BRITISH STANDARD

BS EN
693:2001

Machine tools — Safety — Hydraulic presses

The European Standard EN 693:2001 has the status of a British Standard

ICS 25.120.10

National foreword

This British Standard is the official English language version of EN 693:2001. The UK is obliged to publish EN 693:2001 as a British Standard (BS EN 693:2001). However, attention is drawn to the fact that during the development of this European Standard the United Kingdom has consistently voted against its approval as an EN. The UK believes that the standard is deficient in certain safety requirements compared with the state of the art for these machines in the UK. The standard fails to satisfy some of the relevant essential requirements of the EC Machinery Safety Directive (98/37/EC), as implemented in the UK by the Supply of Machinery (Safety) Regulations 1992 (as amended), which it claims to meet.

As part of BSI's duty of care we draw attention to users of BS EN 693:2001 of our concern that the standard contains inadequate requirements for protection of personnel against access to the danger zone at manually loaded/unloaded machines as specified in Annex IV to the Directive. The concerns relate specifically to clauses **5.3.2** and **5.3.3** in so far as the use of a two-hand control device(s) is concerned. When these devices are provided as the sole safeguard they do not adequately control the risks to other workers. BSI will assume no liability whatsoever for any failure on the part of any user of this standard to consider these aspects.

The UK participation in its preparation was entrusted by Technical Committee MTE/1, Machine tools, to Subcommittee MTE/1/1, Metal forming machine tools, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 August 2001

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English version

Machine tools — Safety — Hydraulic presses

Machines-outils — Sécurité — Presses hydrauliques

Werkzeugmaschinen — Sicherheit — Hydraulische Pressen

This European Standard was approved by CEN on 20 November 2000.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 693:2001 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 143, Machine tools — Safety, the Secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

Annexes A and B to this standard are normative, whereas Annexes C to G and ZA are informative.

This standard also contains a bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

0 Introduction

0.1 This standard is applicable to hydraulic presses as defined in 3.10.

0.2 This standard has been prepared to be a harmonized standard to provide one means of conforming with the essential safety requirements of the Machinery Directive and associated EFTA Regulations.

0.3 The extent to which hazards are covered is indicated in the scope of this standard. In addition, machinery shall comply as appropriate with EN 292 for hazards which are not covered by this standard.

0.4 Complementary guidance is given in the A and B standards to which reference is made in the text (see clause 2). The figures are intended to be examples only and not to give the only interpretation of the text.

1 Scope

1.1 This standard specifies technical safety requirements and measures to be adopted by persons undertaking the design (as defined in 3.11 of EN 292-1:1991), manufacture and supply of hydraulic presses which are intended to work cold metal or material partly of cold metal.

1.2 This standard also covers presses, whose primary intended use is to work cold metal, which are to be used in the same way to work other sheet materials (such as cardboard, plastic, rubber or leather), and metal powder.

1.3 The requirements in this standard take account of intended use, as defined in 3.12 of EN 292-1:1991. This standard presumes access to the press from all directions, deals with the hazards described in clause 4, and specifies the safety measures for both the operator and other exposed persons.

1.4 This standard also applies to ancillary devices which are an integral part of the press. For the safeguarding of integrated manufacturing systems using presses, see also ISO 11161.

1.5 This standard does not cover machines whose principal designed purpose is:

a) sheet metal cutting by guillotine;

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

c) bending or folding;

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. for the construction industry.

1.6 This standard is applicable to machines built after its date of issue.

2 Normative references

This European standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 292-1:1991, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology.*

EN 292-2:1991, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications (and Amendment A1:1995).*

EN 294:1992, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs.*

EN 349:1993, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body.*

EN 418:1992, *Safety of machinery — Emergency stop equipment, functional aspects — Principles for design.*

EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces.*

EN 574:1996, *Safety of machinery — Two-hand control device.*

EN 614-1:1995, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles.*

EN 626-1:1994, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers.*

EN 842:1996, *Safety of machinery — Visual danger signals — General requirements, design and testing.*

EN 894-2:1997, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays.*

EN 894-3:2000, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators.*

EN 953:1997, *Safety of machinery — General requirements for the design and construction of guards (fixed, movable).*

EN 954-1:1996, *Safety of machinery — Safety related parts of control systems — Part 1: General principles for design.*

EN 982:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics.*

EN 983:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics.*

EN 999:1998, *Safety of machinery — Approach speed of parts of the body for the positioning of safety devices.*

prEN 1005-2:1993, *Safety of machinery — Human physical performance — Part 2: Manual handling of objects associated to machinery.*

EN 1037:1995, *Safety of machinery — Prevention of unexpected start-up.*

EN 1050:1996, *Safety of machinery — Principles for risk assessment.*

EN 1088:1995, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection.*

EN 1127-1:1997, *Safety of machinery — Fire and explosions — Part 1: Explosion prevention and protection.*

EN 1299:1997, *Vibration isolation of machines — Information for the application or source isolation.*

EN ISO 3746:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:1995).*

ISO 11161:1994, *Industrial automation systems — Safety of integrated manufacturing systems — Basic requirements.*

EN ISO 11202:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Survey method in situ (ISO 11202:1995).*

ISO/TR 11688-1:1995, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning.*

EN 60204-1:1997, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 204-1:1992, modified).*

EN 61310-2:1995, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 1310-2:1995).*

EN 61496-1:1997, *Safety of machinery — Electrosensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:1997).*

prEN 61496-2:1997, *Safety of machinery — Electrosensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (IEC 61496-2:1997).*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply. Further terms and definitions are provided in relevant A and B standards and in annex A of EN 292-2:1991/A1:1995.

3.1
ancillary device
device intended for use with the press tools and integrated with the press, e.g. devices for lubrication, feed and ejection

3.2
cycle — automatic
operating mode where the slide/ram repeats continuously or intermittently, all functions achieved without manual intervention into the danger zone after initiation

3.3
cycle — operating
movement of the slide/ram from the cycle start position (normally the top dead centre) to the bottom dead centre and back to the cycle stop position (normally the top dead centre)

The operating cycle includes all operations carried out during this movement.

3.4
cycle — single
operating mode where each operating cycle of the slide/ram has to be positively actuated by the operator

3.5
dead centres
points at which the tool, during its travel, is:

- either nearest/closest to the die (generally it corresponds to the end of the closing stroke), known as the bottom dead centre (BDC); or
- furthest from the die (generally it corresponds to the end of the opening stroke), known as the top dead centre (TDC).

