignition of explosive atmospheres caused 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 this International Standard, 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 600791, IEC 60079-2, IEC 60079-5, IEC 60079-6, IEC 60079-7, IEC 60079-11, and IEC 60079-18.

— Electrical apparatus according to IEC 60079-11 or IEC 60079-1 shall be designed to explosion group IIA.

NOTE 1 For groups of electrical apparatus see IEC 60079-0.

— 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.

— 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).

6.1.6 Explosion protection exceptions

Explosion protection is not required for machinery where there are no combustible liquids with a flash point below 55 °C being used and no combustible liquids are sprayed or heated to a temperature above flash point under operating conditions. All other machinery shall satisfy the requirements of EN 1127-1 as well as the requirements of 6.1.3 and 6.1.5.

NOTE 1 For washing units on printing presses, see 6.15.

NOTE 2 Heating of a combustible liquid occurs under operational conditions; for example, in film and printing plate development units with bath heating.

NOTE 3 The requirements of EN 1127-1 are satisfied, for example, 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.

NOTE 4 An example of system failure would be a breakdown of the ventilation system.

6.1.6.1 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 6.1.1, 6.1.2 and 6.1.6.

6.1.6.2 Exceptions for automatic washing devices

Where automatic cylinder (for example, impression or blanket) washing and roller washing devices are attached to printing presses, explosion protection measures otherwise required due to the washing solvent being used may be dropped if

— 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; and

— the solvent does not heat up to a temperature in excess of the flash point (for example, due to heating equipment, waste heat from motors or sun rays); and

— explosive concentrations cannot build up when applying the solvent.

6.2 Spillage from washing devices

Safe replenishing of the washing agent shall be ensured.

NOTE 1 Examples of ways to satisfy this requirement include:

— 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 which check the filling level (tank full indicators, inspection glasses, adequate openings for filling).

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

NOTE 2 An example of a means to prevent leakage is the use of self-locking hose couplings.

6.3 Electrical equipment

All electrical equipment shall be designed such that electrical hazards (for example electric shock, burns) are prevented according to IEC 60204-1. The requirements of IEC 60204-1 shall be fulfilled, taking into account the following additional requirements.

6.3.1 Supply disconnecting device

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

If actuation of a stopping device will cause a low voltage (undervoltage) tripping of the circuit breaker (shunt trip device), a circuit breaker in accordance with 5.3.2 c) of IEC 60204-1:2000 shall be provided to prevent the contactors from welding in the closed position. Where circuits as specified in 5.3.5 of IEC 60204-1:2000 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 according to 5.3.2 d) or e) of IEC 60204-1:2000.

6.3.2 Installation

Electrical devices and conductors shall be installed in such a way that damage from mechanical stresses and environmental influences are prevented.

6.3.3 Insulated single-core conductors

Insulated single-core conductors laid between two terminals inside an enclosure (for example, a switch cabinet) may be without conductor identification by number or alphabet if

— identification by colour is in accordance with 14.2.4, paragraph 2 of IEC 60204-1:2000.

— conductors are secured in position (for example, by using comb-type wire fixation) in such a way that any confusion of conductors when changing electric components is safely prevented.

6.3.4 Testing of electrical equipment

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

6.3.5 Measuring devices

Measuring devices shall comply with IEC 61010-1.

6.4 Working platforms, access stairs, passageways and raised workplaces

6.4.1 General requirements

For regular operation, the means of access and passageways to workplaces shall comply with ISO 14122-1, ISO 14122-2, ISO 14122-3 and ISO 14122-4. For infrequently used workplaces (see 4.31) the exceptions specified in 6.4.3 shall apply.

6.4.2 Working platforms and gangways

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 5.8.1.3.2 for guarding when platforms and gangways are fitted to the feeding or delivery unit.

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

6.4.3 Infrequently used access platforms

6.4.3.1 Ergonomics

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

NOTE Examples of measures by which this can be achieved include:

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

— mobile platforms;

— permanently fixed and hinged platforms.

6.4.3.2 Footstep dimensions

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

normal step height	$\leqslant$ 300 mm
maximum step height	500 mm
minimum width (for one foot)	200 mm
minimum width (for two feet)	300 mm
minimum depth	300 mm

Exception for sheet-fed presses: On sheet-fed offset printing presses with a format width of 750 mm maximum it is acceptable to provide, where required, in deviation from 6.4.3.2 a single step for access to the platform fitted between units (printing units, coating units, delivery units) under the following conditions:

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

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

— the step is fitted half way between floor or gangway and platform; and

— suitable handles are provided.

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

maximum height of upper footstep	1 200 mm
maximum height of intermediate steps	300 mm
minimum depth of footstep	200 mm
maximum height without railing	1 200 mm

Footsteps shall always be provided with handles.

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

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

6.4.3.3 Handle dimensions

Where handles are required, the following dimensions shall apply:

minimum handle depth	40 mm
minimum handle length	110 mm
minimum handle diameter	20 mm

6.4.3.4 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 in height should be provided with at least one handrail (required in Europe). Where a handrail is not feasible and practical, a handhold shall be provided.

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

6.4.3.5 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 clear distance between machine and platform does not exceed 200 mm. For platforms with a height of more than 1,5 m where the distance exceeds 70 mm, toe-plates shall be provided as minimum protection (see Figure 19).

Dimensions in millimetres

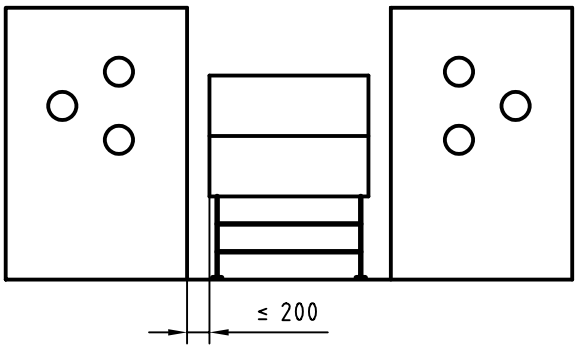


Figure 19 — Mobile platform

6.4.4 Platform, gangway and step surfaces

Platform, gangway and step surfaces shall be slip resistant.

NOTE This may be achieved, for example by using profiled steel plate or material satisfying the requirements of classification group R 10 of ISO 14122-2.

Plates of material with a low slip-resistance capability (e.g. glass) fitted in access floors to allow the operator to observe the production process are permissible if they are fitted at a distance of at least 200 mm from the nearest fall-off edge (e.g. access stairs) and the accessible area of such materials does not exceed 18 000 mm^2 with a maximum width of 90 mm.

Calculations or tests need to be made to verify that a static load of 1 500 N applied to an area of 50 mm $\times$ 50 mm in the centre of such material will not lead to damage.

6.4.5 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°. Depending on the results of a risk analysis, higher pitch angles may be allowed.

NOTE 1 For 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, the height of one flight may be a maximum of 4 m. Stairs with a total height of more than 4 m shall be fitted with an intermediate platform; the following flight shall be 3 m maximum. The platform should be at least 800 mm long where possible, but shall in no case be less than 600 mm.

NOTE 2 The user should be aware of the effects of mathematical conversion and rounding when converting from SI units to U.S./Imperial units. Requirements stated by OSHA may supersede the resulting conversions in the U.S.

6.4.6 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 the smallest width should be 1 m, unless this inhibits ergonomic requirements (for example, handling of objects).

6.4.7 Infrequently used workplaces

For infrequently used workplaces (see 4.31) that cannot be accessed by stairs, secured ladders may be used if the access height does not exceed 2 m. Toe boards and intermediate rails on railings are not required if the falling height is less than 2 m.

