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Machine tools safety — Presses —

Part 1: General safety requirements

Sécurité des machines-outils — Presses —

Partie 1: Exigences générales de sécurité

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Foreword

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

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

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

The committee responsible for this document is ISO/TC 39, *Machine tools*, Subcommittee SC 10, *Safety.*

A list of all parts in the ISO 16092 series can be found on the ISO website.

Introduction

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

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

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance etc.).

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

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

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

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

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

This document is intended to be applied with at least one of the other relevant parts (ISO 16092-2 for mechanical presses, ISO 16092-3 for hydraulic presses and, ISO 16092-4 for pneumatic presses).

Machine tools safety — Presses —

Part 1:
General safety requirements

1 Scope

This document specifies technical safety requirements and measures to be adopted by persons undertaking the design, manufacture and supply of presses which are intended to work cold metal or material partly of cold metal, but which can be used in the same way to work other sheet materials (e.g. cardboard, plastic, rubber, leather, etc.).

NOTE 1 The design of a machine includes the study of the machine itself, taking into account all phases of the "life" of the machine mentioned in ISO 12100:2010, 5.4, and the drafting of the instructions related to all the above phases.

The requirements in this document take account of intended use, as defined in ISO 12100:2010, 3.23, as well as reasonably foreseeable misuse, as defined in ISO 12100:2010, 3.24. This document presumes access to the press from all directions, deals with all significant hazards during the various phases of the life of the machine described in Clause 4, and specifies the safety measures for both the operator and other exposed persons.

NOTE 2 All significant hazards means those identified or associated with presses at the time of the publication of this document.

This document applies to presses which can function independently and can also be used as a guide for the design of presses which are intended to be integrated in a manufacturing system.

The covered presses transmit force mechanically to cut, form, or work cold metal or other sheet materials by means of tools or dies attached to or operated by slides/ram in range in size from small high speed machines with a single operator producing small workpieces to large relatively slow speed machines with several operators and large workpieces.

This document does not cover machines whose principal designed purpose is:

a) metal cutting by guillotine;

b) attaching a fastener, e.g. riveting, stapling or stitching;

c) bending or folding by press brakes or folding machines;

d) straightening;

e) turret punch pressing;

f) extruding;

g) drop forging or drop stamping;

h) compaction of metal powder;

i) single purpose punching machines designed exclusively for profiles, e.g. used in the construction industry;

j) spot welding;

k) tube bending;

l) working by pneumatic hammer.

This document does not cover hazards related to the use of presses in explosive atmospheres.

This document covers the safety requirements related to the use of programmable electronic systems (PES) and programmable pneumatic systems (PPS).

This document is not applicable to presses which are manufactured before the date of its publication.

This document deals with the common significant hazards, hazardous situations and events relevant to presses and ancillary devices which are intended to work cold metal or material partly of cold metal (see Clause 4). This document defines the common safety requirements for presses defined in this clause and shall be used in connection with other parts of the ISO 16092 series.

Specific hazards which are related to the type presses used are dealt with in ISO 16092-2, ISO 16092-3 and ISO 16092-4.

2 Normative references

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

ISO 230-5:2000, *Test code for machine tools — Part 5: Determination of the noise emission*

ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 11428, *Ergonomics — Visual danger signals — General requirements, design and testing*

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

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13849 (all parts), *Safety of machinery — Safety-related parts of control systems*

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

ISO 13851:2002, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

ISO 13854:1996, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

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

ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

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

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122 (all parts), *Safety of machinery — Permanent means of access to machinery*

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

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60947-5-8, *Low-voltage switchgear and controlgear — Part 5-8: Control circuit devices and switching elements — Three-position enabling switches*

IEC 61496-1:2012, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and test*

IEC 61496-2:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 61496-3, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010 and ISO 13849-1:2015 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

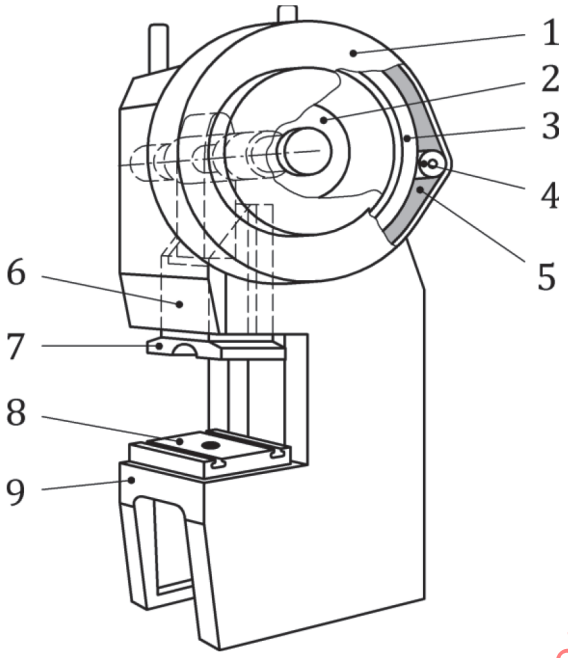
— IEC Electropedia: available at http://www.electropedia.org/

3.1 Groups of presses defined in the different parts of the ISO 16092 series

3.1.1
press
machine designed or intended to transmit energy to a *tool/punch* (3.2.13) for the purpose of the working (e.g. forming or shaping) of cold metal or material partly of cold metal between the tools

3.1.2
mechanical press
press (3.1.1) designed or intended to transmit energy from a prime mover to a *tool/punch* (3.2.13) by mechanical means using a clutch mechanism which transmits torque to impart motion of the flywheel to the slide

Note 1 to entry: See Figure 1.



Key

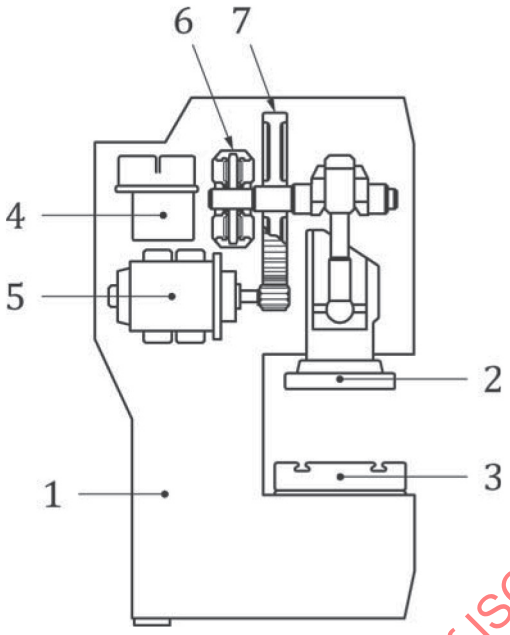
1	flywheel guard	6	slide
2	friction clutch, part revolution clutch	7	slide flange, tool holder
3	flywheel	8	bolster/bed-plate
4	motor pulley	9	bed
5	belt		

Figure 1 — Example of a friction clutch (part revolution clutch) press (tools area safeguards not shown)

3.1.3
mechanical servo press

press (3.1.1) designed or intended to transmit energy to a *tool/punch* (3.2.13) by mechanical means using a servo drive mechanism without clutch mechanism to generate torque to impart motion to the slide

Note 1 to entry: See Figure 2.



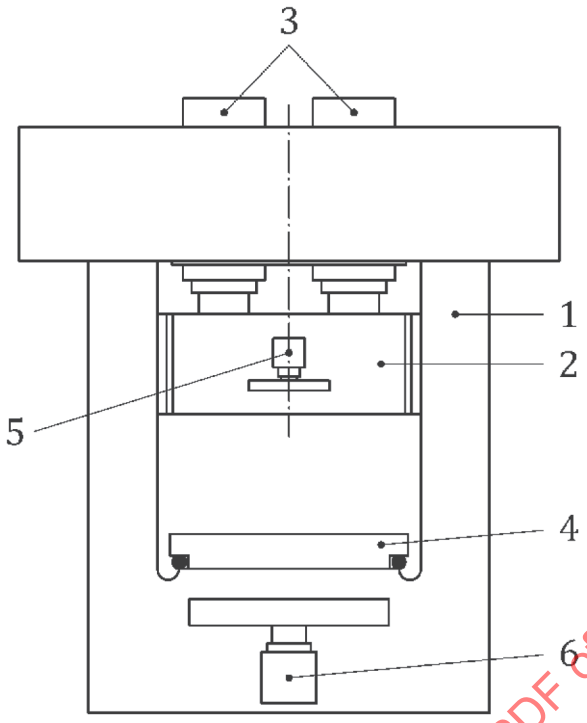
Key

1 frame
2 *slide/ram* (3.2.12)
3 bolster
4 servo drive (controller)
5 servo motor
6 mechanical brake
7 gear

Figure 2 — Example of a mechanical servo press

3.1.4
hydraulic press
press (3.1.1) designed or intended to transmit energy by linear movement between closing *tools* (3.2.15) by hydraulic means

Note 1 to entry: Such energy is produced by the effects of hydrostatic pressure (see Figure 3).