3.6
die
fixed part of the tools used in a press

3.7
die cushion
accessory for a die which accumulates and releases, or absorbs, force as required in some press operations

3.8
early opening interlocking guard
guard associated with an interlocking device which, if opened when any dangerous movement in the tools area has ceased, does not interrupt the operating cycle

3.9
guard locking device
mechanical device to maintain an interlocking guard gate in the closed and locked position until the risk of injury from the hazardous machine functions has passed

3.10
hydraulic press
machine designed or intended to transmit energy by linear movement between closing tools by hydraulic means for the purpose of the working (e.g. forming or shaping) of cold metal or material partly of cold metal between the tools

Such energy is produced by the effects of hydrostatic pressure (see Figures 1 and 2).

3.11
limited movement control device; inching device
control device, the actuation of which permits only a limited amount of travel of a machine element, thus minimizing risk as much as possible; further movement is precluded until there is a subsequent and separate actuation of the control [3.23.8 of EN 292-1:1991]

3.12
monitoring (M)
safety function 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

3.13
muting
temporary automatic suspension of a safety function(s) by safety related parts of the control system during otherwise safe conditions in the operation of a machine [3.7 of EN 954-1:1996]

3.14
overall system stopping performance; overall response time
time occurring from actuating the protective device to the cessation of hazardous motion, or to the machine assuming a safe condition

3.15
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

3.16
position switch
switch which is operated by a moving part of the machine when this part reaches or leaves a predetermined position

3.17
redundancy (R)
application of more than one device or system, or part of a device or a system, with the objective of ensuring that, in the event of one failing to perform its function, another is available to perform that function [3.47 of EN 60204-1:1992]

3.18
restraint valve
device which protects against a gravity fall of the slide/ram

3.19
single stroke function
feature used to limit the motion of the tool to one operating cycle (single cycle) even if the stroke initiating means (e.g. a pedal) is held in the operating position

3.20
slide/ram
main reciprocating press member which holds the tool

3.21
tool
moving part of the tools

3.22
tool protective device
device which protects the tool against damage by stopping the stroke or by preventing its start

3.23
tools
term for the combination of tool and die

3.24
tools — closed
tools designed and constructed to be inherently safe (see Figure C.1)

3.25
up-stroking press
vertical press in which the press table moves upwards during the closing stroke (reciprocal to a down-stroking press, see Figure D.1)

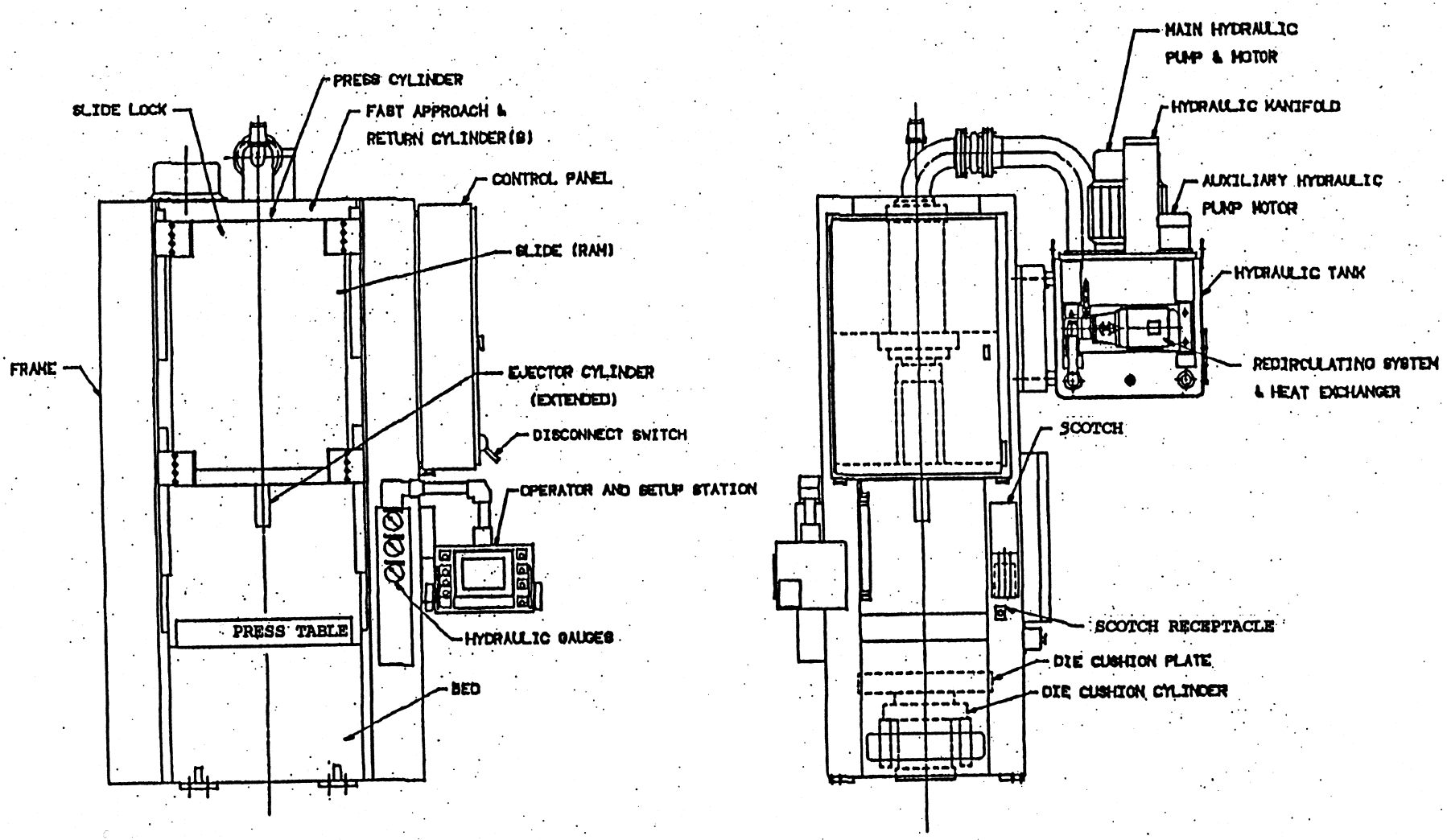


Figure 1 — Example of box frame type hydraulic press (tools area safeguards not shown)