6.4.8 Railings, toe plates and self-closing gates

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

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

6.5 Stability

6.5.1 Unforeseeable changes of position

Machines and their elements shall be designed and equipped to be stable and to ensure that no unforeseeable 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.).

NOTE 1 Examples of means which may prevent unforeseeable changes of position include:

— adequate dimensioning of base;

— low centre of gravity;

— means for anchoring;

— adequate design of wheels on track-mounted assemblies.

If this cannot be accomplished adequately by design, then stability shall be obtained by special safety measures.

NOTE 2 For example, movements of parts of the machine may be restricted, indicators or alarms may warn if stability is endangered, interlocks to prevent tipping may be provided, or the machine may be securely anchored to a foundation.

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

6.5.2 Unintended travel

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

NOTE 1 Examples of means which may be used to prevent unintended travel include:

— 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.

NOTE 2 Unintended travel of wheels and caster wheels with no brakes may occur on machines such as the following: small UV dryers, dampening water devices, inserting devices, jogging tables, sheet folding, riveting, stitching and eyeletting machines, strapping and tying machines, bundling and baling presses, printing slotters, rotary die-cutters and combined machines (in-line).

NOTE 3 Self-locking gears are an example of automatic locking devices.

6.6 High contact temperatures

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

NOTE Examples of means which may be used to safeguard against contact with heated parts include the use of insulation, or guarding by distance.

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

6.7 Noise

Machines shall be so designed and constructed that risks from noise emission produced by the machines and are reduced to the lowest practical level for that type of machine. This could 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 compliance with the requirements specified in prEN 13023.

NOTE Examples of significant sources of noise include:

— gears;

— hydraulic devices;

— compressors, pumps;

— exhaust fans;

— blast air nozzles;

— suction devices (paper dust, trimmings);
— paper embossing;
— cutting, die cutting, creasing of paper, board, paper grinders;
— cylinder rolling motion;
— paper stops;
— separation of paper or board from printing form;
— power transmission systems;
— pneumatic systems.

6.8 Electrostatic toner dust

Where electrostatic toners are used as printing substances, it shall be ensured that persons are not endangered by toner dust.

NOTE 1 This can be achieved for example, by

— using non-hazardous toners;
— providing totally enclosed systems;
— providing adequate dust separation equipment and filters.

NOTE 2 Electrostatic toners are used in digital printing presses.

6.9 Radiation hazards

6.9.1 Laser devices incorporated in machinery

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

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

NOTE 1 Examples of laser devices include laser exposing devices, laser gravure equipment, laser cutting devices.

NOTE 2 Examples of additional safety measures include providing instruction to personnel regarding the use of personal protective equipment.

NOTE 3 For user information see Clause 15, **Information for use**.

6.9.2 Ultraviolet irradiance

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

NOTE 1 UV radiation is emitted, for example, by UV exposing equipment and UV dryers.

In the sheet delivery area of sheet-fed printing presses, a maximum exposure time t_{exp} of 4 h shall be taken as a basis for the calculation.

The values specified for category 1 in Annex D.1 of EN 12198-1:2000 relate 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 of exposure t_{exp} per person to be less than the maximum duration, the UV-B/C radiation

limit value 1×10^{-3} W/m^2 may be multiplied by the factor $8/t_{exp}$ (t_{exp} in hours). 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.

NOTE 2 A lower maximum duration of exposure may be expected on UV exposing equipment, 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).

6.9.3 Ozone hazards caused by UV radiation

Hazards due to ozone caused by UV radiation shall be avoided at the design stage.

NOTE 1 Possible measures for reducing ozone emission include low-ozone UV dryers or provision of exhaust equipment.

Damage to health due to air containing ozone caused by high-energy UV radiation or electron radiation shall be prevented.

NOTE 2 This can be achieved, for example, by adequate extraction systems with ozone filters.

On UV continuous flow drying devices, any hazards caused by the building up of ozone shall be prevented.

NOTE 3 This can be achieved, for example, by using devices with low ozone radiation or by providing exhaust systems which 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.

6.10 Stationary knives

On stationary knife blades, a guard shall be provided for the cutting edge of the knife, wherever possible.

NOTE This does not apply to bed knives in sheet cutters.

Stationary knife blades that can be tilted shall be protected against contact, even when not in working position.

6.11 Rotary tools

On rotary tools, the in-running nips and that part of the peripheral area which is not used for the process shall be protected against contact. Preference shall be given to guards which do not have to be removed for tool change. The requirements of Clause 6 shall be satisfied.

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

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

6.12 Hazardous tools

For the transport and storage of hazardous tools of machines, devices shall be provided that prevent injuries caused by the tools. This requirement also applies to individual tools forming part of assemblies.

NOTE Knives are an example of “hazardous tools”. Knife boxes are an example of “devices”.

6.13 Protruding machine parts

Protruding machine parts that cannot be avoided shall be padded and provided with a distinctly noticeable and permanent hazard marking if they present a hazard of collision.

6.14 Handwheels and cranks

Handwheels and cranks shall be so designed that they do not automatically rotate when the machine operates under production speed.

NOTE This is achieved, for example, where handwheels and cranks are decoupled by spring force during the production run.

6.15 Washing equipment

6.15.1 Hazards due to emission of washing agents

On external washing equipment for printing forms, rollers and scrapers, hazards for operating personnel due to emission of washing agents shall be prevented. This can be done by one or more of the following measures:

— using non-hazardous solvents as far as 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 hazardous substances and by potentially explosive atmospheres.

6.15.2 Grounding of washing equipment

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

6.15.3 Unintended escape of solvents

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

NOTE 1 Penetration into non-explosion-proof areas can be prevented, for example, by using catch tanks of adequate size.

NOTE 2 For further information on fire and explosion protection, see 6.1.

6.16 Alcohol dosing devices

6.16.1 Concentration

Alcohol dosing devices as auxiliary devices on dampening units shall be equipped with facilities to allow 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 % 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, to ensure that a failure of the primary control system shall not allow the volume of alcohol in the dampening water to exceed 20 %.

6.16.2 Prevention of leakage and overflow

On alcohol dosing devices, leakage and overflow of concentrated alcohol into non-explosion-proof areas shall be prevented by adequate measures such as collecting tanks or by means of draining it into the dampening recirculator.

When setting up alcohol tanks, it shall be ensured that the tank cannot fall, and 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 tanks.

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

6.17 Refrigerating devices in ink and dampening units

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

6.18 Powder spraying devices

Where print powder is dusted on, safe replenishing of the print powder during the printing process shall be ensured.

6.19 Routine handling of heavy machine parts

Where heavy machine parts with a lifting load of a least 25 kg 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 15.2.4.1 and 15.2.5.1).

NOTE 1 Examples of machine parts that need to be installed and removed routinely include screen rolls, gravure cylinders, some rubber rolls, and flexo form cylinders.

The 25 kg requirement shall apply when ideal lifting conditions exist. For lifting loads less than 25 kg 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.

NOTE 2 Determination of the lifting condition should take into consideration such things as distance from the body, how high the load is to be lifted, shape of the object being lifted, twisting the body while lifting, etc.

NOTE 3 The user should be aware of the effects of mathematical conversion and rounding when converting from SI units to U.S./Imperial units. In the U.S., requirements stated by OSHA may supersede the resulting conversions.

6.20 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, ANSI/NFPA 86 and EN 746.

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

7 Release from hazardous situation

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

NOTE Such means 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 machinery 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.

NOTE 1 Examples of such auxiliary equipment include splicers and stackers/palletizers.

Portable motion control stations shall function in accordance with 10.4.2. Wireless motion control stations shall function in accordance with 10.4.3.

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 only if

— the unused portion of the machine is disengaged;

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

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

If the motion control station on 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.

NOTE 2 For example, in 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 control 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 9.1.3.1.1).