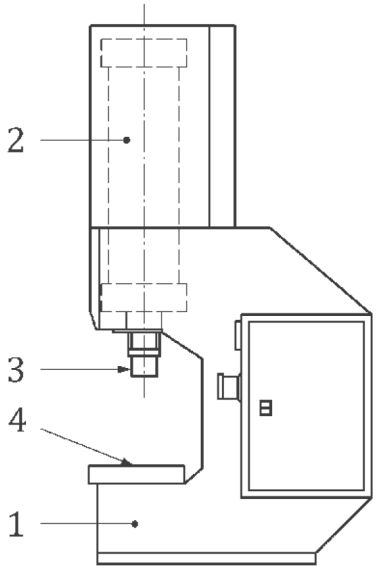
Key

1 frame
2 *slide/ram* (3.2.12)
3 main cylinders
4 bolster
5 ejector — slide
6 cushion — bed

Figure 3 — Example of a down-stroking hydraulic press

3.1.5
pneumatic press
press (3.1.1) designed or intended to transmit energy by linear movement between closing *tools* (3.2.15) by pneumatic means

Note 1 to entry: Such energy is produced by the effects of aerostatic pressure (see Figure 4).



Key

1 frame
2 main cylinder
3 *slide/ram* (3.2.12)
4 bolster

Figure 4 — Example of a down-stroking pneumatic press

3.2 General terms used for parts of a press used in the ISO 16092 series

3.2.1
tools area
area between moving *tools* (3.2.15), moving slide, moving *die cushions* (3.2.6), workpiece ejectors

3.2.2
ancillary device
any device intended for use within the press *tools* (3.2.15) and integrated with the *press* (3.1.1)

Note 1 to entry: Examples of these devices are tools/workpiece lubrication systems, load and unload and *transfer system* (3.2.3).

3.2.3
transfer system
integrated device(s) of the *press* (3.1.1) which moves a material/workpiece through the *tools area* (3.2.1)

Note 1 to entry: Transfer system is also known as “feeder system” or “robot transfer system”.

3.2.4
dead centre
point at which the *tool/punch* (3.2.13), during its travel, is:

— either nearest/closest to the die (generally, it corresponds to the end of the closing stroke), known as bottom dead centre (BDC);

— or furthest from the die (generally, it corresponds to the end of the opening stroke), known as top dead centre (TDC)

3.2.5
die
fixed part of the *tool* (3.2.15)

3.2.6
die cushion
accessory for a *die* (3.2.5) which accumulates and releases, or absorbs, force as required in some *press* (3.1.1) operations

3.2.7
early opening interlocking guard
guard associated with an interlocking device which, if opened when any dangerous movement in the *tools area* (3.2.1) has ceased, prevents any dangerous movement when it is opened and does not interrupt the operating *cycle* (3.4.4)

Note 1 to entry: For example, a guard is opened when any dangerous phase of a closing stroke has passed and does not interrupt the operating cycle.

3.2.8
guard locking
measures to maintain an interlocking guard in the closed position until the risk of injury from the hazardous machine *functions* (3.4.3) has ceased

3.2.9
inching device
control device, a single actuation of which, together with the control system of the machine, permits only a limited amount of travel of a machine element

[SOURCE: ISO 12100:2010, 3.28.9]

3.2.10
part detector
device which detects the workpiece and/or the correct position of the workpiece and which permits or prevents the initiation of the stroke

3.2.11
position switch
switch which is operated by a moving part of the machine when this part reaches or leaves a predetermined position

3.2.12
slide/ram
main reciprocating *press* (3.1.1) member which holds the *tool/punch* (3.2.13)

3.2.13
tool/punch
moving part of the *tool* (3.2.15)

3.2.14
tool protective device
device which protects the *tool/punch* (3.2.13) against damage by stopping the stroke or by preventing its start

3.2.15
tool
combination of *tool/punch* (3.2.13) and *die* (3.2.5)

3.2.16
closed tool
tool – closed
tool (3.2.15) designed and constructed to be inherently safe

Note 1 to entry: See Figure B.1.

3.2.17
electro-sensitive protective equipment
ESPE
assembly of devices and/or components working together for protective tripping or presence-sensing purposes comprising:

— a sensing device;

— controlling *monitoring* (3.3.1) devices;

— output devices;

— all interconnecting wiring

[SOURCE: ISO 13855:2010, 3.1.4, modified — "at minimum" was deleted in the first part of the definition, and the last list item replaced by 2 list items.]

3.2.18
active opto-electronic protective device
AOPD
device whose sensing *function* (3.4.3) is performed by opto-electronic emitting and receiving elements detecting the interruption of optical radiation, generated within the device, by an opaque object present in the specified detection zone

Note 1 to entry: IEC 61496–2 gives detailed provisions.

3.2.19
blanking
optional *function* (3.4.3) that permits an object of a size greater than the detection capability of the *AOPD* (3.2.18) to be located within the detection zone without causing an OFF-state of the output signal switching device(s) [OSSD(s)]

Note 1 to entry: Fixed blanking is a technique wherein the locations of the blanked areas of the detection zone do not change during operation. The detection capability of the other parts of the detection zone remains unchanged.

Note 2 to entry: Floating blanking is a technique wherein the blanked area of the detection zone follows the location of a moving object(s) during operation. The detection capability of the other areas remains unchanged.

3.2.20
active opto-electronic protective device responsive to diffuse reflection
AOPDDR
device, whose sensing *function* (3.4.3) is performed by opto-electronic emitting and receiving elements, that detects the diffuse reflection of optical radiations generated within the device by an object present in a detection zone specified in two dimensions

[SOURCE: IEC 61496-3:2008, 3.301]

3.2.21
presence-sensing device
PSD
electro-sensitive protective equipment (ESPE) (3.2.17) which uses electro-sensitive means or a pressure-sensitive equipment (PSPE) which uses pressure-sensitive means to determine the presence of a specified object within a detection zone

3.3 General terms used for control functions for presses

3.3.1
monitoring
safety *function* (3.4.3) which ensures that a safety measure is initiated if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated

3.3.2
muting
temporary automatic suspension of a safety *function(s)* (3.4.3) by safety-related parts of the control system during otherwise safe conditions in the operation of a machine

3.3.3
overall system stopping performance
overall response time
time occurring from actuating the protective device to the cessation of hazardous motion, or to the *press* (3.1.1) assuming a safe condition

3.3.4
reset
function (3.4.3) within the safety-related part of control system (SRP/CS) used to restore manually one or more safety functions before re-starting a machine

3.4 Operating modes and control functions

3.4.1
operating mode
specific manner of operation of a *press* (3.1.1) or press production system determined by the control system

Note 1 to entry: For specifications on safety facilities and security measures relating to different operating modes, see Clause 5.

3.4.1.1
OFF
operating mode (3.4.1) in which the *press* (3.1.1) is rendered inoperative

3.4.1.2
setting
INCH
JOG
operating mode (3.4.1) in which adjustments are performed

Note 1 to entry: Setting is an operating mode for the purposes of installing or removing tools, adjusting the tools, the safeguarding and other equipment, cleaning, inspection and maintenance where the risks associated with the slide movement are adequately reduced by continuous actuation of a control device by the operator and safeguarding feature to restrict the motion of the slide (for example, a slow speed motion or an intermittent motion of the slide).

3.4.1.3
single cycle
operating mode (3.4.1) for single *cycle* (3.4.4) operation, with manual loading and unloading

Note 1 to entry: Each operating cycle of the *slide/ram* (3.2.12) shall be positively actuated by the operator.

3.4.1.4
automatic cycle
operating mode (3.4.1) where the *slide/ram* (3.2.12) repeats continuously or intermittently

Note 1 to entry: All *functions* (3.4.3) are achieved without manual intervention into the danger zone after initiation.

3.4.1.5
single cycle with AOPD single break
PSDI single break
operating mode (3.4.1) where an *AOPD* (3.2.18) is used for *cycle* (3.4.4) initiation after clearing the AOPD following a single interruption for manual loading and unloading

Note 1 to entry: PSDI means presence-sensing device initiation.

3.4.1.6
single cycle with AOPD double break
AOPD double break
PSDI double break
operating mode (3.4.1) where an *AOPD* (3.2.18) is used for *cycle* (3.4.4) initiation after clearing the AOPD following a double interruption for manual loading and unloading

Note 1 to entry: PSDI means presence-sensing device initiation.

3.4.2
operating mode selection device
facility consisting of an access, selection and activation system for manual selection of the machine's *operating mode* (3.4.1), to which only a restricted group of persons has access

Note 1 to entry: See 5.4.3.

3.4.3
function
operation of a machine or a part of a machine which is specific or required for the intended machine task

3.4.4
cycle
complete movement of the slide and other devices of the *press* (3.1.1) used for production (e.g. cushions, workpiece ejectors) including feeding and removal of the material or workpiece:

— for hydraulic or pneumatic presses or mechanical servo presses, along a programmed motion path from the initial start position back to the same position, or

— for mechanical presses with clutch, from the cycle start position [normally top *dead centre* (3.2.4)] through to bottom *dead centre* (3.2.4) back to the cycle stop position

4 List of significant hazards

This clause contains all significant hazards, hazardous situations and events as far as they are dealt with in this document, identified by risk assessment as significant for the machines defined in the scope and which require a specific action to eliminate or reduce the risk:

These hazards are listed in Table A.1.

Particular attention is given to hazards dealing with the following:

— crushing and shearing between moving parts such as tools, slide, ejectors, components mounted in the die to perform specific functions (see Table A.1);

— entanglement on or drawing into moving parts of the machine, guards, motor and drive machinery, mechanical handling device (see Table A.1);

— ejection of machine components (see Table A.1).

Main danger zones are the following:

— tools area with moving parts;

— mechanical handling device.