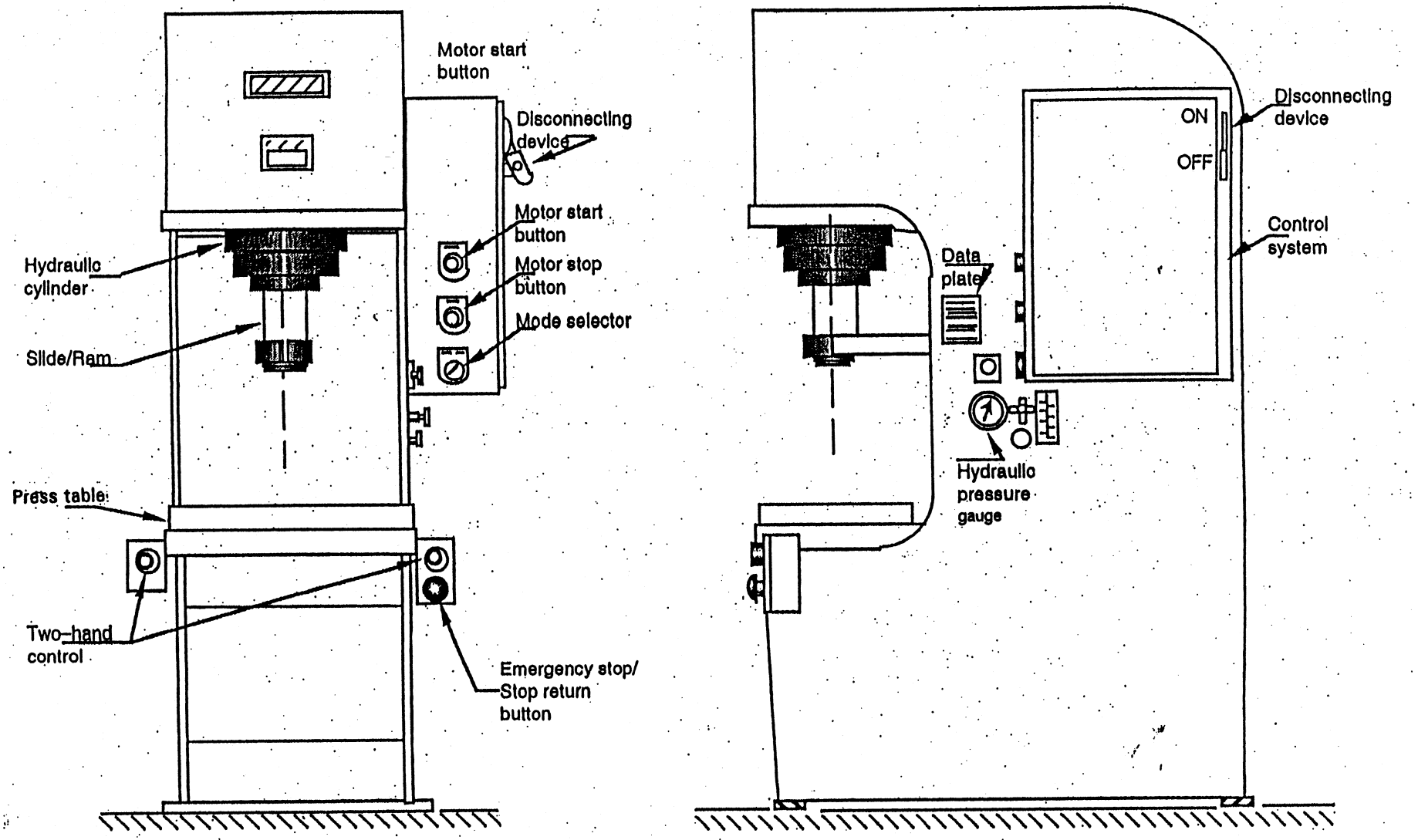


Figure 2 — Example of open front hydraulic press (tools area safeguards not shown)

4 List of hazards

4.1 The list of hazards contained in Table 1 is the result of a risk assessment, carried out as required by EN 1050, for all hydraulic presses covered by the scope of this standard. The technical measures and information for use contained in clauses 5 and 7 and the annexes are based on the risk assessment, and deal with the identified hazards by either eliminating them or reducing the effects of the risks they generate.

4.2 The risk assessment assumes foreseeable access from all directions, as well as unexpected and unintended strokes or gravity falls. Risks to both the operators and other persons who may have access to the danger zones are identified, taking into account all hazards which may occur during the life of the press. The assessment includes an analysis of the effect of failure in the control system.

4.3 In addition, the user of this standard, i.e. the designer, manufacturer or supplier, shall conduct a risk assessment in accordance with EN 1050 with particular attention to:

- the intended use of the press including maintenance, toolsetting and cleaning, and its reasonably foreseeable misuse;
- the identification of the significant hazards associated with the press (see 4.4).

4.4 Table 1 of this standard is a list of significant hazards and their related danger zones normally associated with a hydraulic press. As part of the risk assessment, the designer shall verify whether the list of hazards in Table 1 is exhaustive and applicable to the press under consideration.

Table 1 — Significant hazards, danger zones, preventive measures

Hazards	Danger zone	Preventive measures: relevant clauses of this standard	Relevant clauses of EN 292-1
Mechanical hazards			
Crushing hazard Shearing hazard Cutting or severing hazard Entanglement hazard Drawing-in or trapping hazard Impact hazard	Tools area: - between moving tools - moving slide - moving die cushions - workpiece ejectors - guards Moving parts of electrical, hydraulic and pneumatic equipment Motor and drive machinery Mechanical handling device	5.2 to 5.5 Annexes C, D and E 5.6.1 to 5.6.3 5.6.1 to 5.6.4	4.2.1
Ejection hazard	Machine components Workpieces and tools	5.6.5 7.2.2 i)	
High pressure fluid ejection hazard	Hydraulic systems	5.8.3	4.2.1
Slip, trip and fall hazards	All work at heights Floor area around the press	5.7	4.2.3
Electrical hazards			
Direct contact hazard	Electrical equipment	5.8.1	4.3
Indirect contact hazard Thermal radiation hazard (burns)	Electrical equipment Parts made live by electrical equipment under fault conditions	5.8.1	4.3
Thermal hazards resulting in burns and scalds, by a possible contact of persons	Parts of the hydraulic system	5.8.2	4.4
Hazards generated by noise resulting in hearing losses (deafness)	Any area at the press where there is a risk to hearing	5.8.4	4.5

Table 1 *(continued)*

Hazards	Danger zone	Preventive measures: relevant clauses of this standard	Relevant clauses of EN 292-1
Hazards generated by vibration	Parts of the press where the risk occurs, e.g. the workstation(s)	5.8.5	4.6
Hazards generated by materials and substances processed, used or exhausted by machinery, for example: Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	Hydraulic systems; pneumatic systems and their controls; toxic work materials	5.8.6.1 to 5.8.6.3	4.8
Fire or explosion hazards	Exhaust ventilation and dust collection equipment	5.8.6.4	4.8
Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities) caused, for example, by unhealthy postures or excessive efforts	The working position and controls for operators and maintenance staff handling tools	5.8.7	4.9

5 Safety requirements and measures

5.1 Introduction

The hydraulic presses covered by this standard 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.

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 and Tables 2, 3 and 4);
- protection against hazards due to control system or control component failures (see 5.4);
- safeguarding against hazards which can occur during toolsetting, 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 Prevention of unintended gravity fall during production

5.2.1.1 Where there is a risk of injury (force exceeding 150 Newton), 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 2 and 3. Such a fall may be due to a failure of the hydraulic system, mechanical failure or a failure of the electrical control system. The risk shall be prevented by either:

- a mechanical restraint device;
- a hydraulic restraint device, as defined in 5.2.1.2;
- a combination of a single valve hydraulic restraint device and a mechanical restraint device.