Each control zone shall have a safety signalling system, if the overall vision of personnel by the operator is obstructed or communication between operating personnel may be difficult within that control zone. It shall also have an operator or motion control station as described in Clause 10.

9 Controls

This clause addresses specific controls which shall meet the criteria put forth in this International Standard. Other controls not described in this International Standard may be on the press system; however, such additional controls shall not interfere with the function of those described in this International Standard, nor shall they be able to be confused as having the same function as those described in this International Standard.

9.1 Manual control devices

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 defined by this International Standard shall be flush. As an exception to this requirement, controls on touchpads may be slightly raised or slightly recessed to enhance tactile recognition.

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

Manual control devices shall be designed and located so that:

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

— they can be safely operated without hesitation or loss of time and without ambiguity (e.g. a standard layout of controls reduces 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; and

— 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 account of ergonomic principles. Constraints due to the necessary or foreseeable use of personal protection equipment (such as footwear, gloves, etc.) 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 a risk may result from the hold-to-run control failing to deliver a stop command when released.

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

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

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 60204-1:1997, in addition to the following:

a) Manual controls (actuators) shall be designed and located according to the relevant ergonomic principles, namely:

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

   — they can be safely operated without hesitation or loss of time and without ambiguity;

   — their location (for pushbuttons) and their movement (for other controls) are consistent with their effect; and

   — their operation does not cause additional risk.

b) 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 a risk may result from the hold-to-run control failing to deliver a stop command when released.

c) Controls shall be located outside the hazard zones, except for certain controls which need to be located within a hazard zone.

   NOTE Examples of controls that may be need to be located within a hazard zone include emergency stop controls, teach pendants, etc.

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

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

For emergency stopping devices, the requirements of ISO 13850:1996 and IEC 60204-1:2000 shall be satisfied.

9.1.1 Types of manual controls devices

9.1.1.1 Flush control devices

Flush control devices shall be flush with their respective collars.

9.1.1.2 Guarded control devices

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

9.1.1.3 Mushroom head and palm-type pushbuttons

Mushroom head and palm-type pushbuttons shall protrude at least 9 mm beyond their respective collars. They shall also protrude above the actuators of adjacent unguarded, non-stop function controls. The head of the mushroom head or palm-type pushbuttons shall be at least 25 % larger than the surrounding pushbuttons, with a minimum diameter of 28 mm. See Figure 20.

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

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

Figure 20 — Types of emergency stop pushbuttons

9.1.2 Colours for manual control devices

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

NOTE Although Table 2 indicates both required and preferred implementations, for the purpose of promoting safety in the industry through uniformity manufacturers are encouraged to use the device colours shown as being “preferred” in Table 2.

The colour of the manual control devices, illuminated or non-illuminated, 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 2 — Colours for manual control devices

Control	ISO 12648		Remarks
	Required	Preferred	
Emergency stop	red on yellow background		
Stop/Safe	grey, black, white or red 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	
Limited scope safe	green		used primarily on newspaper presses
Plate position (or comparable control)	black, white or grey	grey	
Other motion-initiating control devices	black, white or grey		

9.1.3 Functions, operations and mechanical specifications of manual control devices

9.1.3.1 Emergency stop

Emergency stop shall satisfy the requirements of ISO 13850:1996 and IEC 60204-1:2000.

9.1.3.1.1 Emergency stop function

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

The emergency stop function shall override all other functions in all operating modes of the machine and shall not disable any system designed to release trapped persons in accordance with Clause 7. It shall not be possible for any start command (intended, unintended or unexpected) to be effective until the emergency stop function has been manually reset.

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

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

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

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.

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

9.1.3.1.2 Emergency stop devices

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

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

NOTE 1 At the present time, the U.S. National Electrical Code (NFPA 79) permits only category 0 or category 1 for emergency stop in the United States.

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

Where a category 0 stop is used for the emergency stop function, it shall have only hardwired 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, final removal of power to the machine actuators shall be ensured and shall be by means of electromechanical components.

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

Types of controls that may be used include:

— mushroom-type or palm-type;

— wires, ropes, bars;

— handles;

— in specific applications, foot pedals without protective cover.

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

Emergency stop devices shall be provided on each machine unit, and at all operation positions. See 10.4.1.

Emergency stop devices shall be located at each operator control station, and at other locations where the initiation of an emergency stop may be required. They 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 4.56).

NOTE 2 An example of the application of this principle is an emergency stop device employing electrical contacts having positive opening operations. Positive opening operation of a contact element is the achievement of contact separation as the direct result of a specified movement of the switch actuator through non-resilient members (e.g. not dependent upon springs).

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

In case of a failure in the emergency stop device (engagement means included) 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 which 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, **Control functions in case of failure**.

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 function shall comply with that specified in this section.

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 in the vicinity;

— the force to be applied to the wire/rope (at maximum deflection) in order to operate 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.

Means to reset the emergency stop device should be placed so that the whole length of the wire or rope is visible from the location of the resetting means.

9.1.3.1.3 Emergency stop and auxiliary devices

For auxiliary devices (requiring an emergency stop device according to this International Standard) that are built into the printing press, the buttons of the emergency stop of the printing press shall function in accordance with the requirements of Clause 8, **Control zones**.

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

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

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

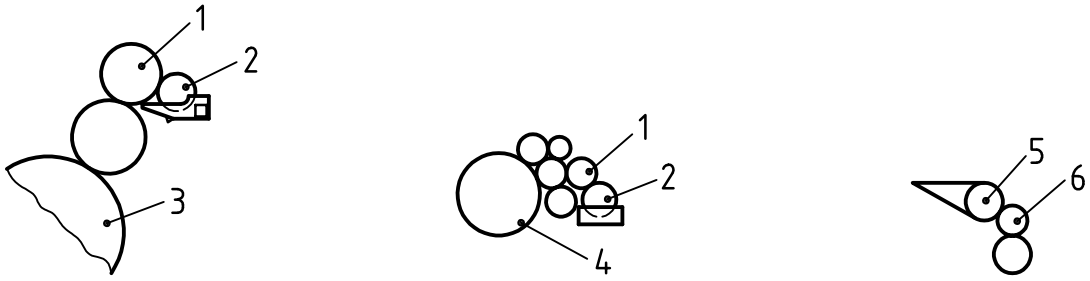
9.1.3.1.4 Emergency stop and ink, dampening, metering, coating or fountain rollers

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; or

— 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. See Figure 21.



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

Key

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

Figure 21 — Coating unit, dampening unit and ink pan

9.1.3.2 Stop/safe pushbuttons

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

NOTE 1 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 described in this International Standard. Keypads and touch screens shall not be used for stop/safe functions.

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

A stop/safe control shall be clearly distinguishable from an emergency stop control, if separate controls are used for each function.

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 of a design that prevents a person from unintentionally releasing the pushbutton to the ready condition.

This pushbutton may be 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.

NOTE 2 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.

9.1.3.3 Other motion stop control devices

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

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

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

9.1.3.4 Run control device

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

Activating a run control initiates continuous (maintained run) machine motion as described in 9.2.

For printing presses, run at zero speed shall not be allowed. A printing press may contain smaller subsystem components which 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 which is part of the press system may be running at zero speed and/or may be in the armed condition.

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

See Clause 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.

9.1.3.5 Inch control (jog) device

9.1.3.5.1 Forward inch control device

The forward inch device shall be a momentary-contact control which functions as described in 9.2, and moves the press in a forward direction.

The control shall be designed and mounted so as to minimize inadvertent operation.

NOTE For example, this can be achieved by the use of a double-push activation as described in 9.2.1.

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 is reached as defined in 5.5. The machine shall stop when the control is released.

Motion with an inch control device while one or more guards are open shall be permitted in accordance with 5.4 and 5.5.