5 Safety requirements and/or measures

5.1 General

The methods or measures to be implemented to eliminate the significant hazards or reduce their associated risks are detailed in this clause in the following manner:

— basic design considerations for major press components or systems (see 5.2);

— safeguarding against mechanical hazards in the tools area under different modes of production (see 5.3);

— protection against hazards due to control system or control component failures (see 5.4);

— safeguarding against hazards which can occur during tool-setting, trial strokes, maintenance and lubrication (see 5.5);

— safeguarding against other hazards (see 5.6 to 5.8).

5.2 Basic design considerations

5.2.1 Hydraulic and pneumatic systems — Common features

5.2.1.1 The general requirements in ISO 4413 and ISO 4414 shall be taken into consideration in designing hydraulic and pneumatic systems, which shall comply with the particular requirements in 5.2.2 and 5.2.3.

5.2.1.2 Filters, pressure regulators, and low pressure cut-off arrangements shall be provided.

5.2.1.3 Pressure control devices shall be provided to ensure that the permitted range of working pressure is maintained.

5.2.1.4 Pressurized transparent bowls (e.g. glass, plastic) shall be protected to prevent injury from projection of fragments, without affecting visibility.

5.2.1.5 All piping, pipe fittings, passages, surge or storage tanks and cored or drilled holes shall be free from burrs or foreign matter which might cause damage to the system. See ISO 4413:2010, 5.4.6.4 and ISO 4414:2010, 5.4.5.4.

5.2.1.6 Each run of piping shall, where practicable, be continuous from one piece of apparatus to another.

Precautions shall be taken to prevent damage by thermal expansion. Rigid piping shall be securely supported at frequent intervals to avoid vibration or movement. Care shall be taken to avoid kinking of flexible pipes and hoses used to carry fluids. Such kinking can cause traps which prevent the fluid exhausting.

5.2.1.7 Where a drop in pressure could lead to unintended dangerous motion of the slide/ram, flexible piping shall not be used. Pipes and pipe connections shall be chosen to prevent such a loss of pressure. Such pipe connections shall not be made with compression fittings, glued rings or similar devices. They shall be made by means of positive connecting joints, or by the welding of two fitted surfaces.

5.2.1.8 Operating valves shall not depend on connected piping for support, e.g. be fitted to a mounting plate or to the cylinder. This is to avoid undesirable effects from vibration which might affect both valves and piping.

5.2.1.9 Control valves and other control components (e.g. regulators and manometers) shall be mounted in positions which provide accessibility and avoid damage (see ISO 4413:2010, 5.3).

5.2.1.10 Where valves are manually or mechanically (as distinct from electrically) operated, the arrangements for restoring the valves shall be positive, i.e. when the actuator of the valve is released, the valve shall automatically move to the safe position. See also 5.4.6.

5.2.2 Pneumatic systems

5.2.2.1 Pneumatic systems which include air receivers or air reservoirs shall be designed and constructed so that the system decompresses to ambient when the pressure generating unit is stopped and the stored energy shall not allow the initiation of a further cycle. If this is not practicable, the parts of the circuit which are maintained under pressure shall be supplied with a manual discharge valve and bear a clear indication (by means of a descriptive plate) of the hazard. See ISO 4414:2010, 5.2.8.

5.2.2.2 Where valves or other parts of the press control system require lubrication, visible automatic means of lubrication shall be provided to introduce the oil into the air line in suitable form.

5.2.2.3 Where silencing systems are fitted, they shall be provided and installed in accordance with the valve manufacturer's instructions for use in safety systems and shall not affect safety functions.

5.2.2.4 Water separators shall be provided.

5.2.3 Hydraulic systems

5.2.3.1 Suitable pressure relief valve(s) shall be provided in hydraulic systems having a hydraulic pumped supply. Means shall be provided to release trapped air either by a bleed device or a self-evacuating system.

5.2.3.2 Hydraulic systems shall be designed so that escaping fluid does not cause injury.

5.2.3.3 Hydraulic systems which include accumulators shall be designed and constructed so that the system decompresses to ambient when the pressure generating unit is stopped and the stored energy shall not allow the initiation of a further cycle. If this is not practicable, the parts of the circuit which are maintained under pressure shall be supplied with a manual discharge valve in addition to the other devices required by standards or rules concerning accumulators (relief valves, gauges, etc.) and bear a clear indication (by means of a descriptive plate) of the hazard. See ISO 4413:2010, 5.4.3.2.

5.2.4 Electric systems

5.2.4.1 The electrical system shall comply with IEC 60204-1.

5.2.4.2 The designer of a press shall consider whether the limits of the electrical supply, the physical environment and the operating conditions of some components are different to those in IEC 60204-1:2016, 4.3 and 4.4. In this case, the choice of the relevant components shall be made in this respect.

5.2.4.3 The protection for the operator interface and press-mounted control devices shall be in accordance with IEC 60204-1, at least IP 54.

5.2.4.4 Enclosures of control gear (except regenerative resistors) shall provide protection in accordance with IEC 60204-1, at least IP 43.

NOTE IP 54 is recommended.

5.3 Mechanical hazards in the tools area

5.3.1 General

The major danger zone at presses is the tools area and preventive measures shall be taken to deal with the relevant hazards. This document indicates in 5.3 to 5.5 how the danger zone at the tools and associated areas, such as moving die cushions and workpiece ejectors and transfer systems, shall be safeguarded. PL tables in the relevant parts of the ISO 16092 series list the safeguarding methods, including mode of production/mode of operation and the requirements for the design of the control and monitoring system:

— single cycle: manual feed or removal (see the relevant PL table in the relevant parts of the ISO 16092 series);

— automatic cycle: solely automatic feed and removal (see the relevant PL table in the relevant parts of the ISO 16092 series).

5.3.2 Safeguarding measures

5.3.2.1 Safeguarding measures which are appropriate for the protection of any exposed person at the tools area shall be one or more of the following:

a) closed tools (see 5.3.2.3, 5.3.2.5,);

b) fixed enclosing guards (see 5.3.2.3, 5.3.2.6,);

c) interlocking guards with or without guard locking (see 5.3.2.7 to 5.3.2.10, 5.3.2.13 and Annex D);

d) control guards with or without guard locking (see 5.3.2.7 to 5.3.2.10, 5.3.2.13 and Annex D);

e) early opening interlocking guards with or without guard locking (see 5.3.2.7 to 5.3.2.10, 5.3.2.13 and Annex D);

f) electro-sensitive protective equipment (ESPE) using active opto-electronic protective devices (AOPDs) (see 5.3.2.11, 5.3.2.13, and Annex D);

g) two-hand control devices (see 5.3.2.12, 5.3.2.13 and Annex D);

h) hold-to-run control devices (see ISO 12100:2010, 6.2.11.9) with a slow closing speed (see 5.5.8).

5.3.2.2 The selected combination of safeguarding measures described in 5.3.2.1 shall protect all exposed persons, i.e. those who may gain access to the danger zone during operation, setting, maintenance, cleaning and inspection activities.

5.3.2.3 Where a press is intended to be manually loaded and/or unloaded, the safeguarding method shall not rely solely on the use of closed tools or fixed enclosing guard(s) unless the closed tools or fixed enclosing guard(s) is used in a press designed for a single specific purpose [see 7.4.2 m) and n)].

5.3.2.4 If the work performed on the press requires access to the danger zone from more than one side, safeguarding shall be provided on each side.

5.3.2.5 The openings and the corresponding safety distances of closed tools (see Annex B) shall meet the requirements laid down in ISO 13857:2008, Table 4 or the opening shall not exceed 6 mm. Any additional crushing hazard outside the closed tools shall be avoided according to ISO 13854:1996, Table 1.

5.3.2.6 Fixed enclosing guards shall comply with ISO 14120. They shall be firmly secured to the machine, another rigid structure or the floor. The feed discharge or any other opening(s) shall comply with ISO 13857:2008, Table 4.

5.3.2.7 Interlocking guards, early opening interlocking guards and control guards shall comply with ISO 14120 and prevent, in conjunction with fixed guards, access to the danger zone in the tools area, during any dangerous movement. Initiation of the stroke shall be prevented until the guard gate is closed. The associated interlocking devices shall be designed and constructed in accordance with ISO 14119 and the safety-related parts of the control system shall conform to the relevant parts of the ISO 16092 series. Control guards shall also conform to ISO 12100:2010, 3.27.6 and 6.3.3.2.5.

5.3.2.8 Where an interlocking guard or a control guard has an early opening feature, it shall function as an early opening interlocking guard.

5.3.2.9 When using an interlocking guard as a control guard, it shall not be possible to remain undetected between the guard and the danger zone. This can be prevented using additional safeguarding means. These additional safeguarding means shall either be an AOPD (type 4) or a fixed guard kept in place permanently (e.g. by welding) or an interlocking guard in accordance with ISO 14119:2013, 5.4, if this guard is only actuated during tool-setting, trial or maintenance.

Control guards shall only be used when the opening stroke length is equal to or less than 600 mm and the depth of the press table is equal to or less than 1 000 mm. The control guard(s) shall be securely held open (e.g. by spring or counterweight) to avoid gravity fall which can cause unintended cycle initiation.

5.3.2.10 The guards mentioned in 5.3.2.7 shall be provided:

a) either with guard locking, to prevent the opening of the guard gate until any dangerous movement in the tools area has ceased; guard locking devices shall fulfil ISO 14119:2013, 6.2.2;

b) or without guard locking, but designed to bring the dangerous movement to a stop before the danger zone can be reached.