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

5.2.1.2 Where mechanical restraint is not used and the risk of injury from a gravity fall exists, the hydraulic restraint devices shall consist either of:

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.

5.2.1.3 On a press made solely for:

- automatic operation;
- use with closed tools;
- use with fixed enclosing guards;
- use with slow closing speed and hold-to-run control (see 5.3.18);

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

5.2.1.4 There shall be a system for automatically checking that the restraint system as defined in 5.2.1.1 is functioning correctly, and no press stroke shall be possible after any of the systems has failed (see Figure D.1 and 5.4.1.2).

5.2.1.5 See also 5.4.1.2 and 5.4.1.3 on the control system requirements to prevent uncovenanted strokes.

5.2.2 Prevention of gravity fall during maintenance or repair

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

NOTE: The risk of injury will not occur between the tools of an upstroking 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 EN 1037).

5.2.2.2 On presses with an opening stroke length of more than 500 mm and a depth of table of more than 800 mm, the device shall be permanently fixed and integrated with the press. 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.

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

5.2.3 Hydraulic and pneumatic systems — Common features

5.2.3.1 The general requirements in EN 982 and 983 shall be taken into consideration in designing hydraulic and pneumatic systems, which shall comply with the particular requirements in 5.2.3, 5.2.4 and 5.2.5.

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

5.2.3.3 Devices shall be provided to ensure that the permitted range of working pressure is maintained.

5.2.3.4 Transparent bowls (e.g. glass, plastic) shall be protected to prevent injury from flying particles, without affecting visibility.

5.2.3.5 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 5.3.4.2.3 of EN 982:1996 and 5.3.4.2.3 of EN 983:1996.

5.2.3.6 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 used to carry fluids. Such kinking can cause traps which prevent the fluid exhausting.

5.2.3.7 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.

5.2.3.8 Operating valves shall not depend on connected piping for support. This is to avoid undesirable effects from vibration which might affect both valves and piping.

5.2.3.9 Control valves and other control components (e.g. regulators and manometers) shall be mounted in positions which provide accessibility and avoid damage (see 5.2.1 of EN 982:1996).

5.2.3.10 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 5.4.7.

5.2.4 Hydraulic systems

5.2.4.1 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 (R and M in Table 2).

5.2.4.2 Hydraulic systems which include accumulators shall allow the fluid pressure to fall when the pressure generating unit is disconnected from the energy supply; the stored energy shall not allow the initiation of a further stroke. If this is impossible, 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, pneumatic gauges, etc.) and bear a very clear indication (by means of a descriptive plate) of the hazard.

5.2.4.3 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.

5.2.4.4 For downstroking 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 unauthorized 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 sustain 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.

5.2.5 Pneumatic systems

5.2.5.1 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.

5.2.5.2 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.

5.2.5.3 Water separators shall be provided.

5.2.6 Electrical systems

5.2.6.1 The electrical system shall comply with EN 60204-1 in full.

5.2.6.2 The designer of a press should consider whether the limits of the electrical supply, the physical environment as well as the operating conditions of some components are different to those in 4.3 and 4.4 of EN 60204-1:1997. In this case, the choice of the relevant components has to be made in this respect.

5.2.6.3 The emergency stop shall function as a category 0 stop (see 9.2.5.4 of EN 60204-1:1997 and 5.4.6.2).

5.2.6.4 Two-hand control devices shall conform for the mode of production: single cycle, manual feed or removal to 5.3.16 and Table 2 and to 5.5.7 for tool-setting, maintenance and lubrication.

5.2.6.5 The minimum degree of protection for the operator interface and press-mounted control devices shall be of at least IP 54 (see 10.1.2 of EN 60204-1:1997).

5.2.6.6 Enclosures of control gear shall provide a degree of protection of at least IP 54 (see 12.3 of EN 60204-1:1997).

5.2.6.7 The identification of other conductors than the neutral or protection conductors shall be in accordance with the choices mentioned in 14.2.4 of EN 60204-1:1997.

5.3 Mechanical hazards in the tools area

5.3.1 The major danger zone at hydraulic presses is the tools area and preventive measures shall be taken to deal with the relevant hazards. This standard indicates in 5.3 to 5.5 how the danger zone at the tools and associated areas, such as moving die cushions, blanking holders and workpiece ejectors, shall be safeguarded. Tables 2, 3 and 4 list the safeguarding methods including mode of production, mode of cycle initiation, mode of operation and the requirements for the design of the control and monitoring systems:

- single cycle: manual feed or removal (Table 2);
- automatic cycle: manual feed or removal (Table 3);
- automatic cycle: solely automatic feed and removal (Table 4).

5.3.2 Safeguarding measures described in EN 292-1 and -2 which are appropriate to the safeguarding of any operator at the tools are listed below. Designers, manufacturers and suppliers shall select the safeguarding methods which reduce the risks as far as possible, considering the significant hazards (see Table 1) and the mode of production (see Tables 2, 3 and 4):

a) closed tools (see EN 294, EN 349, 5.3.4, 5.3.9 and annex C);

b) fixed enclosing guards (see EN 294, EN 953, 5.3.4, and 5.3.10);

c) interlocking guards with or without guard locking (see EN 953, EN 1088, 5.3.11, 5.3.13, 5.3.17 and annex D);

d) control guards with or without guard locking (see 4.2.2.5 of EN 292-2:1991/A1:1995, EN 953, EN 1088, 5.3.11, 5.3.13, 5.3.17 and annex D);

e) early opening interlocking guards with or without guard locking (see EN 953, EN 999, EN 1088, 5.3.11, 5.3.13, 5.3.14, 5.3.17 and annex D);

f) electro-sensitive protective equipment (ESPE) using active opto-electronic protective devices (AOPDs) (see EN 999, EN 61496-1, prEN 61496-2, 5.3.15, 5.3.17 and annex E);

g) two-hand control devices (see EN 574, EN 999, 5.3.16 and 5.3.17);

h) hold-to-run control devices (see 3.23.3 of EN 292-1:1991) with a slow closing speed (equal or less than 10 mm/s, see 5.3.18) principally for toolsetting (see 5.5).

5.3.3 The selected combination of safeguarding measures described in 5.3.2 shall protect all exposed persons, i.e. those who may gain access to the danger zone during operation, setting, maintenance, cleaning and inspection activities, as described in 4.2.

5.3.4 Where a hydraulic press is capable of being 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 supplied as a part of the press for a single specific purpose [see 7.2. j) and k)].

5.3.5 The requirements of the safety measures listed in 5.3.2 are given in 5.3.9 to 5.3.18 and shall be met in addition to those established by the relevant standards (see clause 2).

5.3.6 The provided guards and protective devices shall be at least interfaced with the control system of the press in the same category as required for these guards and devices.