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.

9.1.3.5.2 Reverse inch control device

A reverse inch control shall be a momentary-contact guarded control. The control shall be designed and mounted so as to minimize inadvertent operation.

A reverse inch control initiates press motion at inch speed in a reverse direction as specified in 9.2.1.

9.1.3.5.3 Forward/reverse inch control

A forward/reverse inch control shall be a single device incorporating a two-position selector and a momentary-contact control, that initiates press motion as defined in 9.2.1.

With the selector switch in the forward position, the inch control shall function in accordance with 9.1.3.5.1. With the selector switch in the reverse position, the inch control shall function in accordance with 9.1.3.5.2.

9.1.3.6 Ready

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.

9.1.3.7 Reset

The control used for the reset function shall be a momentary-contact control that resets a tripped circuit.

NOTE This International Standard permits the use of the inch control to activate the reset function. In this case, the colour of the control conforms with the requirements for the inch control.

Motion controls shall not be enabled until all faults are cleared, all interlocks are made and all stop/safe pushbuttons are released. The reset function shall not automatically enable motion controls unless the above conditions have been satisfied.

If the above 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 9.1.3.5 for use of an inch control to accomplish the reset function.

9.1.3.8 Faster control

A faster control shall be a momentary-contact control.

A faster control, when depressed 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 9.2.2 at minimum continuous run speed.

9.1.3.9 Slower control

A slower control shall be a momentary contact control which decreases press speed.

The slower control may also be used in conjunction with the inch control to initiate machine motion at minimum continuous run speed as defined in 9.2.2.

9.1.3.10 Limited scope safe

If so equipped, a limited scope safe device shall be a maintained-contact device mechanically interlocked with the adjacent ready control. The limited scope safe device shall be unlatched by depressing the associated ready control.

While the limited scope safe device is depressed, a machine or machine element at standstill shall not move.

Pressing a stop/safe pushbutton shall take precedence over the limited scope safe function.

9.1.3.11 Plate position control

When an interlocked guard is open and hazardous points are unprotected, press motion shall only occur according to hold-to-run conditions as defined in 5.4.1.4 and 5.5.

Alternatively, if all hazards are protected, a plate position device may be a momentary-contact device. 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.

9.1.3.12 Other motion-initiating controls

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

9.2 Initiating machine motion

When initiating machine motion, the requirements of Clause 13 shall apply.

9.2.1 Initiating machine motion at inch speed

On a machine at standstill, machine motion at inch speed may be initiated by either of the following methods:

a) activating the inch or reverse inch control through the warning period; or

b) sequential activation of the same inch or reverse inch control.

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

9.2.2 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 either the run, slower or faster control with the inch control in the same operator control station while the machine is in the ready condition, a warning period is initiated, followed by machine motion at a speed set by a speed setting device; or

c) activation of either the run, slower or faster device with the inch device in the same operator control station while the machine is in the permissive period, machine motion is initiated at a speed set by a speed setting device without going through an additional warning period if all hazards are protected.

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

9.2.3 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 9.6. Maximum crawl speed is determined by the ability of the slowest acting trip nip guard to safeguard the hazard.

NOTE Hazards may be protected, for example, by trip nip bars.

9.3 Hold-to-run controls

Hold-to-run controls shall require continuous actuation of the control devices to achieve operation.

9.4 Two-hand controls

Two-hand controls as safety devices are acceptable only if any hazardous movement stops when one manual control device 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 5.5 for hold-to-run devices designed as two-hand controls.

9.4.1 Two-hand controls on cables

Two-hand controls on cables (pendant style control station) used for make-ready and trouble-shooting are permissible if, from the place of operation of the two-hand control, it shall be 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 mechanical stresses to be anticipated and be provided with tension relief measures.

9.4.2 Two-hand controls safeguarding hazard points

Where two-hand controls are used to safeguard hazards that are infrequently accessed, hydraulic/pneumatic two-hand controls shall meet the requirements specified for type III A, and electric/electronic two-hand controls shall meet the requirements specified for type III B of ISO 13851.

Where two-hand controls are used for safeguarding hazard points requiring routine and regular access, hydraulic/pneumatic two-hand controls shall satisfy the requirements specified for type III B, and electric/electronic two-hand controls shall satisfy the requirements specified for type III C of ISO 13851.

9.5 Electro-sensitive protective devices

9.5.1 General requirements

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

9.5.2 ESPDs which safeguard routine/regular access

In deviation from 5.7.2, electro-sensitive protective devices which safeguard routine and regular access to the hazard zone, shall satisfy the requirements of Type 4 of IEC 61496-1 and IEC 61496-2.

9.5.3 Positioning of ESPDs

The hand approach speed specified in ISO 13855 shall be used as a basis for determining the correct positioning of the electro-sensitive protective device (ESPD).

9.5.4 Use of ESPDs to prevent whole body access

Where electro-sensitive protective devices are used for preventing whole body access to safeguarded hazard zones, at a minimum a photoelectric beam shall be provided at a height of 400 mm and another beam at 900 mm.

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

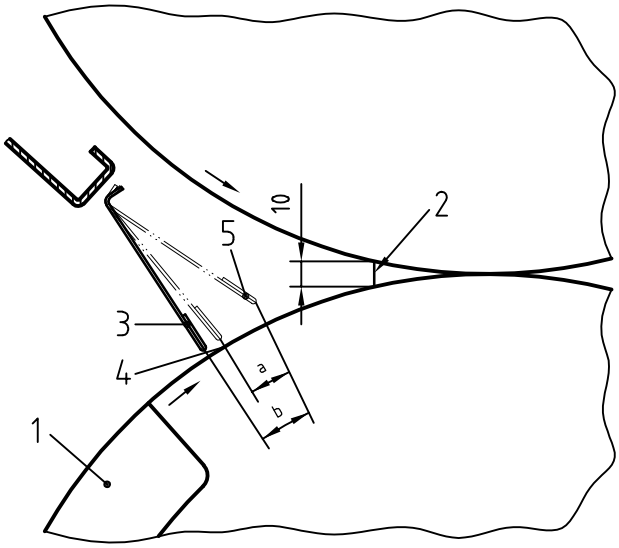
Pressure-sensitive mats and pressure-sensitive bumpers shall satisfy the requirements of ISO 13856-1.

Trip devices shall satisfy the requirements of EN 1760-2. The requirements of category 3 of ISO 13849-1:1999 shall be satisfied.

Trip devices and pressure-sensitive mats which safeguard routine and regular access to a hazard point and their related signal processing shall comply with category 4 of ISO 13849-1:1999.

Pressure-sensitive bumpers and trip devices shall function such that the hazardous movements which they are safeguarding shall be stopped before personnel can reach the hazard. See Figure 22.

Dimensions in millimetres



Key

1 cylinder gaps
2 nip point
3 normal guard position
4 tripping the stop function
5 maximum guard position

[a] Maximum stopping path of the hazardous motion.
[b] Maximum length of the movement of the trip device.

Figure 22 — Tripping devices

9.7 Braking devices, clutches

9.7.1 Switching off of braking device

The braking device may be switched off only

a) by a maintained contact control, if the disengagement of the brake is interlocked with the hazardous machine movement; or

b) by means of a momentary contact control which, when released, re-engages the braking device.

NOTE Braking devices are switched off, for example, when powered machines operate in a non-powered mode.

9.7.2 Clutch or brake failure on single-stroke machines

On single-stroke operation type machines, clutch or brake failures shall not cause any hazardous movement.

NOTE A single-stroke operation machine is one which completes a single cycle, 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

The use of either an operator control station or a motion control station is determined by the desired functions to be performed at its location. The following subclauses specify the contents of, and if necessary, the location of operator control stations.

