
**Machine tools safety — Presses —
Part 3:
Safety requirements for hydraulic
presses**

Sécurité des machines-outils — Presses —

Partie 3: Exigences de sécurité pour les presses hydrauliques

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO 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).

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This document was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 10, *Safety*.

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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.

It 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 by the above-mentioned stakeholder groups by means of this document:

- 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 in 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 in addition to ISO 16092-1.

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Machine tools safety — Presses —

Part 3: Safety requirements for hydraulic presses

1 Scope

This document, in addition to ISO 16092-1, specifies the technical safety requirements and measures to be adopted by persons undertaking the design, manufacture and supply of hydraulic presses which are intended to work cold metal or material partly made up of cold metal.

The presses covered by this document 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 complex workpieces.

This document deals with all significant hazards relevant for hydraulic presses when they are used as intended and under the conditions of misuse which are reasonably foreseeable by the manufacturer (see [Clause 4](#)). All the phases of the lifetime of the machinery as described in ISO 12100:2010, 5.4 have been taken into consideration.

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2 Normative references (standards.iteh.ai)

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

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

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 16092-1:2017, *Machine tools safety — Presses — Part 1: General safety requirements*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 13849-1:2015, ISO 16092-1:2017 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

restraint valve

device which protects against a gravity fall of the slide/ram

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events 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 ISO 16092-1:2017, Table 1. Additional hazards are listed in [Annex A, Table A.1](#).

5 Safety requirements and/or measures

5.1 General

Hydraulic presses shall comply with the safety requirements and/or protective/risk reduction measures of this clause. In addition, the machine shall be designed according to the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

5.2 Basic design considerations

5.2.1 Hydraulic and pneumatic systems — Common features

ISO 16092-1:2017, 5.2.1 shall apply.

5.2.2 Pneumatic systems

ISO 16092-1:2017, 5.2.2 shall apply.

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5.2.3 Hydraulic systems

[ISO 16092-3:2017](https://standards.iteh.ai/catalog/standards/sist/3a896023-73dc-4ebd-8a6d-16092-1:2017/5.2.3)
<https://standards.iteh.ai/catalog/standards/sist/3a896023-73dc-4ebd-8a6d-16092-1:2017/5.2.3>

In addition to requirements given in ISO 16092-1:2017, 5.2.3, the following shall apply.

5.2.3.1 Controlled gravity descent may be a deliberate design feature to facilitate rapid closing of the tools.

In such a case, all the oil in the cylinder supporting the slide/ram shall be passed through the main control valve or valves in a redundant and monitored system (see [Table 1](#) and/or [Table 2](#)).

5.2.3.2 The circuit shall be protected by pressure limiting valves. These valves shall not be capable of alteration without the use of a tool. Also, they shall be set at a pressure which is no more than 10 % higher than the maximum operating pressure.

5.2.3.3 For down-stroking presses, provision shall be made to protect the cylinder and components containing the fluid in the lower part of the cylinder from damage due to pressure intensification. A relief valve used for this purpose shall be direct operated, sealed and locked against unauthorised adjustment, and shall be set at a pressure at least 10 % above the maximum system pressure so that it only opens in the case of a fault. The components it protects shall be designed to withstand the pressure at which the valve is set. The relief valve shall be constructed so that, if a single break in the spring occurs, the space between the windings remains less than one wire thickness. The spring shall be guided so as to maintain the function of the relief valve.

5.2.4 Electric systems

ISO 16092-1:2017, 5.2.4 shall apply.

5.3 Mechanical hazards in the tools area

5.3.1 Major danger zone

ISO 16092-1:2017, 5.3.1 shall apply.

5.3.2 Safeguarding measures

In addition to requirements given in ISO 16092-1:2017, 5.3.2, the following shall apply.

Slow closing speed used in combination with hold-to-run control devices shall not exceed 10 mm/s. The speed shall not be limited by adjustment of variable parameters (see [Tables 1, 2](#) and [Annex F](#)). The hold-to-run control device shall consist of a single button/foot-pedal and shall fulfil the requirements of IEC 60947-5-8. For foot-pedals, the force shall not exceed 350 N for switching from position 2 to position 3.

5.3.3 Other safety requirements

ISO 16092-1:2017, 5.3.3 shall apply.

5.3.4 Release of trapped persons between the tools

ISO 16092-1:2017, 5.3.4 shall apply.

5.3.5 Release of persons trapped inside enclosed areas

ISO 16092-1:2017, 5.3.5 shall apply.