5.3.2.11 ESPE using AOPDs in the form of light curtain shall comply with the following.

a) AOPDs shall conform to type 4 of IEC 61496-1:2012 and be designed and constructed according to IEC 61496-2:2013. Deactivation of the AOPD by the operating mode selection device-shall also switch off the indicator lights of the AOPD and their output signal switching devices (OSSD).

b) Access to the danger zone shall only be possible through the detection zone of the AOPD (see Annex C). Additional safeguarding shall prevent access to the danger zone from any other direction; the remaining openings shall follow the corresponding values of ISO 13857.

c) On sides of the press from which the press is operated in production mode, where it is possible to remain undetected between the detection field of AOPD and the danger zone of the press with a gap exceeding 75 mm, additional safeguarding means shall be provided (see Figure C.1).

   These additional safeguarding means shall either be an AOPD (type 4) or a fixed guard kept in place permanently (e.g. by welding) or an interlocking guard in accordance with ISO 14119:2013, 5.4, if this guard is only actuated during tool-setting, trial or maintenance.

   On sides of the press from which the press is not operated in production mode, the AOPD shall not be used for cycle initiation.

d) It shall not be possible to initiate any hazardous movement while any object is detected by the AOPD.

e) The press manufacturer may provide AOPD blanking options operable only by key operated or key lockable or equivalent secure means, according to IEC 60204-1:2016, 9.2.3.5. The press manufacturer may provide the following AOPD blanking options.

1) AOPD operating by reflecting the transmitted light beam back along its own path comprising:

— an additional reflector(s) (blanking reflector) placed in the detection zone;

— additional safeguarding, e.g. fixed guard(s);

— the blanking reflector and additional safeguarding mounting.

2) Non-retro-reflective AOPD with blanking zone comprising:

— additional safeguarding, e.g. fixed guards;

— the additional safeguarding mounting.

In both options, the configuration of the additional reflector(s)/blanking zone shall not allow an item with a diameter equal to or greater than the size of the test piece specified by the supplier/manufacturer of the AOPD to be undetected by the AOPD within the whole of the detection zone. In addition, the additional safeguarding shall be so designed and positioned that it is not possible to reach the danger zone without detection. The shape, material and length of the test piece shall conform to IEC 61496-2.

f) Where the AOPD is also used for cycle initiation, either single or double break (see also Annex C), the following shall be considered.

1) The height of the press table shall be equal to or more than 750 mm above the standing level of the operator.

If the table is less than 750 mm in height, this height shall be achieved by the use of an additional guard(s); this guard and all other guards preventing access to the tools area shall be kept in place permanently, e.g. by welding, or by the use of an interlocking guard. It shall not be possible to stand between the physical barrier and the table or tools, or beside the table or tools.

2) The opening stroke length shall be equal to or less than 600 mm and the depth of the press table shall be equal to or less than 1 000 mm.

3) The detection capability shall not exceed 30 mm (see Table D.1).

4) Before the first cycle initiation, the reset function(s) shall be actuated (e.g. push button, foot-pedal).

5) The possibility to initiate the press motion upon clearing of the AOPD shall be limited to the pre-set time.

This maximum time which can be pre-set shall not exceed 30 s starting from the end of the previous operating cycle.

If the time of reinitiation of the press motion exceeds the pre-set time, a manual reset of the cycle initiation function shall be required.

6) If there is more than one AOPD safeguarding the press, only one of them at the point of operation place shall be selected for cycle initiation at any one time.

5.3.2.12 For two-hand control devices as operator safeguard used in production mode the following applies:

a) Two-hand control devices shall conform to type III C in ISO 13851:2002.

b) When a press has a horizontal access to the hazard zone of more than 650 mm, two-hand control devices shall not be provided as the sole safeguarding (see Figure 5 for situation with horizontal access to hazard zone of equal or less than 650 mm).

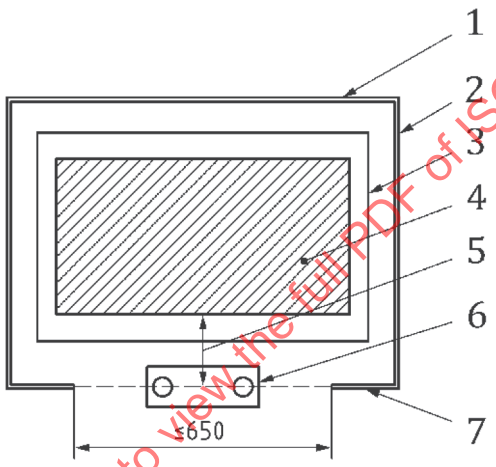
The access to the hazardous area shall be restricted either by:

— guards conforming to 5.3.2.1 b) or c); or

— ESPEs using AOPD conforming to type 4 of IEC 61496-2 or AOPDDR conforming to type 3 of IEC 61496-3 (see Annex D).

Their safety-related stop functions shall conform to required performance level given in PL tables in the relevant parts of the ISO 16092 series.

c) The number of two-hand control devices in operation shall correspond to the number of operators (see 5.4.3.4).



Key

1	back guard	5	minimum distance
2	side guard	6	two-hand control device
3	press table	7	front guard with aperture restriction
4	hazard zone		

Figure 5 — Two-hand control device, case of a press with a horizontal access to the hazard zone of equal or less than 650 mm

5.3.2.13 Interlocking guards without guard locking, control guards without guard locking, early opening interlocking guards without guard locking, ESPE using AOPDs and two-hand control devices shall be placed in such a position that the operator cannot reach the danger zone before any dangerous movement in the tools area has ceased. Calculation of this minimum distance shall be based on the overall response time of the press coming to a stop and on the speed of movement of the operator. See ISO 13855 and Annex D.

When the safeguarding devices are mechanically attached to the press and their position can be altered, the devices shall, in order to maintain the minimum distance, be interlocked or capable of being locked in position, so that they can only be moved with the use of tools or keys.

5.3.2.14 When persons can remain in the hazardous zone(s) without being visible to the operator, a means to prevent restart shall be provided, for example, a presence-sensing device or door closure inhibition by captive keys. The means shall conform to required performance level given in PL tables in the relevant parts of the ISO 16092 series.

5.3.3 Other safety requirements

5.3.3.1 The press shall be designed and constructed so that tools can be secured to the press in such a way that no hazard can arise in the event of a single component fault or power failure.

5.3.3.2 All fastenings on the press, such as screws, nuts or glue joints, shall be assembled in such a way that parts do not loosen and cause injury.

5.3.3.3 The means of manual adjustment, e.g. to the stroke or slide adjustment, or speed change, the alteration of which can cause a hazard, shall have a reliable locking device which only allows adjustment by means such as a tool, a key or an electronic password.

5.3.3.4 On automatically running presses with handling devices which are an integral part of the press, the leading edge of the coil shall be automatically guided into progression tools, where it is practicable.

If the leading edge of the coil cannot automatically be guided during loading through the handling device and the progression tools, the manufacturer shall provide the handling devices with:

a) either a hold-to-run control device with three positions and slow speed (less than 33 mm/s of the hazardous movement). The hold-to-run control device shall consist of a single button/foot-pedal switch and shall fulfil the requirements for enabling devices defined in IEC 60947-5-8. For foot-pedals switches, the force shall not exceed 350 N for switching from position 2 to position 3;

b) or an inching device. These devices shall be operational when any guard on the press is moved from its protective position, so that the leading edge can be manually guided by the use of ancillary handling devices (grips, tongs, magnetic holders).

5.3.4 Release of trapped persons between the tools

Where there is a risk of persons being trapped between the tools, means shall be provided to release them [see also 7.4.2 t)], e.g. using a mechanical slide adjustment system.

5.3.5 Release of persons trapped inside enclosed areas

Where there is a risk of persons being trapped inside enclosed areas, means shall be provided to open the guards from inside the enclosed area. Guards with locking devices shall be provided with either an escape release or emergency release according to ISO 14119:2013, 5.7.5.2 and 5.7.5.3.

5.3.6 Prevention of gravity fall during maintenance or repair

Where there is a risk of injury (force exceeding 150 N) from a gravity fall of the slide/ram, a mechanical restraint device, e.g. a scotch, safety block or slide locks, shall be provided for use during repair or any necessary intervention between the tools other than normal manual feeding.

NOTE The risk of injury does not occur between the tools of an up-stroking press, but can occur below the moving tool.

Where the device is not capable of absorbing the entire press force, it shall be interlocked to the press control, so that a closing stroke cannot be performed while the device is in position, and the press slide/ram is retained in the upper position (see ISO 14118).

5.4 Control and monitoring system

5.4.1 Control and monitoring functions

5.4.1.1 Overview

This subclause applies to all safety-related components which directly or indirectly control or monitor the function of moving parts of the press or its tools.

5.4.1.1.1 General

ISO 13849 (all parts) shall be applied for safety-related electrical, hydraulic, pneumatic and mechanical parts of control systems.

IEC 60204-1 shall be applied for the electrical equipment.

ISO 4413 shall be applied for the hydraulic fluid power systems.

ISO 4414 shall be applied for the pneumatic fluid power systems.