10.1 Location of operator control stations

Operator 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).

NOTE Examples of routine, repetitive operations are plate changes, clearing jams, adjusting operations, etc.

10.2 Operator control station orientation

In an operator control station, controls shall be arranged so that the emergency stop is readily accessible from an operating position.

NOTE The stop/safe may function as an emergency stop if it meets the criteria defined for an emergency stop.

10.3 Typical operator control stations

The respective order of controls should be uniform throughout the press system. When an operator control station is located with other operator functions, it shall be distinctly set apart from those functions by spacing, marking or framing.

10.4 Motion control stations

When a motion control station contains both a motion control and a stop/safe pushbutton, the stop/safe function shall affect the same machine or group of machines within the system affected by the motion control in that motion control station.

Stop/safe and motion control controls should be arranged in a uniform pattern throughout the system.

The respective order of 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 from those functions by spacing, marking or framing.

10.4.1 Minimum motion control station

Each operating position capable of initiating motion, shall have an emergency stop function on or at the operating position.

A motion control station at a location at which an operator has access to a hazard through a movable guard shall contain a stop/safe or emergency stop pushbutton (if it serves the stop/safe function).

NOTE A single stop/safe pushbutton which is also used as an emergency stop control may be used as long as it meets the requirements for both an emergency stop and a stop/safe pushbutton.

10.4.2 Motion control station location

Every operating position of the system shall have a motion control station within arm's reach of the operator and shall be placed so that the operator does not have to reach past moving parts.

Within a hazardous zone, the only motion-initiating device permitted shall be the inch device and a reverse inch device as specified in 5.5.

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.

All safety-related stop functions shall be hard wired or have redundant electronic control, unless national body regulations do not permit redundant electronic controls.

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 an 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 5.5.

10.4.3 Remote control

10.4.3.1 Remote control via data link

Press systems which utilize warning periods as defined in 13.1.2 and permissive periods as defined in 13.1.3, may use remote control communications links for the purposes of performing diagnostic and calibration functions, including those functions requiring remote activation of machine motion.

10.4.3.1.1 Maintaining system and data integrity

The equipment manufacturer or service provider shall take into consideration the following measures, and shall comply with category 3 as defined in ISO 13849-1:1999, and/or they shall be accomplished by a computer system in accordance with Category 3 of ISO 13849-1:1999.

Measures shall be in place to:

— guard against transmission of faulty data; and

NOTE 1 Data integrity during transmission can be achieved, for example, by the implementation of a block protection process or comparable other measures with block replication. The block size of data 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 CRC (Cyclic Redundancy Check) 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 polynomial of degree 16 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 bit are recognized, including all odd bit positions.

— ensure that the remote control data link is established to the correct and intended press system control computer; and

NOTE 2 Press system identification may be achieved, for example, by use of a unique machine identification code in the safe portion of the control system, normally multi-digit, which should be compared with the identification transferred by remote transmission. The identification code should, for example, be checked by means of the CRC mechanism or comparable measures.

— guard against the possibility of unauthorized persons establishing a data link to the press system control computer.

NOTE 3 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 which should contain at least a 64-bit coding method equivalent to those in on-line banking, and also include a check of the unique machine identification.

10.4.3.1.2 Data link line blocking

Access to a local press system control computer via a remote control data link shall be able to be disabled (blocked) by disconnecting the remote control communications line connection to the press system control computer.

There shall be a minimum of the following two such disconnects:

— a switch (safety relay) controlled by the safety guard interlock system (see 5.4.1.5); and

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

10.4.3.1.3 Indication of remote control datalink enabled

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

NOTE This can be achieved, for example, by:

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

— notification message on a display screen(s).

10.4.3.1.4 Indication of remote control datalink activated

Whenever there is a remote control communications link established to the local press system control computer, there shall be a method for personnel at the local press system to be aware of the active remote control datalink condition.

NOTE This can be achieved, for example, by blinking indicator light(s) on one or more control stations, or a blinking notification message on a display screen(s).

10.4.3.1.5 Remote control use of warning and permissive periods

A remote control datalink shall not have the ability to initiate machine motion without the use of the same warning and permissive periods defined in 13.1.2 and 13.1.3 and in effect during normal local operation of that press system.

10.4.3.1.6 Response to remote control data link motion command

The design of the press system controls shall require that every command initiated by the remote control data link which causes the press system to enter warning and permissive periods for machine motion must be responded to by a manually generated local ready signal issued within the warning or permissive periods before motion may begin.

Remote control shall not be permitted to initiate motion on any equipment for which hold-to-run control serves as the only hazard protection. Remote control shall not override any safety-related functions.

Failure to receive the local ready signal shall cause the 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 data link line.

10.4.3.1.7 Remote control data link time-out

The press system shall be equipped with a time-out function which, when a remote control data link is established, if not reset manually by local personnel within a period of less than 30 min from the last manual reset, will cause the press system to stop under the same conditions and with the same effects, including blocking of the data link line, as a trip of the press system safety guard interlock system.

10.4.3.1.8 Acceptance test for software changes

After any software change which may potentially affect safety functions of a machine, the authorized person(s) shall conduct a comprehensive acceptance test of the safety functions which may be affected by the newly recorded data at the machine (not by remote access), on the basis of broad functional tests. For this test, the

manufacturer (or manufacturer's agent) shall provide detailed instructions to the authorized person(s) at the installation site (for example, in the form of check lists).

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 recorded in a protocol which shall be signed by the responsible authorized person(s) at the machine site and retained by the manufacturer.

10.4.3.2 Wireless motion control stations

NOTE 1 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 minimum requirements for such controls, should they be 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 that will block the operator's ability to see the equipment being moved.

d) Each operator control station, which is not affixed to the machine it controls, shall carry a clear indication of which machine is intended to be controlled by that control station.

e) The controls meet the requirements set forth in Clause 9 and its subclauses.

f) The wireless control station shall contain a control which, when activated, shall generate an emergency stop command. As stated in 9.1.3.1, 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 operator 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.

   NOTE 2 An example of a failure would be 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 operator control station, a clear warning shall be given to the operator when a variation in battery voltage exceeds specified limits. Under those circumstances, the operator 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.

10.4.4 Other operator functions in a motion control station

When a motion control station contains other operator functions, they shall be distinctly set apart from those functions by spacing, marking or framing.

11 Control systems

11.1 General requirements

11.1.1 Hydraulic, pneumatic, electric and electronic control systems

On the hydraulic/pneumatic control system, the safety-related parts shall satisfy category 1 of ISO 13849-1:1999. On the electric/electronic control system, the safety-related parts shall satisfy category 3 of ISO 13849-1:1999. Single main power contactors which satisfy the requirements of category 1 of ISO 13849-1:1999 may be used.

Faults in the auxiliary relays and contactors of the control circuit shall be detected and cause the machine to shut down.

When using computers, modems, or PLCs (programmable logic controllers), safety-related malfunctions shall be detected and cause the machine to shut down.

NOTE 1 When using computers, modems, or PLCs, this requirement may, for example, be satisfied by monitoring the function of safety-related signals using parallel control systems or redundant contact-type circuit breaking principles.

NOTE 2 Safety-related parts of control systems include, for example, emergency stop circuits, electric interlocking circuits, or limitation of displacement or operating speed on hold-to-run controls. (Also see ISO 13849-1:1999 for definitions.) External influences, as well as faults in the control systems, could result in hazardous movements and hazards. Examples of hazardous movements, depending on the type of machine, include:

— 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 where stopping of the movement is intended.

A hazard may also be the build-up of potentially explosive atmospheres.

11.1.2 Electronic adjustable speed drives

On electronic adjustable speed drives, the control system shall be designed such that in the event of any guard or safety device causing the machine to stop, either the main contactor will be switched off or any other appropriate measure be taken.