5.3.6 Prevention of gravity fall during maintenance or repair

In addition to requirements given in ISO 16092-1:2017, 5.3.6, the following shall apply.

5.3.6.1 On presses with an opening stroke length of more than 500 mm and a depth of table of more than 800 mm, a mechanical restraint device shall be permanently fixed and integrated with the press. It can be manually operated.

If an integrated device, when active, cannot be easily seen from the operator's position, an additional clear indication of the position of the device shall be provided.

5.3.6.2 Where the restraint device is provided as protection during production and is mechanically linked to a main guard which needs to be removed for maintenance purposes, additional mechanical restraint devices, which can be manually positioned where necessary, shall be provided.

5.3.7 Prevention of unintended gravity fall during production (down-stroking press)

5.3.7.1 Measures shall be provided to prevent an unintended gravity fall of the slide/ram in the production mode with manual or automatic feed or removal, see [Tables 1](#) and [2](#). Such a fall can be due to a failure of the hydraulic system, mechanical failure or a failure of the electrical control system. In this case:

- a mechanical restraint device, or
- a hydraulic restraint device, as defined in [5.3.7.2](#), or
- a combination of a single valve hydraulic restraint device and a mechanical restraint device shall be provided.

The restraint devices shall operate automatically and shall be effective whenever the tool is stopped and operator access to the tools is possible.

5.3.7.2 Where mechanical restraint devices are not used, hydraulic restraint devices shall consist of either:

- a) two separate hold-up or return cylinders each with a hydraulic restraint valve, capable of independently holding the slide/ram, or
- b) two hydraulic restraint valves, one of which is fitted as close as possible to the cylinder outlet, using flanged or welded pipework, capable of holding the slide/ram.

NOTE Further requirements are given in [Tables 1](#) and [2](#).

5.3.7.3 On a press made solely for:

- automatic operation in conjunction with interlocking guards with guard locking, or
- use with closed tools, or
- use with fixed enclosing guards,

a single valve hydraulic restraint device, or a mechanical restraint device, shall be provided as a minimum.

5.3.7.4 There shall be a system for monitoring that the restraint system as defined in [5.3.7.1](#) is functioning correctly, and no press stroke shall be possible after any part of the system has failed (see [Tables 1, 2](#) and [Annex D, Figure D.1](#)).

5.3.7.5 Requirements for prevention of unintended strokes are laid down in [Tables 1, 2](#) and ISO 16092-1:2017, 5.4.1.2 to 5.4.1.4.

5.4 Control and monitoring system

5.4.1 Control and monitoring functions

In addition to requirements given in ISO 16092-1:2017, 5.4.1, the following control and monitoring functions shall apply.

Power interlocking as defined in ISO 14119:2013, 3.31, may be provided for presses fitted with interlocking guards. The guard interlocking device shall be positively linked with the manually actuated valve to reverse or cut off directly the flow of hydraulic fluid to and from the actuator.

NOTE For examples of power interlocking, see [Figure D.2](#) and ISO 14119.

5.4.2 Muting

In addition to requirements given in ISO 16092-1:2017, 5.4.2, the following shall apply.

The means for setting the point at which the safeguarding system is muted during the closing stroke shall be:

- a position signal, and
- a pressure signal or suitable alternative, signals which actuate when the tools are closed and the machine begins to apply the force.

5.4.3 Selection devices

ISO 16092-1:2017, 5.4.3 shall apply.

5.4.4 Position sensors

ISO 16092-1:2017, 5.4.4 shall apply.

5.4.5 Control devices

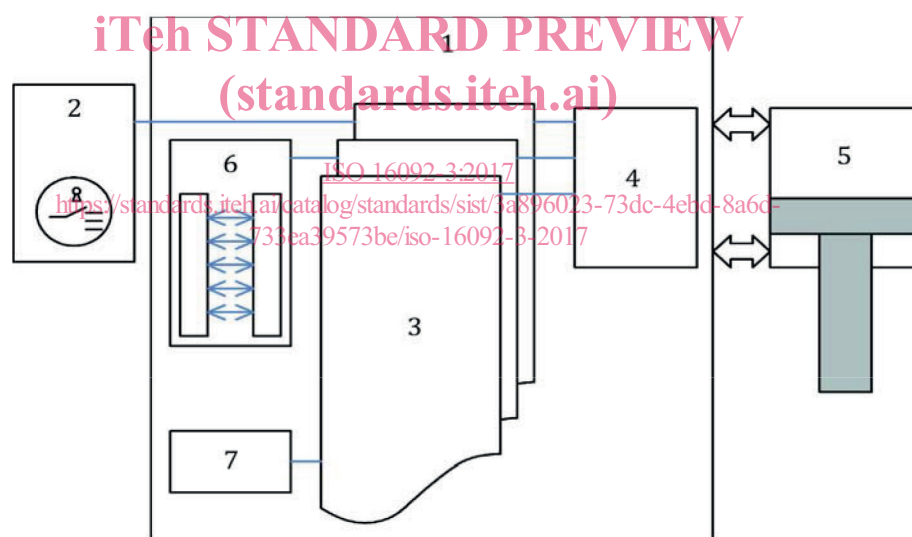
ISO 16092-1:2017, 5.4.5 shall apply.