5.4.1.1.2 Control systems shall be designed in such a way that controls shall be re-actuated in order to initiate any hazardous functions after a stop has been initiated by any of the following:

a) changing the mode of control or operation;

b) an interlocking guard has been opened and closed;

c) a manual reset of a safeguarding device;

d) an operating power failure;

e) a primary pressure failure;

f) after actuation of tool protective device or part detector;

g) insertion of an interlocked mechanical restraint device.

5.4.1.1.3 In the event of an actuation of an interlocking guard, ESPE, a separate manual reset function is required to permit restarting:

a) if a person can pass through an interlocking guard;

b) if an ESPE using the AOPD used for cycle initiation is not interrupted in a pre-set time;

c) if an ESPE using the AOPD is interrupted during any dangerous movement in the cycle;

d) if an ESPE using the AOPD is interrupted on either sides or rear of the press from which the press is not operated.

The reset control device shall be within viewing distance of the danger zone, but out of reach from the danger zone and

— be provided through a separate and manually operated device (e.g. push button),

— only be achieved if all safety functions and safeguards are operative,

— not initiate motion or a hazardous situation by itself,

— be by deliberate action,

— enable the control system for accepting a separate start command, and

— each manual reset operation shall only be effective after an activation (raising edge signal) or de-activation (falling edge signal) of the corresponding reset control device.

There shall not be more than one reset control device for each detection zone. If the press is safeguarded by means of side and back AOPDs, a reset control device shall be provided on each detection zone.

Any manual reset function shall not be delayed and have an immediate effect.

5.4.1.1.4 This subclause applies to presses fitted with protective devices or guards of the following types, namely:

— ESPE using AOPDs or AOPDDRs;

— interlocking guards and control guards;

— two-hand control devices used in production mode.

If a fault occurs in the safety-related parts of these protective devices or control system, then:

a) an unintended start-up shall not be possible;

b) the safe functioning of the protective device shall be maintained;

c) it shall be possible to stop the machine during the dangerous movement;

d) the control system shall stop the machine immediately during the dangerous phase of the closing stroke or, at the latest, at the end of the operating cycle;

e) the control system shall prevent any initiation of the next operating production cycle until the fault is eliminated.

In order to meet these requirements, the safety-related parts of the control systems shall conform to PL tables in the relevant parts of the ISO 16092 series.

This subclause does not apply to presses solely used with automatic feed and removal working in automatic cycle and fitted with an interlocking guard with guard locking (see 5.3.1).

5.4.1.1.5 Where a press is subject to considerable shock and vibration, the design of the control system shall take into account the requirements of the following:

a) ISO 12100:2010, 6.2.12.2;

b) ISO 4413:2010, 5.3.1;

c) ISO 4414:2010, 5.3.1;

d) IEC 60204-1:2016, 4.4.8 and 10.1.5.

5.4.1.1.6 Emergency stop function on actuation shall stop all hazardous machine functions, either as stop category 0 or 1 according to IEC 60204-1:2016, 9.2.2 and comply with the requirements of ISO 12100:2010, 6.3.5.2 and ISO 13850.

5.4.1.1.7 If a failure in one channel of a redundant system is self-revealing, i.e. the loss of the function itself prevents the next operating cycle, further monitoring of that channel is not required.

5.4.1.1.8 Means (e.g a push button) shall be provided to bring the machine to a complete stop (i.e. normal stop). The stop shall function as a stop category 0 or 1 according to IEC 60204-1:2016, 9.2.2.

The press's stop control shall have priority over the start controls.

5.4.2 Muting

Muting can be provided for, ESPE using AOPDs or AOPDDRs [see 5.3.2.12 b)] and two hand control devices. When muting is provided, the protective devices shall only be muted at a point in the opening stroke, or when the hazardous phase of the closing stroke is passed and there is no risk of injury. Muting shall not be allowed while hazardous movements including auxiliary movements are present within the tooling area. Trapping points at ejectors, die cushions and blanking holders shall be taken into account. The safeguarding system shall become operative again at least at the start of the closing stroke.

Muting shall only be provided by the following operation modes:

— single cycle;

— single cycle with AOPD single break;

— single cycle with AOPD double break.

Muting function shall conform to PL tables in the relevant parts of the ISO 16092 series.

5.4.3 Selection devices

5.4.3.1 Where there is a choice of operating modes, cycle initiation or safety system of the press (e.g. single stroke, inch or continuous, front or back, or front and back), selection devices shall be provided. For the performance level of the selection, see PL tables of the relevant parts of the ISO 16092 series. The control system shall ensure that no start-up or any other hazardous movement is initiated or continued when the selection device is operated.

"OFF"/"0" mode shall be provided to prevent initiation or continuation of any hazardous movement of the press such as slide, cushion, ejector movement.

5.4.3.2 Where one selection device is provided (e.g. selector switch or other selection functions as described in 5.4.3.7), it shall be used to select the operating mode together with the appropriate mode of safeguarding, which can be one or more guards or protective devices (see 5.3.2.2). Where mode of operation and mode of safeguarding can be selected separately, the control system shall ensure that the appropriate and corresponding mode(s) of safeguarding is (are) selected before initiating any operation.

5.4.3.3 If a press is also intended to be used according to 5.3.2.1 a) or b) and at the same time operated, e.g. by foot pedal switch, this mode of production shall be chosen by an additional selection device operated by a separate key or within a key locked enclosure or equivalent secure means according to IEC 60204-1:2016, 9.2.3.5. The selection of this mode shall automatically give a clear indication at the press that it shall be used only with closed tools or fixed enclosing guards.

5.4.3.4 Multiple operator selection. If there is more than one operator at the press, safeguarding device shall be provided for each operator. Where a number of two-hand controls or removable control stations are used, the press shall only be operable if the combination selected corresponds exactly to the combination physically connected to the press.

5.4.3.5 The access to the mode selection device shall only be possible from outside the hazardous areas. If access to other selection devices is necessary from inside a hazardous area, no hazardous situation shall arise due to operating the selection device.

5.4.3.6 Selector switches used for the selection of safety-related functions shall be key operated or key lockable or have equivalent secure means, according to IEC 60204-1:2016, 9.2.3.5. The selection shall be visible and clearly identifiable. If the key is removed, the selector switches shall be locked to avoid unauthorized operations. If the switch is set in an intermediate position, no operation shall be possible.

5.4.3.7 The requirements for selection devices other than selector switches are as follows.

The selection of a safety-related mode (e.g. operating mode, mode of cycle initiation or mode of safeguarding) shall be permitted only via an access system. The access system is not required to comply with any safety function and is out of the scope of the safety-related parts of the control system (see Figure 6).

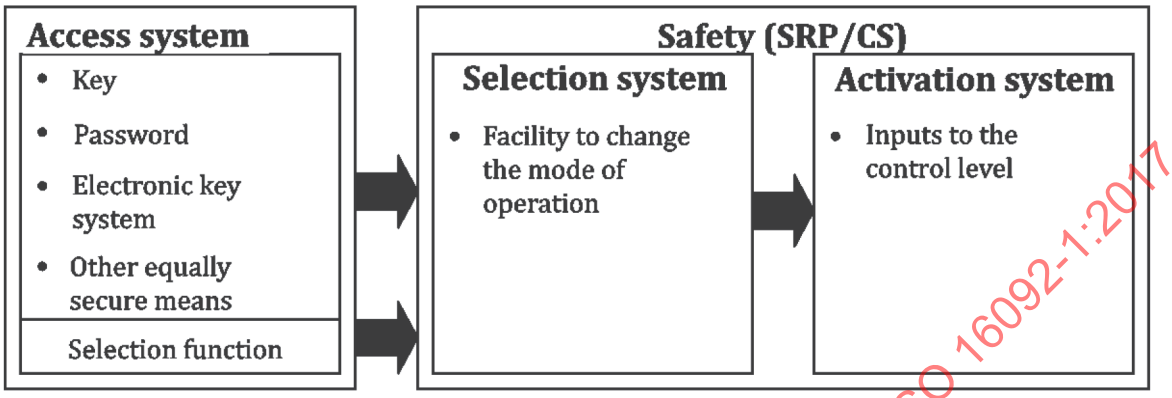


Figure 6 — Border between the access system and the safety system

The operating mode selection system and the associated activation systems shall ensure that only one operating mode is selected and enabled at any time.

The means of safeguarding and cycle initiation selection systems and the associated activation systems shall ensure that at least one safeguarding measure is selected and enabled at any time.

The selected operating mode shall be clearly visible, for example, by visual display on the operating panel, by coloured signal lamps, or a text on the user interface [human–machine interface (HMI)]. See also Annex E.

5.4.3.8 If more than one location (control console) is available for operating mode selection, a production shall only be permitted when the operating mode selection devices of all control consoles are set to a production mode (e.g. automatic mode).

5.4.4 Position sensors

The position sensors (for example, position switches, proximity sensors; see IEC 60204-1:2016, 10.1.4) and the means of their operation (for example, cam) shall be designed to maintain after setting their position, their mutually correct relationship with the operating means and particularly, the correct location relative to the stroke movement. When using a pneumatic or hydraulic valve as a position sensor, the same requirements shall be achieved.

5.4.5 Control devices

5.4.5.1 Push buttons, and start control devices shall be adequately designed and arranged to prevent accidental operation. Foot pedals switches shall be shrouded so as to permit access from one direction only and actuation by one foot only.