On electronic adjustable speed drives which feed energy back into the electric circuit during stopping, appropriate control-related measures shall be taken (in addition to pulse blocking) to ensure that the main contactor is switched off no later than after 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 1 On electronic adjustable speed drives, the speed of rotation of the motor is changed, for example, by shifting the supply voltage and/or frequency.

NOTE 2 “Safety devices” include, for example, emergency stop devices, electro-sensitive protective devices, trip devices.

NOTE 3 “Other appropriate measures” include, for example, the application of a mechanical brake with a braking torque greater than the drive torque of the motor. An “additional control measure” is, for example, switching off after a preset time by using an electric/electronic device (timer).

11.1.3 Main energy source cut-off

When an emergency stop device is fitted with a main contactor which detects a low voltage condition, it shall disconnect the main power supply under category 1 of ISO 13849-1:1999.

NOTE The opening contact of the emergency stop device directly disconnects, for example, the power supply to the low-voltage tripping coil.

11.1.4 Residual pile monitoring systems

Residual pile monitoring systems shall comply with category B of ISO 13849-1:1999 as a minimum.

11.1.5 Unobserved unguarded hazard zones

When more than one interlocking guard is open and any unguarded hazard zones cannot be observed from the operating position (the conditions described in 5.4.1.4), the circuits controlling all the guard interlocks that prevent machine motion under hold-to-run condition shall satisfy the requirements of category 1 of ISO 13849-1:1999. The interlocking may be computer controlled.

NOTE For areas which are not visible from the operating position, see 5.7.

All other safety-related parts of control systems, including limitation of displacement or operating speed on hold-to-run controls and preventing machine motion under continuous run condition, shall satisfy 11.1.

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

For those hand-fed machines where the operator has routine and regular access to hazard points where the operator's hands can come into contact with the tools or the path of tool movement, the following additional requirements of 11.2.1 to 11.2.4 shall apply.

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

11.2.1 Hydraulic/pneumatic control system

On the hydraulic/pneumatic control system, the safety-related parts shall satisfy category 3 of ISO 13849-1:1999.

11.2.2 Electric/electronic control system

On the electric/electronic control system, the safety-related parts shall satisfy category 4 of ISO 13849-1:1999.

11.2.3 Main contactors

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

11.2.4 Systems using electronic braking

Systems using electronic braking shall have an additional electro-mechanical or pneumatic-mechanical brake, which works independently of the electronic brake, for back-up. 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 9.6.

In addition, the following requirements shall be satisfied where on screen printing presses substrates are fed manually between the printing form 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 9.6;

— electro-sensitive protective devices shall comply with 9.5.2.

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

12 Ergonomics and labelling of indicators and actuators

When not specified elsewhere in this International Standard, the ergonomic design and labelling requirements relating to indicators and actuators as defined in IEC 61310-1 and IEC 61310-2 shall be satisfied.

13 Signals and warning devices

A warning system shall be required for press systems in which the overall vision of personnel by the operator is obstructed, or communication between operating personnel may be difficult.

NOTE 1 This condition may exist when, for example:

— the machine length exceeds 7 m;

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

— the printing system includes machines on different floors; or

— on automatic platen machines, the control panels are in positions from which the waste discharge area cannot be observed.

An audible alarm as defined in 13.1, or an area light warning system, as described in Annex E, shall be used. A warning system using an audible alarm is preferred.

NOTE 2 In Europe, the audible alarm system is required.

Optional personnel warning lights as defined in 13.1.4 may be used in addition to an audible alarm.

NOTE 3 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.

Warning signals shall:

— occur before the initiation of machine motion; and

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

If the press system can be reconfigured into multiple control zones, each zone should have a warning system capable of operating independently. See Clause 8, **Control zones**.

13.1 Audible warning system

13.1.1 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.

13.1.2 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.

During the warning period, the audible alarm shall sound for at least 1 s.

For warning systems equipped with personnel warning lights, the red personnel warning lights shall have a discernible flash.

At the end of the warning period, one of two things may occur:

a) The following “double push” sequence is preferred:

   — At the end of the warning period machine motion will occur as the result of releasing a motion control during or after the warning period, and reactivating a motion control during the permissive period.

   — The warning period shall be cancelled by depressing a stop/safe pushbutton or opening a safety circuit.

As an alternative, the following sequence is permitted:

b) Machine motion shall occur as the result of holding a motion control through the warning period and into the permissive 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.

13.1.3 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 using the double push to initiate motion (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 six seconds, 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 the single push is used to initiate motion at inch speed (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.

NOTE 1 For example, for production reasons, it may be preferable to use the double push system to initiate inch, but a single push to initiate run at production speed.

The permissive period is cancelled by depressing a stop or stop/safe pushbutton, or 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 23 and 24.

NOTE 2 If the optional personnel warning light system is used, refer to Table 2.

NOTE 3 The permissive period allows for successive inch or reverse operations without each being preceded by a warning period.