5.4.6 Valves

Manual override devices shall not be fitted to restraint valves. If manual override devices are incorporated into other valves for test or maintenance purposes, they shall require the use of a tool to operate the override.

5.4.7 Performance level of safety functions

Safety functions of hydraulic press shall meet the requirements stated in the [Tables 1](#) and [2](#). [Figure 1](#) shows an example of all relevant parts of control system of hydraulic press with a safety function to stop down stroke of the slide by ESPE using AOPD.



Key

- 1 overall SRP/CS of a safety function “Stop slide down stroke by ESPE using AOPD”
- 2 selector switch – modes of operation and mode of safeguarding
- 3 “Logic”: control parts (Plausibility check of selection, Logic of AOPD, Logic of muting...)
- 4 output: hydraulic safety related part
- 5 hydraulic actuator
- 6 “Input”: ESPE using AOPD
- 7 “Input”: muting sensors, muting the ESPE during non-hazardous opening stroke

Figure 1 — Example of a safety function with all relevant safety related parts

The performance levels in [Tables 1](#) and [2](#) are the minimum required performance levels and already take the probability of occurrence into account.

Table 1 — Summary of requirements for the operator safeguarding of the danger zones at the tools, die cushions, work-piece ejectors and transfer systems areas (see ISO 16092-1:2017, 5.3.1) for different modes of operation — Mode of production: Single cycle, manual feed or removal

Main safety system	Hazardous movement	Safety function	Minimum required PL (PLr) for safety function and I, L and O	Basis for the design of input, logic, output of safety function			
				Requirement for category of Input, Logic and Output ^a	I – Input (sensor area)	L – Logic (control)	O – Output (pre-actuator)
Closed tools used as the only means of protection [see ISO 16092-1:2017, 5.3.2.1 a)]	Movement (e.g. closing stroke) of the slide, die cushions, (work-piece) ejectors	Cycle initiation/ Stop	PL a	Cat B	Any ^g	Any	Hydraulic system (see 5.2.3)
		Cycle initiation/ Stop	PL a	Cat B	Any ^g	Any	
Fixed enclosing guard used as the only means of protection [see ISO 16092-1:2017, 5.3.2.1 b)]	Movements of the slide, die cushions, work-piece ejectors and transfer systems	Cycle initiation/ Stop	PL a	Cat B	Any ^g	Any	Monitored hydraulic valves (see 5.3.7.2 and 5.3.7.4)
		Hold to run control	PL d	Cat 3	2 electromechanical contacts ^{g h}	Safety related logic	
Slow closing speed and hold to run control for a press solely made for this use [see ISO 16092-1:2017, 5.3.2.1 h) and 5.3.2.1]	Movement (e.g. closing stroke) of the slide, die cushions, work-piece ejectors	Slow closing speed	PL d	Fault exclusion	No Input (Permanent limitation of speed by hydraulic means)	No Logic (Permanent limitation of speed by hydraulic means)	

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Table 1 (continued)