5.4.5.2 Emergency stop device shall be in accordance with ISO 13850 and IEC 60204-1:2016, 10.7.

5.4.5.3 There shall be at least one emergency stop button within direct reach of each operator. If an emergency stop device is incorporated in a removable control station, then at least one measure to indicate whether the emergency stop device is active or inactive shall be provided on this removable control station.

5.4.5.4 In order to avoid unintended start-up, portable pedestals or pendants incorporating start buttons shall be designed in accordance with IEC 60204-1:2016, 4.4.8, with regard to stability and support, and IEC 60204-1:2005, 10.6.

5.4.6 Valves

See the relevant parts of the ISO 16092 series.

5.4.7 Performance level of safety functions

See PL tables in the relevant parts of the ISO 16092 series.

5.5 Tool-setting, trial strokes, maintenance and lubrication

5.5.1 The machine shall be designed so that tool-setting, maintenance and lubrication can be carried out safely.

The need for access and manual intervention during setting and maintenance shall be minimized, e.g. an automatic system or remote application may be used for lubrication.

5.5.2 Means shall be provided to allow hazardous motions during tool-setting, maintenance and lubrication to be carried out with guards and protective devices in position and operational (see 5.3.2.1).

Where this is not practicable, the requirements specified in the relevant parts of the ISO 16092 series apply.

5.5.3 The safeguarding measures during trial strokes (single operating cycle) required for tool-setting or adjustment shall meet the requirements laid down in 5.3.

5.5.4 Manually adjustable feeder devices shall be capable of being set with the slide stationary.

5.5.5 Unless the protective devices used in normal production can be retained in use, the manufacturer shall provide control devices on each accessible side of the press so that at least one person at each side, with a clear sight of the access zone, is required to participate in initiation.

If, taking into account the intended use, it is foreseeable that more than one person can be on a side, additional devices (e.g. enabling devices, selector switches, warning signals) shall be provided.

5.5.6 If a moveable guard shall be opened during setting or maintenance, it shall be an interlocking guard (see ISO 14120:2015, 6.4.4.1). The stop function of the interlocking device shall conform to the required performance level given in PL tables in the relevant parts of the ISO 16092 series.

5.5.7 Two-hand control devices shall conform at least to type II in ISO 13851:2002, Table 1.

5.5.8 Two-hand control or hold-to-run control devices provided only for tool-setting shall be arranged in such a way as to be unsuitable for production. The requirements of ISO 12100:2010, 6.2.11.9 shall be fulfilled. Specific requirements are laid down in the relevant parts of the ISO 16092 series.

5.5.9 The interfacing between hold-to-run control devices, two-hand control devices and the operative parts of the control system shall conform to the required performance level given in PL tables in the relevant parts of the ISO 16092 series.

5.5.10 Periodic examinations shall be capable of being carried out with tools which are generally available or with special tools which are provided with the press.

NOTE See 7.4 for the requirements to be specified in the instructions handbook.

5.6 Mechanical hazards — Other

5.6.1 Drive and transmission machinery and ancillary devices, not safeguarded by means described in 5.3 and 5.5, which are an integral part of the press shall be at least safeguarded by means of the following:

a) fixed enclosing guards, where access is required once or less than once per shift (see ISO 14120:2015, 6.4.2 and 6.4.3);

b) movable interlocking guards, where access is required more than once per shift (see ISO 14120:2015, 6.4.2 and 6.4.4);

c) an interlocking guard with guard locking, if the dangerous movement does not come to a rest before the danger zone can be reached and where access is required more than once per shift (see ISO 14119:2013, 4.3).

The guards listed above are not required if the danger zone is out of reach because protected by fixed elements of the machine acting as fixed guards, and the safety distances are in compliance with ISO 13857:2008.

5.6.2 The safety-related parts of the control systems for interlocking devices (see ISO 14119) shall conform to PL tables in the relevant parts of the ISO 16092 series.

5.6.3 Ejection hazards created by machine components or parts of them shall be eliminated by design or by additional shielding, which are both capable of withstanding the foreseeable forces (see ISO 14120:2015, 8.1). See also 7.4.2 in relation to workpieces and tools.

5.6.4 If the press is equipped with a die cushion, it shall be used within the pressure rating of the unit. The surge tank on a pneumatic die cushion shall have a pressure relief valve installed to reduce the risk of unintended movements of the die cushion and the blank holder.

5.7 Slips, trips and falls

5.7.1 Where raised work stations are provided with the machine, they shall be provided with adequate guard rails and toe-boards. Safe means of access shall be provided to the work stations according to ISO 14122 (all parts).

5.7.2 All working areas on the press shall be designed, constructed and supplied so as to minimize the risk of slips, trips and falls (e.g. perforated sheet metal, antislip matting).

5.8 Protection against other hazards

5.8.1 Electrical hazards

All electrical equipment shall be designed and constructed to prevent electrical shock hazards in accordance with IEC 60204-1:2016, Clause 6.

5.8.2 Thermal hazards

Means such as shielding, insulation shall be provided to prevent burns by accessible parts of the press, which can exceed, the recommended temperature limit values specified in ISO 13732-1:2006, 4.2.1.2 and 4.2.1.3. Examples for shielding are given in ISO 13732-1:2006, Annex E.

5.8.3 High pressure fluid ejection hazards

Additional shielding, e.g. screens, hose in hose systems, shall be provided to flexible piping installed adjacent to an operator's working position to reduce the risk resulting from a failure in the flexible piping system.

5.8.4 Hazards generated by noise

5.8.4.1 The press shall be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source.

When designing a press, the information and technical measures to control noise at source given in ISO/TR 11688-1 shall be followed.

NOTE ISO/TR 11688-2 provides useful information on noise generation mechanisms in machinery.

5.8.4.2 The design shall take into account noise from each source. Appropriate technical measures for reducing noise at the main sound sources of the press are the following:

a) noise at the tools: damping means on the press;

b) workpiece ejection: silenced nozzles;

c) pneumatic exhaust: silencers;

d) feeding and transfer systems: acoustic enclosures, damping facilities;

e) structurally transmitted noise: anti-vibration machine mounts.

Additional or alternative measures giving identical or higher reduction efficiency can be used. In any case, declared noise emission values are the decisive criterion for the noise emission of a given machine. The manufacturer shall be able to supply the necessary information concerning the measures incorporated in order to reduce noise at source.

5.8.4.3 The measurement and declaration of noise emission values shall be made according to Annex F.

5.8.5 Hazards generated by vibration

The design of the press shall be such that vibration which can cause injury shall be avoided. This can be reached, for example, by isolation of the press from the floor and foundation conditions according to 7.4.2 g) and EN 1299.

5.8.6 Hazards generated by materials and substances

5.8.6.1 Hazardous substances shall not be used wherever possible in the construction of the press, and the use of materials which can cause injury or damage to health shall be eliminated (e.g. asbestos).

5.8.6.2 The formation of aerosols and respirable oil mists in unhealthy concentration shall be prevented, e.g. from oil used to lubricate pneumatic systems. Where this hazard cannot be eliminated, the press shall be equipped so that aerosols and respirable oil mists can be evacuated, filtered or treated by adequate means, e.g. extraction points.

5.8.7 Hazards generated by neglecting ergonomic principles

5.8.7.1 The press and its controls shall be designed to provide a good work posture which is not fatiguing.

5.8.7.2 The positioning, labelling and illumination (if necessary) of control devices and facilities for materials and tool set handling shall be in accordance with ergonomic principles.

5.8.7.3 Where necessary on the press, work stations and the zones in which control devices, guards and protective devices are located shall be lit sufficiently to ensure that all work equipment and materials can be properly seen, and that eye strain is also avoided.

5.8.7.4 Parts of the press, which weigh more than 25 kg and require to be lifted, shall include necessary attachments to accommodate the fitting of a lifting device.

NOTE Further guidance is given in IEC 60204–1, ISO 6385, ISO 9355-2, ISO 9355-3 and EN 1837.

6 Verification of the safety requirements and/or measures

The crosses in Table 1 indicate the method(s) by which the safety requirements and protective measures described in Clause 5, Clause 7 and Annex D shall be verified, together with a reference to the corresponding clauses/subclauses in this document.

Table 1 — Safety requirements and/or measures to be verified

Clauses/ subclauses	Safety requirements and/or measures	Visual inspection[a]	Performance check/ test[b]	Measurement[c]	Drawings/ calculations/ technical data[d]
5.2	Basic design considerations				
5.2.1	Hydraulic and pneumatic systems — Common features				
5.2.1.2	Filters	x			x
5.2.1.3	Pressure range devices	x	x		x
5.2.1.4	Transparent bowls	x			
5.2.1.5	Pipes and pipe connections/burrs or foreign matters	x			x
5.2.1.6	Continuous piping	x			
	Thermal expansion	x	x		
	Rigid piping support	x			x
	Kinking of flexible pipes	x	x	x	
5.2.1.7	Pipes and pipe connections	x			x
5.2.1.8	Operating valve support	x			x
5.2.1.9	Control valves and other control components location	x			x
5.2.1.10	Valve restoring	x	x		x
5.2.2	Pneumatic systems				
5.2.2.1	Decompression to ambient	x			x
5.2.2.2	Lubrication	x			x
5.2.2.3	Non-clogging silencers	x	x		x

[a] Visual inspection is used to verify the features necessary for the requirement by visual examination of the components supplied

[b] A performance check/test verifies that the features provided perform their function in such a way that the requirement is met

[c] Measurement verifies, by the use of instruments, that requirements are met to the specified limits.