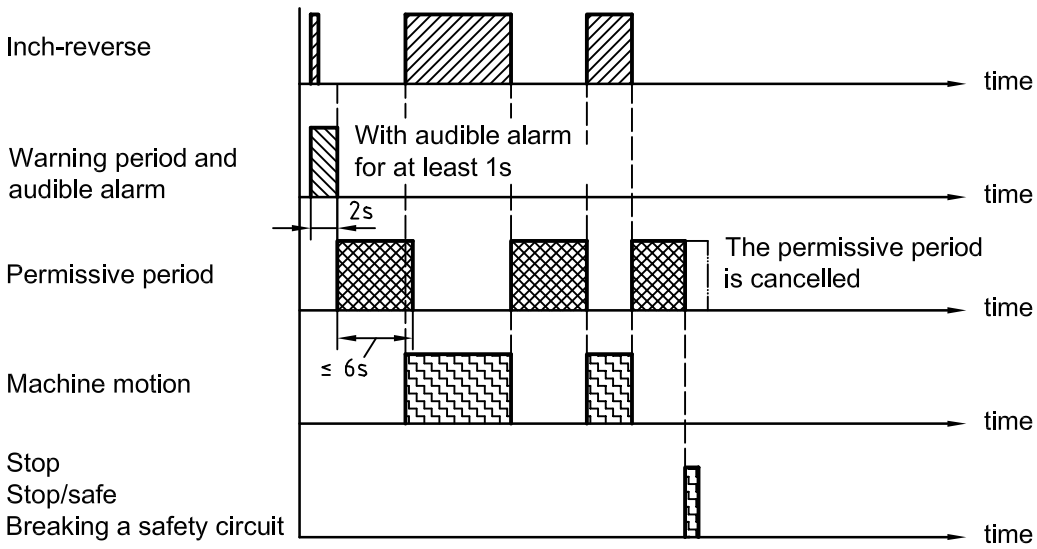


Figure 23 — Audible warning system with double-push sequence

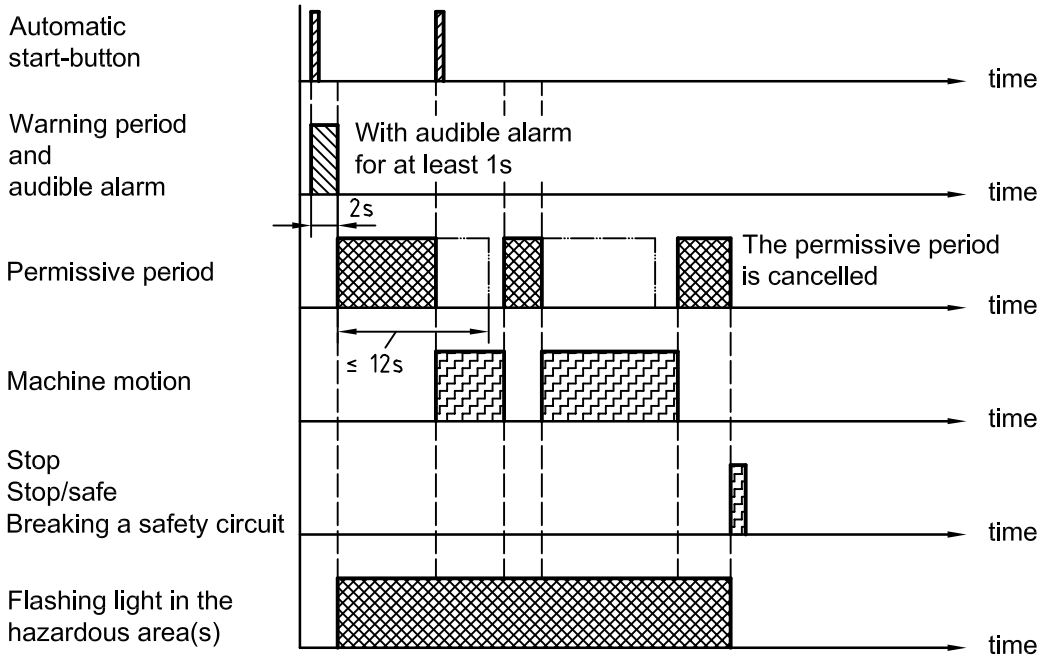


Figure 24 — Audible warning system for automatic machine mode with double-push sequence

13.1.4 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 safe conditions. The colour red indicates a ready or running condition. The colour green indicates a safe condition.

Personnel warning lights shall be located clearly in view from any operator control station and before entering the press frames. These personnel warning lights shall be distinctive 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. If personnel warning lights mounted in a horizontal orientation can be viewed from both sides, resulting in a reversal of the colour sequence, horizontal orientation shall not be permitted.

NOTE The restrictions for horizontal orientation are to ensure that personnel, especially those with visual considerations such as colour blindness, can expect the colour sequence to always be the same.

The personnel warning lights and audible alarm shall comply with Table 3.

13.1.5 Optional personnel warning lights for automatic set-up operations

Red lights may be used to warn of machine motion of an automatic set-up system on printing press systems. The light shall flash for two seconds 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.

Table 3 — State of warning devices for audible warning system with personnel warning lights

Warning device status	Machine condition					
	Stop/Safe	Ready or Fault	Warning period	Permissive period	Machine motion	Armed
Green light	On [a]	Off	Off	Off	Off	Off
Red light	Off	On	Flash	Flash	On/Off [b]	On/Flash [c]
Audible alarm	Off	Off	On	Off [d]	Off	Off/Pulse [c]

[a] To provide an optional stop/safe pushbutton locating feature, at the place where the stop/safe is activated, the green personnel warning light may 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 13.1.3 for an exception.

13.2 Area light warning system

An area light warning system, as defined in Annex E, may be used instead of the audible warning system defined in 13.1.

NOTE This 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.

NOTE The following documents are known to specifically address the design and use of warning signs and labels:

— European Council Directive 92/58/EEC of 24 June 1992

— ANSI Z535.3, *Criteria for Safety Symbols*

— ANSI Z535.4, *Product Safety Signs and Labels*

— 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*

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

— 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 on or 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 listed and described in ISO 12100-2:

— name and address of manufacturer;

— CE mark (for machines and products to be launched on the EEC market);

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

— designation of series or type, if any;

— serial number, if any;

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

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 in as far as the pressure generator is not a component part of the pile lifting and lowering device;

— maximum carrying capacity;

— for format sizes above 2,5 m^2 a sign saying that riding on the device is forbidden.

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 according to IEC 60825-1, where required.

15.1.4 Machinery with UV radiation

On machinery where UV radiation of category 1 minimum according to EN 12198-1 is expected, the category number according to 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 they are not protected against contact by insulation or additional guards.

15.2 Contents of instruction handbook

Instruction handbooks shall be devised in accordance with ISO 12100-2.

15.2.1 Each machine

Each machine shall be accompanied by an instruction handbook containing the minimum according to 15.1 of this International Standard, and basic specifications according to ISO 12100-2.

NOTE See Annex D for examples of instruction handbook layout.

15.2.2 Machines using flammable liquids

The instruction handbook for machines using flammable liquids with a flash point below 55 °C shall contain the instruction that the flooring in an area extending 1,0 m beyond the zone 1 hazardous area shall be conductive.

15.2.3 Additional requirements

In addition to the above requirements, the instruction handbook(s) shall, where required:

a) describe the protective measures to prevent accidental contact with hot machine parts with a surface temperature of more than 65 °C;

b) specify those areas on the machine suitable for fitting suction devices in order to avoid the emission of hazardous gases, vapours and dusts, also specifying the required suction capacity;

c) describe any residual risks which cannot be excluded despite the safety measures provided, and shall identify where special training is required and which personal protective measures (for example protective gloves and clothing) are to be taken;

d) give all information and instructions required where use in potentially explosive atmospheres can be foreseen;

e) warn against persons being crushed between moving machine parts and parts of the building by mounting the machine at adequate distances;

f) inform about the requirements for interfaces connecting the machine with preceding or following equipment and to external power supplies (operation of emergency stop control systems, overall system control etc.);

g) give instructions for the proper handling and adjusting of guards;

h) for machines working with web material, give instructions for safe threading of the web.

See Annex D for examples of instruction handbook layout.

15.2.4 Sheet-fed printing press systems

15.2.4.1 Handling heavy machine parts

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

15.2.4.2 Residual risk from ink ducts

The residual risk existing when ink ducts are swung down shall be mentioned in the instruction handbook.

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

15.2.4.3 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 For example, access may be for test sheet removal or for inserting pile wedges.

15.2.4.4 Sheet-fed presses used for printing on board or metal sheet

On sheet-fed printing presses that are also used for printing on board or metal sheet, the instruction handbook shall identify the residual risk existing where ISO 13852:1996 cannot be applied in the feeding area for production reasons.

15.2.4.5 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 are to be stopped.

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

15.2.4.6 Powders

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

15.2.5 Web-fed printing press systems

15.2.5.1 Handling heavy machine parts

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

15.2.5.2 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 are to be stopped.

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

15.2.5.3 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, for example, operation of a stop control with mechanical latch or emergency stop device before beginning of the operation in the danger area.

15.2.5.4 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 danger area before starting the hold-to-run operation.

15.2.6 Screen printing presses

15.2.6.1 Ventilation and admissible liquids

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

15.2.6.2 Access between screen printing frame and machine frame

Instruction handbooks shall indicate that, before access between screen printing frame and 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.

15.2.6.3 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 minimum distance between doctor blade and screen frame is 25 mm.

15.2.6.4 Crushing point between doctor blade and screen or machine table

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

15.2.6.5 Residual risks related to doctor blade

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

15.2.7 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.

NOTE Such parameters, for example, can be pressure of washing liquid, speed of rotation of washing rollers and brushes, length of washing process. Solvent vapours may cause risks of, for example, explosion or damage to health.

15.2.8 Continuous flow drying devices

15.2.8.1 Inks and coatings

Where the use of inks and coatings is restricted to certain types for avoidance of explosion risks according to 6.1.1 – 6.1.6, 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.

15.2.8.2 Solvents

The instruction handbook shall contain a warning that solvents are not allowed to be placed in the area of the continuous flow drying device to avoid an explosive hazard and that solvents are not allowed to be placed in the area of the drying device (for example during manual washing of cylinders or rollers).