Main safety system	Hazardous movement	Safety function	Minimum required PL (PLr) for safety function and I, L and O	Basis for the design of input, logic, output of safety function			
				Requirement for category of Input, Logic and Output ^a	I – Input (sensor area)	L – Logic (control)	O – Output (pre-actuator)
Slow closing speed and hold to run control for a press where the speed exceeds 10 mm/s in other operating modes [see ISO 16092-1:2017, 5.3.2.1 h) and 5.3.2.1]	Movement (e.g. closing stroke) of the slide, die cushions, work-piece ejectors	Hold to run control	PL d	Cat 3	2 electromechanical contacts ^{g h}	Safety related logic	Monitored hydraulic valves (see 5.3.7.2 and 5.3.7.4)
		Slow closing speed	PL d	Cat 2 ^k	No specific input (Slow closing speed control system is mainly enabled by selection means function)	Safety related logic ^l	Monitored hydraulic valve ^l in combination with permanent 10 mm/s speed limitation hydraulic device or flow limiting valve permitting fault exclusion (e.g. an orifice) shall be used (see ISO 13849-2:2009, Table C.5)
Interlocking guard with or without guard locking (with or without early opening feature) or control guard (with or without early opening feature) [see ISO 16092-1:2017, 5.3.2.1 c), d) and e)]	Movements (e.g. closing stroke) of the slide and die cushions	Cycle initiation by other control device than the guard	PL a	Cat B	Any but not actuated by the guard itself	Any	Logic control shall act on the appropriate part of the electrical control system
		Cycle initiation by control guard	PL e ^{b c}	Cat 4	Interlocking device of the guard	Safety related logic	Safety related electrical control system
		Stop by interlocking device of guard without guard locking [see ISO 16092-1:2017, 5.3.2.7 and 5.3.2.10 b)]	PL e ^{b c}	Cat 4	Interlocking device (2 sensors or equivalent solution) ^{e f}	Safety related logic	Hydraulic system (see 5.2.3 and 5.3.7.4)

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Table 1 (continued)

Main safety system	Hazardous movement	Safety function	Minimum required PL (PLr) for safety function and I, L and O	Basis for the design of input, logic, output of safety function			
				Requirement for category of Input, Logic and Output ^a	I – Input (sensor area)	L – Logic (control)	O – Output (pre-actuator)
Interlocking guard with or without guard locking (with or without early opening feature) or control guard (with or without early opening feature) [see ISO 16092-1:2017, 5.3.2.1 c), d) and e)]	Movements (e.g. closing stroke) of the slide and die cushions	Stop by interlocking device of guard with guard locking [see ISO 16092-1:2017, 5.3.2.7 and 5.3.2.10 a)]	PL e b c	Cat 4	Interlocking device of guard with sensors or equivalent solution) ^{e f}	Safety related logic	Hydraulic system (see 5.2.3 and 5.3.7.4)
Interlocking guard with or without guard locking (with or without early opening feature) or control guard (with or without early opening feature) [see ISO 16092-1:2017, 5.3.2.1 c), d) and e)]	Movements (e.g. closing stroke) of the slide and die cushions	Prevention of restart by an additional safeguarding of a control guard by AOPD (see ISO 16092-1:2017, 5.3.2.9)	PL d	Cat 3	AOPD	Safety related logic	Logic control shall act on the appropriate part of the electrical control system

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Table 1 (continued)

Main safety system	Hazardous movement	Safety function	Minimum required PL (PLr) for safety function and I, L and O	Requirement for category of Input, Logic and Output ^a	Basis for the design of input, logic, output of safety function		
					I – Input (sensor area)	L – Logic (control)	O – Output (pre-actuator)
Interlocking guard with or without guard locking (with feature) or control guard (with or without early opening feature) [see ISO 16092-1:2017, 5.3.2.1 c), d) and e)]	Movements (e.g. closing stroke) of the slide and die cushions	Prevention of restart by an additional safeguarding of a control guard by interlocking guard (see ISO 16092-1:2017, 5.3.2.9)	PL c	Cat 1 for Input, Cat 3 for Logic and Output	Interlocking device	Safety related logic	Logic control shall act on the appropriate part of the electrical control system
	Movements of work-piece ejectors and transfer systems	Stop by interlocking device of guard without guard locking [see ISO 16092-1:2017, 5.3.2.7 and 5.3.2.10 b)]	PL db d https://standards.iteh.ai/catalog/standards/sist/3a896023-73dc-4ebd-8a6c-733ea39573be/iso-16092-3-2017	Cat 3	Interlocking device (2 sensors or equivalent solution) ^{e f}	Safety related logic	Hydraulic or pneumatic system
Interlocking guard with or without guard locking (with feature) or control guard (with or without early opening feature) [see ISO 16092-1:2017, 5.3.2.1 c), d) and e)]	Movements of work-piece ejectors and transfer systems	Prevention of restart by an additional safeguarding of a control guard by AOPD (see ISO 16092-1:2017, 5.3.2.9)	PL d	Cat 3	Interlocking device of guard with guard locking (2 sensors or equivalent solution) ^{e f}	Safety related logic	Logic control shall act on the appropriate part of the electrical control system