[d] Drawings/calculations/technical data verifies that the design characteristics of the components provided meet the requirements.

Table 1 *(continued)*

Clauses/ subclauses	Safety requirements and/or measures	Visual inspection[a]	Performance check/ test[b]	Measurement[c]	Drawings/ calculations/ technical data[d]
5.2.2.4	Water separators	x			x
5.2.3	Hydraulic systems				
5.2.3.1	Pressure relief valve	x	x		x
	Trapped air release	x	x		x
5.2.3.2	Escaping fluid	x			x
5.2.3.3	Accumulators discharge	x	x		x
5.2.4	Electrical systems				
5.2.4.1	Compliance with IEC 60204–1	x		x	x
5.2.4.2	Limits of the electrical supply	x			x
5.2.4.3	Protection of operator interface	x			x
5.2.4.4	Protection of enclosures	x			x
5.3	Mechanical hazards in the tools area				
5.3.2	Safeguarding measures				
5.3.2.2	Protection of all exposed persons	x			x
5.3.2.3	Protective device, part of the press	x	x		x
5.3.2.4	Protection on each side	x			x
5.3.2.5	Closed tools	x	x	x	
5.3.2.6	Fixed enclosing guards	x	x	x	x
5.3.2.7	Interlocking guards and control guards	x	x	x	x
5.3.2.8	Early opening feature	x	x	x	x
5.3.2.9	Control guards: stroke length ≤ 600 mm and table depth ≤ 1 000 mm	x		x	x
5.3.2.10 a)	Guards in 5.3.2.7 with guard locking	x	x		x
5.3.2.10 b)	Guards in 5.3.2.7 without guard locking	x	x	x	x
5.3.2.11	ESPE using AOPD in the form of light curtain				
5.3.2.11 a)	Type 4 IEC 61496–1	x			
5.3.2.11 b)	Possible access	x	x	x	
5.3.2.11 c)	Possible standing position	x	x	x	
5.3.2.11 d)	Initiation prevention	x	x		x
5.3.2.11 e)	Additional reflectors, safeguarding	x	x	x	
5.3.2.11 f)	Single/double break	x	x		x
5.3.2.11 f), 1)	Height: ≥ 750 mm, additional guards	x		x	
5.3.2.11 f), 2)	Stroke length ≤ 600 mm and table depth ≤ 1 000 mm	x		x	

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Table 1 *(continued)*

Clauses/ subclauses	Safety requirements and/or measures	Visual inspection[a]	Performance check/ test[b]	Measurement[c]	Drawings/ calculations/ technical data[d]
5.3.2.11 f), 3)	Detection capability ≤ 30 mm	x	x	x	x
5.3.2.11 f), 4)	Before first cycle reset function	x	x		x
5.3.2.11 f), 5)	Pre-set time ≤ 30 s		x	x	
5.3.2.11 f), 6)	Cycle initiation by one AOPD only		x		x
5.3.2.12	Two-hand control devices				
5.3.2.12 a)	Type III C	x	x	x	
5.3.2.12 b)	Horizontal opening	x	x		x
5.3.2.12 c)	One device for each operator	x	x		x
5.3.2.13	Interlocking guards without guard locking	x	x	x	x
5.3.2.14	Prevention of unintended restart	x	x		x
5.3.3	Other safety requirements				
5.3.3.1	Tool securing	x	x		x
5.3.3.2	Fastenings	x			x
5.3.3.3	Adjustment locking	x	x		
5.3.3.4	Leading edge of a coil	x	x		x
5.3.3.4 a)	Hold-to-run control device and slow speed	x	x	x	x
5.3.3.4 b)	Inching device	x	x	x	x
5.3.4	Release of trapped persons between the tools	x	x		x
5.3.5	Release of persons trapped inside enclosed areas				
	Escape release of guard locking	x	x		x
	Emergency release of guard locking	x	x		x
5.3.6	Prevention of gravity fall during maintenance or repair	x	x		x
5.4	The control and monitoring system				
5.4.1	Control and monitoring functions				
5.4.1.1.1	General control and monitoring functions	x	x	x	
5.4.1.1.2	Re-actuation of controls	x	x		x
5.4.1.1.3	Manual reset functions	x	x		x
5.4.1.1.4	Fail-safe condition, redundant and monitored functions	x	x		x
5.4.1.1.5	Shock and vibration		x	x	

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[d] Drawings/calculations/technical data verifies that the design characteristics of the components provided meet the requirements.

Table 1 *(continued)*

Clauses/ subclauses	Safety requirements and/or measures	Visual inspection[a]	Performance check/ test[b]	Measurement[c]	Drawings/ calculations/ technical data[d]
5.4.1.1.6	Emergency stop function		x		x
5.4.1.1.7	Self-revealing		x		x
5.4.1.1.8	Press stop control	x	x	x	x
5.4.2	Muting				
	All dangerous movement passed	x	x		x
5.4.3	Selection devices				
5.4.3.1	No start-up when operating	x	x		x
	OFF mode functional	x	x		x
5.4.3.2	Selection of safeguarding modes	x	x		
	Corresponding modes	x	x		
5.4.3.3	Closed tools/fixed enclosing guards, indication	x	x		x
5.4.3.4	Multiple operator selection	x	x		x
5.4.3.5	Access from outside the hazardous areas	x	x		
5.4.3.6	Key operated selector switches	x	x		
5.4.3.7	Operating/safeguarding mode selection	x	x		
5.4.3.8	Automatic mode selection	x	x		
5.4.4	Position sensors				
	Relationship	x	x	x	x

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Table 1 *(continued)*

Clauses/ subclauses	Safety requirements and/or measures	Visual inspection[a]	Performance check/ test[b]	Measurement[c]	Drawings/ calculations/ technical data[d]
5.4.5	Control devices				
5.4.5.1	Adequate shrouding	x	x	x	
5.4.5.2	Emergency stop device	x	x		x
5.4.5.3	Emergency stop buttons location	x	x	x	x
5.4.5.4	Portable start buttons	x	x		
5.5	Tool-setting, trial strokes, maintenance, lubrication				
5.5.1	Minimized need for access	x	x		
5.5.2	Movement of the slide/ram with guards and protective devices operational according to 5.3.2.2	x			x
5.5.3	Trial strokes	x	x		x
5.5.4	Feeder devices	x	x		x
5.5.5	Control devices on accessible sides	x	x		x
	Clear sight	x			
	Additional devices	x	x		
5.5.6	Interlocking guard	x	x		x
	Direct opening switch	x	x		
	Interfacing	x	x		x
5.5.7	Two-hand control devices of type II	x	x		x
5.5.8	Control devices for tool-setting	x	x	x	
5.5.9	Interfacing	x	x		x
5.5.10	Periodic examinations	x	x		
5.6	Mechanical hazards — Other				
5.6.1	Drive and transmission machinery and ancillary devices				
5.6.1 a)	Fixed guards	x	x	x	x
5.6.1 b)	Movable interlocking guards	x	x	x	x
5.6.1 c)	Interlocking guards with guard locking device	x	x	x	x
5.6.2	PL of interlocking devices	x	x		x
5.6.3	Ejection hazards	x	x		x
5.6.4	Die cushion	x	x	x	x
5.7	Slips, trips and falls				
5.7.1	Guard rails and toe-boards	x	x	x	x
	Means of access	x	x	x	
5.7.2	Press area	x			
5.8	Protection against other hazards				

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[d] Drawings/calculations/technical data verifies that the design characteristics of the components provided meet the requirements.

Table 1 *(continued)*

Clauses/ subclauses	Safety requirements and/or measures	Visual inspection[a]	Performance check/ test[b]	Measurement[c]	Drawings/ calculations/ technical data[d]
5.8.1	Electrical hazards	x	x	x	x
5.8.2	Thermal hazards	x	x	x	x
5.8.3	High pressure fluid ejection hazards	x	x		
5.8.4	Hazards generated by noise	x	x	x	x
5.8.5	Hazards generated by vibration	x	x	x	x
5.8.6	Hazards generated by materials and substances	x	x	x	x
5.8.7	Hazards generated by neglecting ergonomic principles	x	x	x	x
7	Information for use	x			
7.1	General information for use				
7.2	Marking	x			
7.3	Warnings	x			
7.4	Instructions handbook	x			
Annex D	Calculation of minimum distances	x	x	x	x

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[d] Drawings/calculations/technical data verifies that the design characteristics of the components provided meet the requirements.

7 Information for use

7.1 General

Information for use shall be provided in accordance with ISO 12100:2010, 6.4.

7.2 Marking

The press shall be marked with the following:

a) name and address of the manufacturer and, where applicable, business name and full address of the authorized representative;

b) designation of the machinery;

c) year of construction;

d) mandatory marking;

NOTE 1 Each country can have specific mandatory marking.

NOTE 2 For presses and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European directive(s), e.g. Machinery.

e) serial number;

f) designation of series or type;

g) mass of the press, without tools or ancillary devices;

h) lifting points for transportation and installation purposes;

i) nominal force;

j) maximum stroke length;

k) maximum tool dimensions and mass;

l) supply data for electrical, hydraulic and pneumatic systems (e.g. minimum pneumatic pressure);

m) overall system stopping performance or stopping time of the slide including response time of the control system of the press and corresponding minimum distance(s);

n) any limitation on the type of protective device(s) and mode of operation, e.g. only closed tools.