15.2.8.3 Mist of UV inks and UV coatings

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

15.2.8.4 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:

— removing the web from its operating position (threaded through the drying device) before starting the washing; or

— using cleaning material (solvents) which have a safety data sheet indicating that the explosion limit is “not applicable” at the expected operating temperature of the drying device; or

— using user-created “Standard Operating Procedures” for press operators so that they limit the flow rate of solvents into the drying device to that rate producing acceptable solvent concentration limit as defined by EN 1539 and ANSI/NPFA 86.

15.2.9 Oxidizers, incinerators and thermal cleaning plants

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

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

— flammable 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 flammable 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.

15.2.10 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 spillages need to be removed immediately.

15.2.11 Washing equipment for printing plates

For washing equipment for printing forms, 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.

15.2.12 Pile turners and reel turners

On pile turners, the maximum load capacity shall be clearly indicated.

Annex A
(informative)

Hazards on 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, this list may assist the manufacturer in identifying the risks on their piece of equipment. The manufacturer should be aware there may be other hazards not included in this list which need to be identified during the risk assessment process.

NOTE For additional information on hazard analysis, refer to ISO 14121.

Table A.1 — Significant hazards, hazard zones, safety measures

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 interlocking 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 interlocking 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 forms printing — rollers with equi-directional revolutions — digital printing presses **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

Table A.1 (*continued*)

Significant hazards	Hazard zone
Mechanical hazards (continued)	**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 UV radiation laser	**Pre-press machinery** — UV exposing equipment — laser exposing equipment **Sheet-fed printing presses, web-fed printing presses, coating units** — laser exposing equipment **Continuous flow drying devices** — emission of UV radiation
Hazards generated by noise resulting in hearing loss	**All machines**

Table A.1 (*continued*)

Significant hazards	Hazard zone
Hazards from substances and material used for processing, machine operation or which are emitted during the process hazards resulting from contact with or inhalation of harmful fluids, gases, fumes, dusts	**Pre-press machinery** — charging and discharging of liquid substances — solvent vapours **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 flammable substances — ignition of flammable 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	**Pre-press machinery** — production of master copies, film and printing form exposing **Sheet-fed and web-fed printing presses, coating units** — alcohol dosing equipment

Annex B
(normative)

Explosion protection zones

B.1 General classification of hazardous places

To determine the extent of measures necessary to avoid effective ignition sources, the hazardous places are classified into zones based on the frequency and duration of occurrence of a hazardous explosive atmosphere.

NOTE 1 In the following text where the term "gas" or "gas/vapour" is used, it implicitly covers mist atmospheres.

A place in which an explosive atmosphere is not expected to occur in such quantities as to require special precautions shall be regarded as non-hazardous within the meaning of this International Standard.

Taking into account 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, other measures for the avoidance of effective ignition sources for combustible dusts compared to combustible gases/vapours are 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.

B.2 Zones for gases/vapours

The following definitions of zones shall apply:

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

NOTE 1 In general these conditions, when they occur, arise inside containers, pipes and vessels, etc.

Zone 1: A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mists is likely to occur in normal operation occasionally.

NOTE 2 This zone can include, among others:

— the immediate vicinity of zone 0;

— the immediate vicinity of feed openings;

— the immediate vicinity around filling and emptying openings;

— the immediate vicinity around fragile equipment, protective systems, and components made of glass, ceramics and the like;

— the immediate vicinity around inadequately sealed glands, for example on pumps and valves with stuffing-boxes.

Zone 2: A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

NOTE 3 This zone can include, among others, places surrounding zones 0 or 1.

Table B.1 — 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, form cylinder, intermediate roller and the freshly printed material are located. The area of the ink fountain, extending at right angle 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 which results from the vertical projection of the danger area of the printing units. The area of the ink container of the printing units which 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 silk 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.
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.

Table B.1 (*continued*)

Equipment type	Zone	Zone description
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 which 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 which 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 which 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 permissible:

— with an evaluation value of $E \leqslant 6$:

  solid stepladders guarded against slipping away with a pitch angle of 46° to 60° maximum and lateral handrails;

— with an evaluation value of $E \leqslant 3$:

  solid stepladder with a pitch angle of 46° to 74° minimum;

— with an evaluation value of $E \leqslant 2$ and $E_2 \leqslant 0$:

  ladders with a pitch angle of 75° to 90°.

The evaluation is computed using the formula:

$$E = E_1 + E_2 + A_1 + A_2 \qquad \text{(C.1)}$$

where

E is the total evaluation;

E_1 is the evaluation E_1, according to Table C.1;

E_2 is the evaluation E_2, according to Table C.2;

A_1 is the additional factor A_1, according to Table C.3;

A_2 is the additional factor A_2, according to Table C.3.

Table C.1 — Evaluation E_1 for the frequency of use

Frequency of use	Evaluation E_1
Less than once per week	1
Not more than once per week	2
Not more than once per day	3
More than once per day	4

Table C.2 — Evaluation E_2 for the frequency of use

Carrying objects	Evaluation E_2 [a]
No objects to be carried in the hands	0
Light objects ($\leqslant$ 5 kg)	1
Objects of moderate weight (> 5 kg and $\leqslant$ 10 kg)	2
Heavy objects (> 10 kg)	3

[a] Where the height covered is less than 1,5 m, the value is deemed to be $E_2 = 0$.

Table C.3 — Additional factors A_1 and A_2

Additions	Additional factors A_1, A_2
Addition if at least one bulky object has to be carried	$A_1 = 1$
Addition if the height to be covered is more than 3 m	$A_2 = 1$

Annex D
(informative)

Example of layout of instruction handbooks

In addition to information required by this International Standard to be included in instruction handbooks, it is suggested that the following information also be included. This list is not all-inclusive and is intended to serve as a guideline.

Information relating to the machine

— name and address of the manufacturer or supplier;

— designation of series or type;

— performance data, data on noise emission;

— description of application of machinery (intended use);

— specification of workplaces on the machine;

— etc.

Information relating to safety

— diagrams or cross-sections of machine showing safety devices and measures;

— risks caused by neglecting safety measures;

— safe working practices;

— safety information for the operator;

— unintended use;

— etc.

Information relating to transport, handling and storage of the machine

— safety measures;

— dimensions and weight of the machine;

— etc.

Commissioning, de-commissioning

— assembly and mounting;

— commissioning and de-commissioning;

— etc.

Information relating to installation of the machine

— fixing and anchoring conditions;

— space needed for operation, use and maintenance;

— permissible environmental conditions;

— instructions for connecting the machine to power supply;

— etc.

Information relating to the use of the machine

— description of manual control devices;

— instructions for set-up and adjustment, 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;

— etc.

Information relating to maintenance of the machine

— nature and frequency of inspections;

— preventive measures (repair parts, lubrication);

— spare parts;

— trouble-shooting;

— etc.

Annex E
(normative)

Area warning light system

E.1 Area lights

The area lights shall consist of white lights positioned about the machine in sufficient number and of adequate intensity so that when flashing off (dim) and on (bright), the varying reflected intensity is apparent in the appropriate machine motion zone(s).

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. The area lights are flashing and a minimum of two (2) 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.

Exception: If for operational reasons it is necessary that the permissive period exceed six seconds, a permissive period of no more than 12 s is permitted with the addition of a flashing light in the hazardous area(s) (for example, in the delivery area). The light shall flash throughout the entire permissive 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. 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 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 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 lights shall be on (bright).

E.6 Flashing operation

The release of all stop/safe pushbuttons shall initiate flashing operation.

Flashing operation when machine motion will be in the forward direction shall have a period of 1 s or less with a duty cycle of 50 %.

Table E.1 — Status of warning devices for area warning lights

Warning device	Machine condition					
	Stop/Safe	Fault	Warning period	Permissive period	Machine motion	Armed
Area 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.

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