5.3.7 If the work performed on the press requires access to the danger zone from more than one side, arrangements shall be provided for the fitting of a guard or a device giving the same level of protection for the operator on each side.

5.3.8 Where a very large press may be used for special “one-off” pressing of large components, for example pressure vessel ends, and use of a guard is impracticable, the designer, manufacturer and supplier shall make provision as necessary for allowing in such cases a safe method of work to be applied by the user, for example provision of controls to be moved to a safe position with a good view of the tools/workpiece and if necessary additional audible warnings or visual danger signals (see EN 842). If this press is not exclusively dedicated to this work, clauses 5.3.2 to 5.3.7 shall apply.

5.3.9 Closed tools shall be inherently safe. Their openings and the corresponding distances shall meet the requirements laid down in Table 4 of EN 294:1992 or not exceed 6 mm. Any additional crushing hazard outside the closed tools shall be avoided following Table 1 of EN 349:1993 (see annex C).

5.3.10 Fixed enclosing guards shall comply with EN 953. They shall be firmly secured to the machine, another rigid structure or the floor. The feed opening shall comply with Table 4 of EN 294:1992.

5.3.11 Interlocking guards and control guards shall comply with EN 953 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 6.2.2 of EN 1088:1995, and the safety related parts of its control system shall conform to category 4 of EN 954-1:1996. Control guards shall also conform to 3.22.6 of EN 292-1:1991 and 4.2.2.5 of EN 292-2:1991.

5.3.12 Using an interlocking guard as a control guard, it shall not be possible to stand 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 clause 6.2.1 of EN 1088.

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. These restrictions do not apply when the control guard is controlled by a hold–to–run control device.

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.

5.3.13 The guards mentioned in 5.3.11 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;

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

5.3.14 Where an interlocking guard or a control guard has an early opening feature, it shall function as an early opening interlocking guard (see 3.8).

5.3.15 ESPE using AOPD in the form of light curtain shall comply with the following:

a) AOPDs shall conform to type 4 of EN 61496–1:1997, and be designed and constructed according to prEN 61496-2:1997;

b) access to the danger zone shall only be possible through the detection zone of the AOPD. Additional safeguarding shall prevent access to the danger zone from any other direction;

c) where it is possible to stand in a position between a AOPD and the danger zone of the press, additional means, for example further beams, shall be provided to detect a person standing there. The maximum permissible undetected gap shall be equal to or less than 75 mm;

d) it shall not be possible to initiate any dangerous movement while any part of the body is interrupting the AOPD;

e) the means of resetting shall be so positioned that, from that position, there is a clear view of the danger zone. There shall not be more than one reset control device on 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;

f) where the AOPD operates by reflecting the transmitted light beam back along its own path and additional reflector(s) are placed within the detection zone, then the configuration of the additional reflector(s) shall not allow an item of thickness equal to or greater than the specified test piece size (see 4.1.2 of EN 61496-2:1998) to be undetected by the AOPD within the whole of the detection zone, unless other measures are taken to ensure that it is not possible to reach the danger zone;

g) where the AOPD is also used for cycle initiation, either single or double break:

i) 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;

ii) 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;

iii) the detection capability shall not exceed 30 mm (see Table A.1);

iv) before the first cycle initiation, the reset function(s) shall be actuated (e.g. push button, foot pedal);

v) the facility to initiate the press motion upon clearing of the AOPD shall be limited to the pre-set time. This pre-set time shall not be capable of exceeding 30 s starting from the end of the previous operating cycle. The AOPD shall be required to be manually reset, if the pre-set time has been exceeded;

vi) if there is more than one AOPD safeguarding the press, only one of them at the front shall be selected for cycle initiation at any one time;

h) switching off the AOPD by the selector switch shall also switch off the indicator lights.

5.3.16 Two-hand control devices shall comply with the following:

a) two-hand control devices shall conform to type III C in Table 1 of EN 574:1996;

b) the number of two-hand control devices in operation shall correspond to the number of operators indicated at the selection system;

c) initiation of output signals shall not be possible using one hand, hand and elbow of the same arm, forearm(s) or elbow(s), hand and other parts of the body.

5.3.17 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 does not have time to reach the danger zone before any dangerous movement in the tools area has ceased. Calculation of the safety 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 EN 999 and annex A.

5.3.18 Hold-to-run control devices with slow closing speed shall have a provision which ensures that the speed cannot exceed 10 mm/s. If other operating modes (see Tables 2, 3 and 4) allow higher speed than 10 mm/s, then the slow speed shall be manually selected by operating a selector switch which activates the hold-to-run control device and simultaneously sets slow speed. The speed shall not be limited by adjustment of variable parameters.

5.3.19 Other requirements

5.3.19.1 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.

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

5.3.19.3 The means of manual adjustment, e.g. to the stroke or slide/ram 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.

5.3.19.4 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 press with:

a) either a hold-to-run control device with three (3) positions and slow speed (less than 10 mm/s). The hold-to-run control device shall consist of a single button having the following positions:
- 1st stop;
- 2nd run;
- 3rd stop again.

After pushing the button over a pressure point in position 3, a restart shall only be possible after returning the button to position 1;

b) or an inching device (see 5.5.9).

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).

5.3.20 Release of trapped persons

Means shall be provided to release any person trapped at the tools area [see also 7.2.2 q)].

5.4 The control and monitoring system

5.4.1 Control and monitoring functions

This subclause shall apply to all safety related components which directly or indirectly control or monitor the functioning of moving parts of the press or its tools. EN 60204-1 shall be followed for the design of electrical systems and EN 954-1 for the safety related parts of the electrical, hydraulic, pneumatic and mechanical systems.

5.4.1.1 Control systems shall include safety functions designed in such a way that controls have to be re-actuated in order for the press to perform a stroke:

a) after changing the mode of control or operation;

b) after an interlocking guard has been closed;

c) after a manual reset of the safety system;

d) after an operating power failure;

e) after a primary pressure failure;

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

g) after removal of an interlocked mechanical restraint device.

5.4.1.2 In the event of an intervention of a safety system (interlocking guard, ESPE using the AOPD), separate manual reset functions are required to restore the normal intended operation:

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 protects sides of the press from which the press is not operated.

Reset controls shall be within viewing distance of the danger zone, but out of reach from the danger zone. The reset functions shall fulfil at least a single system with monitoring (S and M).

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

- ESPE using AOPDs;
- interlocking guards (but see 5.4.1.6) and control guards;
- two-hand control devices used for normal operation.

This subclause does not apply to presses solely used for automatic feed or removal working in automatic cycle and fitted with an interlocking guard with guard locking (see Table 4).

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, in other cases*, 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 category 4 of EN 954-1:1996. The start and stop functions in the safety related parts of the press control system shall be hardwired, redundant and monitored (R and M).