7.3 Warnings

If provided, audible warning shall be according to ISO 7731 and visual danger signals shall be according to ISO 11428.

7.4 Instructions handbook

7.4.1 The manufacturer shall provide an instructions handbook in accordance with ISO 12100:2010, 6.4.5.

7.4.2 The instructions handbook shall include the following information:

a) repeat of the information with which the press is marked (see 7.2);

b) intended use and reasonably foreseeable misuse and prohibited applications

c) documents attesting that the machine complies with mandatory requirements;

d) general description of the press;

e) drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the press and for checking its correct functioning;

f) description of the work station;

g) instructions for safe transport, mounting, installation and dismounting (floor and foundation conditions, services, anti-vibration mountings, handling conditions, etc.);

h) instructions for how the initial test and examination of the press and guarding system shall be carried out before first use and being taken into service;

i) instructions on control systems including circuit diagrams for electrical, hydraulic and pneumatic systems. Where a PES or PPS is provided, the circuit diagrams shall show the clear relationship at the interface between any hardwired part and the PES or PPS;

j) information on noise levels likely to be generated during the noise test (see 5.8.4 and Annex F) with the following warning: “WARNING: noise emission values obtained using the noise test code in Annex F of ISO 16092-1 are likely to underestimate the noise emitted by the press in real operating conditions.”;

k) details of any further protection for the operator which is necessary to deal with residual risks, e.g. hearing protection, eye protection or foot protection;

l) information on the protective measures against hazards from dust or aerosols or respirable oil mists;

m) instructions for safe use, selection of modes of operation, initiation and the operator's protective system (in particular, where closed tools or fixed enclosing guards are allowed or several operators can control the press including the need to disconnect any control station not in use in any particular two-hand control station) setting, trial strokes, maintenance, (with specification of the spare parts to be used when these affect the health and safety of the operator), cleaning and programming (where required) on avoidance of danger from all hazards, including ejection hazards created by workpieces, tools or parts of them, fluids, linings, etc.;

If hazardous movements of die functions (e.g. part lifters, cores, ejectors) are controlled by the press control and their output elements (e.g. valve, contactor, current converter) are provided as a part of the press, the press manufacturer shall state the PL and the category in accordance with ISO 13849-1, which the press control for the die functions fulfils.

n) particular training and information needed by persons who are appointed to prepare presses for use, including suitable and sufficient instruction in:

— press mechanisms;

— protective devices;

— accident causation and prevention;

— the work of the tool-setter;

— tool design;

— use of closed tools and fixed enclosing guards (see 5.3.2.6);

— suitable and sufficient instruction in the maintenance of fluid quality and filter changes;

o) details of any pre-production inspection of the guard or protective device required after tool-setting or adjustment of the tools;

p) specification for any fluid to be used in hydraulic systems and for lubrication, braking or transmission system;

q) descriptions of foreseeable failure modes and advice on detection, prevention and correction by periodic maintenance;

r) instructions for any test or examination necessary after repair of the press which can affect the safety functions;

s) instructions for periodic maintenance, test and examination of the press, guards and protective devices, including maintenance, testing and examination intervals (see 5.5.10);

t) instructions for the use of the means for releasing trapped persons (see 5.3.4);

u) Information about the restriction of manual loading and unloading (see 5.3.2.3).

It is recommended that check lists be prepared for the operations covered by items h), o) and s). In particular, for the safety examinations, there shall be a specific check list which can be signed by the examiner.

Annex A
(informative)

Significant hazards, hazardous situations and protective measures

Annex A contains the significant hazards, hazardous situations and events identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk. See Table A.1.

Table A.1 — Significant hazards, hazardous situations and protective measures

ISO 12100:2010, Annex B	Origin of hazards	Hazardous situations on presses	Relevant clauses/ subclauses in this document
1 Mechanical hazards			
B.1	Cutting parts	Tooling	7.3, 7.4.2
B.1	Elastic elements	Maintenance on hydraulic and pneumatic elements	5.2.1, 5.2.2, 5.2.3, 5.8.3, 7.3, 7.4.2
B.1	Falling objects	Falling of workpiece	5.6.4, 7.3, 7.4.2
B.1	Gravity	Maintenance or repair/setting of the slide/ram	5.3.6, 7.3
B.1	Height from the ground	Maintenance, repair on the top of the press	5.5.1, 5.7, 7.3
B.1	High pressure	Maintenance on hydraulic and pneumatic elements	5.2.1, 5.2.2, 5.6.4, 5.8.3, 7.3
B.1	Instability	Transport, installation, operation for unfixed machines	7.2, 7.3
B.1	Kinetic energy	See ISO 16092-2	5.3, 7.3
B.1	Moving elements	All operations	5.3, 5.4, 5.5, 5.6, 7.3
B.1	Rotating elements	See ISO 16092-2	5.3, 5.4, 7.3
B.1	Rough, slippery surface	Maintenance, repair	5.7.2, 7.3
B.1	Stored energy	Maintenance on hydraulic and pneumatic elements, variable speed drives	5.2, 7.3
2 Electrical hazards			
B.1	Arc Electromagnetic phenomena Electrostatic phenomena Live parts Overload Parts which have become live under fault conditions Short circuit Thermal radiation	Setting, machining and maintenance	5.8.1, 7.3

Table A.1 *(continued)*

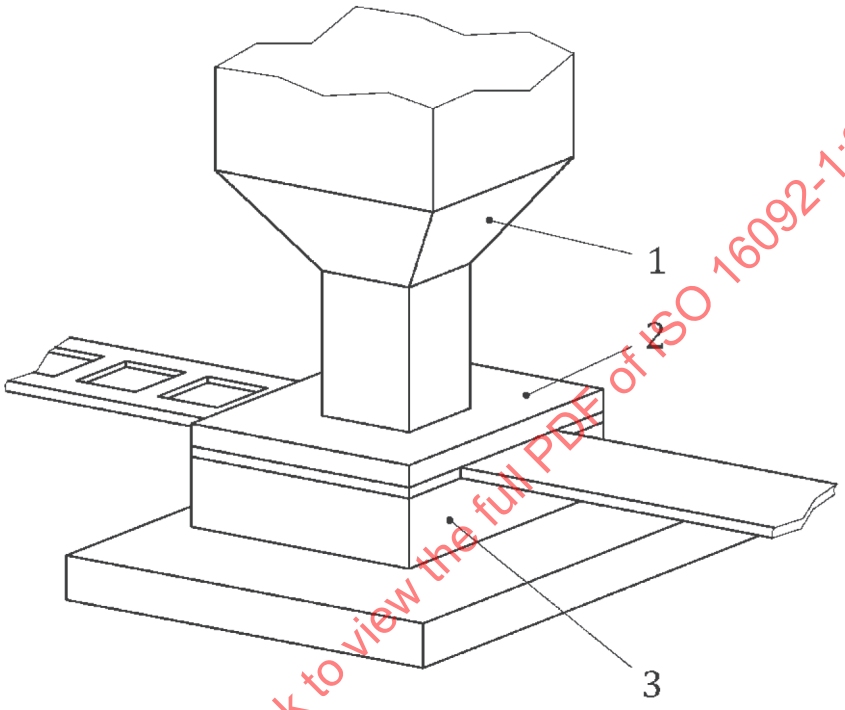
ISO 12100:2010, Annex B	Origin of hazards	Hazardous situations on presses	Relevant clauses/ subclauses in this document
3 Thermal hazards			
B.1	Objects or materials with a high or low temperature Radiation from heat sources	Hot tools, machine parts and workpiece	5.8.2, 7.3, 7.4.2
4 Noise hazards			
B.1	Cavitation phenomena Exhausting system Gas leaking at high speed Manufacturing process (stamping, cutting, etc.) Moving parts Scraping surfaces Unbalanced rotating parts Whistling pneumatics Worn parts	All modes of operation and maintenance situation	5.8.4, 7.3
5 Vibration hazards			
B.1	Cavitation phenomena Misalignment of moving parts Mobile equipment Scraping surfaces Unbalanced rotating parts Worn parts	All modes of operation and maintenance situation	5.8.5, 7.3
6 Material substance hazards			
B.1	Dust Fluid Mist	All modes of operation and maintenance situation	5.8.6, 7.3

Table A.1 *(continued)*

ISO 12100:2010, Annex B	Origin of hazards	Hazardous situations on presses	Relevant clauses/ subclauses in this document
7 Ergonomic hazards			
	Access Design or location of indicators and visual displays units Design, location or identification of control devices		
B.1	Effort Flicker, dazzling, shadow, stroboscopic effect Local lighting Mental overload/underload Posture Repetitive activity Visibility	All modes of operation and maintenance situation	5.3.2, 5.3.3, 5.4, 5.5.1, 5.5.7, 5.5.8, 5.8.7, 7.3
8 Hazards associated with environment in which the machine is used			
B.1	Dust and fog Electromagnetic disturbance Moisture Pollution Temperature Water	All modes of operation and maintenance situation	7.3, 7.4.1

Annex B
(informative)

Closed tools



Key

1 tools
2 stripper plate
3 die

Figure B.1 — Closed tools at a mechanical press

The use of closed tools is usually practicable when blanking operations from strip are carried out and when more than one operation is combined in a single set of tools. Enclosure can be achieved by arranging for the stripper plate, which is attached to the die, to be sufficiently thick to prevent the tool from being withdrawn from it (see 5.3.2.3 and 5.3.2.5).