* Examples of this are:

1) where a fault occurs in one channel of a two channel control system, so that the other channel remains operative;

2) where a fault occurs during parts of the cycle other than the dangerous phase of the closing stroke.

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

a) 3.7.3 of EN 292-2:1991/A1:1995;

b) 5.2.1 of EN 982:1996;

c) 5.2.1 of EN 983:1996;

d) 12.1 of EN 60204-1:1997.

5.4.1.5 The redundant and monitored press control system shall operate in two separate functioning systems. Either system shall be independently capable of stopping the hazardous movement, irrespective of the condition of the other. Failure of either system shall be detected through monitoring, and another closing stroke prevented. If failure of one system is self-revealing, i.e. the loss of the function itself prevents the next operating cycle, further monitoring of that system is not required.

5.4.1.6 Power interlocking may be provided for presses fitted with interlocking guards. With the pump running, the guard interlocking device shall be positively linked with the manually actuated valve to reverse directly the flow of hydraulic fluid to and from the actuator. See Figure D.2.

5.4.2 Muting

5.4.2.1 Muting (see 3.13) may be provided for ESPE using AOPDs and two-hand control devices. They shall only be muted at a point in the opening stroke, or when the dangerous phase of the closing stroke is passed and there is no risk of injury at the tools. Trapping points at ejectors, die cushions and blanking holders shall be taken into account. The safeguarding system shall become operative again at or before the start of the downstroke.

In addition:

a) the muting position shall be secured against unauthorized adjustment by provision of special tools, key entry or electronic passwords;

b) any additional hazard existing during the opening stroke shall be prevented, e.g. by fixed guards;

c) the signals for the initiation of muting shall be monitored.

5.4.2.2 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, which will actuate when the tools are closed and the machine begins to apply the force.

5.4.2.3 Muting may also be provided for the gate of an interlocking guard fitted to a hydraulic press, where early opening of the gate is allowed when the dangerous phase of the closing stroke has passed.

5.4.3 Programmable electronic systems (PES), programmable pneumatic systems (PPS) and safety related functions

5.4.3.1 The use of PES and PPS shall not reduce any level of safety laid down in this standard.

5.4.3.2 Where a press is controlled by a PES or a PPS, the safety related functions shall not rely solely on the PES or PPS.

5.4.4 Selector switches

5.4.4.1 Where there is a choice of modes of operation, cycle initiation or safety system of the press (e.g. single stroke, inch or continuous, front or back, or front and back), selector switches shall be provided. The design shall ensure that, for each position not in use, circuits are completely isolated by positively operated contacts, or by redundant and monitored hardware. If the switch is set in an intermediate position, no operation shall be possible. The control system shall ensure that no start-up is initiated when the selector switch is operated.

5.4.4.2 Where one selector switch is provided, it shall be used to select the appropriate mode of safeguarding, which can be two or more guards or protective devices (see 5.3.3). Where two or more selector switches are provided and the mode of safeguarding is connected to the control system, the chosen mode of operation shall be automatically linked to the corresponding mode of safeguarding.

5.4.4.3 If a press is also intended to be used according to 5.3.2 a) or b) and at the same time operated, e.g. by foot switch, without any other safeguarding, this mode of production shall be chosen by an additional selector switch operated by a separate key or within a key locked enclosure. The selection of this mode shall automatically give a clear indication at the press that only closed tools or fixed enclosing guards shall be used.

5.4.4.4 If there is more than one operator at the machine, the level of protection shall be the same for each operator. Where a number of two-hand control devices can be used, the press shall only be operable if the combination selected corresponds exactly to the combination physically connected to the press.

5.4.4.5 Selector switches for safety related functions shall be key operated, according to 9.2.3 of EN 60204-1:1997. The selection shall be visible and clearly identifiable.

5.4.5 Position switches (see 10.1.4 of EN 60204-1:1997)

The means of operation of a position switch (see 3.16) and the switch itself shall be designed to maintain, after setting their position, their correct relationship to one another, the operating cam and particularly the stroke.

5.4.6 Control devices

5.4.6.1 Push button, foot switch and start control devices shall be adequately shrouded to prevent accidental operation. Foot switches shall permit access from one direction only and by one foot only. Treadles shall not be used.

NOTE: A treadle is a bar actuated by foot used for cycle initiation; it can be used by more than one person simultaneously or singly. (Only a national remark in the English version.)

5.4.6.2 Emergency stop buttons shall on actuation stop all dangerous movement, functioning as category 0 in 4.1.5 of EN 418:1992.

5.4.6.3 There shall be at least one emergency stop button within direct reach of each operator including the operator(s) at the rear of the press. Any disconnectable control station shall not incorporate an emergency stop button if the press can be operated while this control station is disconnected.

5.4.6.4 In order to avoid unintended start-up, portable pedestals or pendants incorporating start buttons shall be designed in accordance with 4.4.8 of EN 60204-1:1997, with regard to stability and support, and 10.6 of EN 60204-1:1997.

5.4.7 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 effect the override.

5.5 Toolsetting, trial strokes, maintenance and lubrication

5.5.1 The machine shall be designed so that toolsetting, 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 Facilities shall be provided to allow the movement of the slide/ram during toolsetting, maintenance and lubrication to be carried out with guards and protective devices in position and operational (see 5.3.2). Where this is not practicable, at least one of the following facilities shall be provided:

a) two-hand control device in accordance with 5.5.7 and arranged so that it cannot be used for production, e.g. by its positioning and distance from the tools area, using slow speed; equal or less than 10 mm/s, limited movement;

b) slow speed (less than 10 mm/s) and hold-to-run control device;

c) using an inching device.

5.5.3 All trial strokes (single operating cycle) after toolsetting or adjustment are considered in this standard as production strokes, and the safeguarding 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/ram 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 there will be more than one person on a side, additional devices (e.g. enabling devices, selector switches, warning signals) shall be provided.

5.5.6 If a movable guard has to be opened only for toolsetting or maintenance, it shall be an interlocking guard (see 6.4.3 of EN 953:1997). The minimum standard of interlocking is a switch of the positive opening operation type complying with EN 1088. The interfacing to the safety related parts of the control system shall not rely solely on one relay.

5.5.7 Two-hand control devices shall comply with the following:

a) two-hand control devices shall conform at least to type II in Table 1 of EN 574:1996;

b) initiation of output signals shall not be possible using one hand, or hand and elbow of the same arm.

5.5.8 Hold-to-run control devices and inching devices shall be hardwired and the safety related parts of the control system shall conform to category 2 of EN 954-1:1996.

5.5.9 The movement produced by the inching device shall be so small as to prevent a hazardous situation and shall be limited by a time control or by a distance control. The slide/ram movement shall not exceed 6 mm per inching step.

5.5.10 Two-hand control devices or hold-to-run control devices provided only for toolsetting shall be arranged in such a way as to be unsuitable for normal use.

5.5.11 The interfacing between hold-to-run control devices, two-hand control devices, inching devices and the safety related parts of the control system shall not rely solely on one relay.

5.5.12 The press and its safeguarding shall be designed so that periodic examinations can be carried out using such tools as are provided with the press.

5.6 Mechanical hazards — other

5.6.1 Drive and transmission machinery, and ancillary devices which are an integral part of the press and are supplied with the press, shall be at least safeguarded by means of:

a) fixed guards, where access is required once or less than once per shift (see 6.4.1 of EN 953:1997);

b) movable guards interlocked with the control system, where access is required more than once per shift (see 6.4.1 of EN 953:1997);

c) an interlocking guard with guard locking and delayed unlocking, if the dangerous movement does not come to a rest before the danger zone can be reached (see 7.4 of EN 1088:1995).

The guards listed above are not required if the danger zone is out of reach according to Tables 1 and 2 of EN 294:1992 and access is not required for regular maintenance (e.g. lubrication, setting, cleaning).

5.6.2 The delayed unlocking shall be arranged in such a way that a timer or a motion detector controls the guard locking.

5.6.3 The safety related parts of the control systems for interlocking devices (see EN 1088) shall conform at least to category 1 of EN 954-1:1996.

5.6.4 Ancillary devices which are not controlled by the press shall be additionally interlocked to the press control system so that during any intervention no hazardous situation can arise. See 1.4.

5.6.5 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 8.1 of EN 953:1997. See also 7.2.2 j) in relation to workpieces and tools.

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 station. See [1] in Bibliography.

5.7.2 The press shall be designed, constructed and supplied so as to minimize the risk of slips, trips and falls in the press area.

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 clause 6 of EN 60204-1:1997.

5.8.2 Thermal hazards

Means such as shielding, insulation shall be provided to prevent burns by accessible parts of the press, e.g. parts of the hydraulic system, which can exceed the recommended temperature limit values specified in EN 563.

5.8.3 High pressure fluid ejection hazards

Additional shielding, e.g. screens, 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.

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 listed below:

a)	fluid transmission:	damping facilities;
b)	motor and pump:	acoustic panels (partial or total);
c)	noise at the tools:	damping facilities on the press;
d)	workpiece ejection:	silenced nozzles;
e)	pneumatic exhaust:	silencers;
f)	feeding and transfer systems:	acoustic enclosures, damping facilities;
g)	structurally transmitted noise:	anti-vibration machine mounts.

Additional or alternative measures giving an 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 EN ISO 3746 and EN ISO 11202, as appropriate.

NOTE: It is anticipated that, in a future revision to this standard, the work currently in preparation within ISO/TC 39 (ISO/CD 230-5 and ISO/CD 8500) will be used as a basis for the measurement and declaration of noise.

5.8.4.4 The minimum information to be provided concerning the measurement of airborne noise emissions is the following:

- **machine data:**
  - a) name and address of the manufacturer;
  - b) year of construction;
  - c) designation of series or type;
  - d) serial/prototype number of the press under test;
  - e) nominal force;
  - f) closing and working speed; minimum and maximum if variable speed range;
- **operating conditions during measurement:**
  - g) closing and working speed;
  - h) number of strokes per minute;
  - i) stroke length;
  - j) installation and mounting conditions [see F.1];
    and either
  - k) force applied in kN [see F.3 b)];
  - l) pressure applied in MPa during retraction;
  - m) tooling details [see F.3 c)];
  - n) type and thickness of the material used [see F.3 d)];
    or
  - o) test conditions under load, replacing m) and n) [see F.4];
- **measurement:**
  - p) location of the press under test, with respect to the reflecting plane [see F.2];
  - q) measurement procedure [see F.5];
  - r) measurement positions [see F.6];
  - s) measurement time [see F.7];
- **results:**
  - t) the background sound pressure levels, if the correction factor is required;
  - u) the equivalent continuous A-weighted sound pressure level in the operator's position;
  - v) the peak C-weighted instantaneous sound pressure level in the operator's position;
  - w) the sound power emitted where the equivalent continuous A-weighted sound pressure level exceeds 85 dB (A).

(In the case of very large presses, i.e. in excess of 10 000 kN, instead of the sound power level, the equivalent continuous sound pressure levels at specified positions around the press may be indicated).

5.8.4.5 Information on the conditions for noise measurement of hydraulic presses is given in 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, e.g. by isolation of the press from the floor foundations. See 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 Adequate means shall be provided to prevent the formation of aerosols and respirable oil mists in unhealthy concentration, e.g. from oil used to lubricate pneumatic systems.

5.8.6.3 If it is known that hazardous substances are intended to be processed by the user, e.g. hard metal powder, the safeguarding systems shall be designed to minimize operator exposure and to accept, if necessary, exhaust ventilation. See EN 626-1.

5.8.6.4 Design measures for exhaust ventilation and dust collection equipment shall include features to minimize the risk from fire and explosion. See EN 1127-1.

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 with a lifting device shall include necessary attachments to accommodate the fitting of a lifting device. See prEN 1005-2.

5.8.7.5 Tanks containing hydraulic fluid shall be placed or oriented in such a way that the filler and drain pipes can be easily reached.

5.8.7.6 Further guidance on ergonomic principles is given in EN 60204-1, EN 614-1, EN 894-2 and EN 894-3. See also [2], [3] and [4] in Bibliography.

Table 2 — Requirements for the operator safeguarding of tools for different modes of operation — Mode of production: single cycle, manual feed or removal

Operator safety system (note 1)	Cycle initiation	Start and stop function (note 2)		Muting option (note 3)	Remarks
		El.	Hydr.		
Closed tools	Any	S	S	No	See 5.3.4 and 5.3.9.
Fixed enclosing guard	Any	S	S	No	See 5.3.4 and 5.3.10.
Interlocking guard with guard locking	Any other than the guard itself	R and M (see remark)	S and M	No	See 5.3.11 and 5.3.13. Direct power interlocking of the hydraulic circuit may be provided as an alternative to R and M (see 5.4.1.6 and Figure D.2).
Interlocking guard without guard locking	Any other than the guard itself	R and M	R and M	No	See 5.3.11, 5.3.13 and 5.3.17.
Control guard with guard locking	Guard itself	R and M	S and M	No	See 5.3.11, 5.3.12 and 5.3.13.
Control guard without guard locking	Guard itself	R and M	R and M	No	See 5.3.11, 5.3.12, 5.3.13 and 5.3.17.
Early opening interlocking guard	Any	R and M	R and M	Yes	Either use of appropriate safety distance (see 5.3.17) or guard locking which is effective during the dangerous movement of the tools (see 5.3.13 and 5.3.14).
ESPE using the AOPD	Any, but see remarks 2 and 3	R and M	R and M	Yes	See 5.3.15. 1. Use of appropriate safety distance (see 5.3.17). 2. Where there is a gap between tools large enough to be fully entered, a separate stroke initiation device shall be provided. 3. Restrictions using single or double break [see 5.3.15 g)].
Two-hand control device	Two-hand control device	R and M	R and M	Yes	See 5.3.16. Use of appropriate safety distance (see 5.3.17).
Hold-to-run control device and slow closing speed	Hold-to-run control device	S	S	Yes	1. Principally for toolsetting (see 5.5). 2. Maximum slow closing speed: 10 mm/s (see 5.3.18).

SYMBOLS

a) El. = electrical
b) Hydr. = hydraulic
c) M = monitoring (see 3.12)
d) R = redundancy (see 3.17)
e) S = single system

NOTE 1: For toolsetting, see 5.5.

NOTE 2: See 5.4.1 for the objectives of the control system.

NOTE 3: See 5.4.2.

Table 3 — Requirements for the operator safeguarding of tools for different modes of operation — Mode of production: automatic cycle, manual feed or removal

Operator safety system (note 1)	Cycle initiation	Start and stop function (note 2)		Muting option (note 3)	Remarks
		El.	Hydr.		
Closed tools	Any	S	S	No	See 5.3.4 and 5.3.9.
Fixed enclosing guard	Any	S	S	No	See 5.3.4 and 5.3.10.
Interlocking guard with guard locking	Any other than the guard itself	R and M (see remark)	S and M	No	See 5.3.11 and 5.3.13. Direct power interlocking of the hydraulic circuit may be provided as an alternative to R and M (see 5.4.1.6 and Figure D.2).
Interlocking guard without guard locking	Any other than the guard itself	R and M	R and M	No	See 5.3.11, 5.3.13 and 5.3.17.
ESPE using the AOPD	Any other than the device itself	R and M	R and M	Yes	See 5.3.15. Use of appropriate safety distance (see 5.3.17).

SYMBOLS
a) El. = electrical
b) Hydr. = hydraulic
c) M = monitoring (see 3.12)
d) R = redundancy (see 3.17)
e) S = single system
NOTE 1: For toolsetting, see 5.5.
NOTE 2: See 5.4.1 for the objectives of the control system.
NOTE 3: See 5.4.2.

Table 4 — Requirements for the operator safeguarding of tools for different modes of operation — Mode of production: automatic cycle, solely automatic feed and removal

Operator safety system (note 1)	Cycle initiation	Start and stop function (note 2)		Muting option (note 3)	Remarks
		El.	Hydr.		
Closed tools	Any	S	S	No	See 5.3.4 and 5.3.9.
Fixed enclosing guard	Any	S	S	No	See 5.3.4 and 5.3.10.
Interlocking guard with guard locking	Any other than the guard itself	S	S	No	An unintended start up shall be prevented. The control circuit of the guard gate shall be redundant and monitored by an initial check. See also 5.3.11 and 5.3.13.
Interlocking guard without guard locking	Any other than the guard itself	R and M	R and M	No	See 5.3.11, 5.3.13 and 5.3.17.
ESPE using the AOPD	Any other than the device itself	R and M	R and M	No	See 5.3.15. Use of appropriate safety distance (see 5.3.17).

SYMBOLS
a) El. = electrical
b) Hydr. = hydraulic
c) M = monitoring (see 3.12)
d) R = redundancy (see 3.17)
e) S = single system
NOTE 1: For toolsetting, see 5.5.
NOTE 2: See 5.4.1 for the objectives of the control system.
NOTE 3: See 5.4.2.

6 Verification of the safety requirements and/or measures

Table 5 indicates by crosses the method(s) by which the safety requirements and measures described in clause 5 shall be verified, together with a reference to the corresponding subclauses in this standard.

Table 5 — Means of verification of the safety requirements and/or measures

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations/ Technical data (note 4)
5.2	**BASIC DESIGN CONSIDERATIONS**				
5.2.1	PREVENTION OF UNINTENDED GRAVITY FALL DURING PRODUCTION BY MECHANICAL AND/OR HYDRAULIC RESTRAINT DEVICES				
5.2.1.1	Mechanical and/or hydraulic restraint devices	x	x	x	x
5.2.1.2	Operative in case of failure in the control system	x	x		x
5.2.1.3	Hydraulic restraint devices consisting of:				
5.2.1.3 a)	two separate cylinders	x	x		x
5.2.1.3 b)	hydraulic restraint valves	x	x		x
5.2.1.4	Restraint system automatic check	x	x		x
5.2.2	PREVENTION OF UNINTENDED GRAVITY FALL DURING MAINTENANCE OR REPAIR BY MECHANICAL RESTRAINT DEVICES				
5.2.2.1	Strength	x	x	x	x
	Interlocking	x	x		x
5.2.2.2	Integral to the press (500 mm; 800 mm)	x	x		x
	Position indication	x	x		x
5.2.2.3	Additional mechanical restraint devices	x	x		x
5.2.3	HYDRAULIC AND PNEUMATIC SYSTEMS - COMMON FEATURES				
5.2.3.2	Filters	x			x
	Pressure regulators	x	x		x
	Low pressure cut-off arrangements	x	x		x
5.2.3.3	Pressure range devices	x	x		x
5.2.3.4	Transparent bowls	x			
5.2.3.5	Burrs or foreign matters	x			x
5.2.3.6	Continuous piping	x			
	Thermal expansion	x	x		

Table 5 *(continued)*

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations/ Technical data (note 4)
	Rigid piping support	x			x
	Kinking of flexible pipes	x	x	x	
5.2.3.7	Pipes and pipe connections	x			x
5.2.3.8	Operating valve support	x			x
5.2.3.9	Control valves and other control components location	x			x
5.2.3.10	Valve restoring	x	x		x
5.2.4	HYDRAULIC SYSTEMS				
5.2.4.1	Controlled gravity descent		x		x
5.2.4.2	Accumulators discharge	x	x		x
5.2.4.3	Pressure limiting valve	x	x		x
5.2.4.4	Pressure relief valve	x	x		x
5.2.5	PNEUMATIC SYSTEMS				
5.2.5.1	Visible means of lubrication	x			x
5.2.5.2	Non-clogging silencers	x	x		x
5.2.5.3	Water separators	x			x
5.2.6	ELECTRICAL SYSTEMS				
5.2.6.1	Compliance with EN 60204-1	x			x
5.2.6.2	Environment, operating conditions	x			x
5.2.6.3	See 5.4.6.2				
5.2.6.4	See 5.3.16 and 5.5.7				
5.2.6.5	Operator, control devices, interface	x			x
5.2.6.6	Enclosures of control gear	x			x
5.2.6.7	Identification of conductors	x			
5.3	**MECHANICAL HAZARDS IN THE TOOLS AREA**				
5.3.3	Protection of all exposed persons	x			x
5.3.4	Protective device, part of the press	x	x		x
5.3.6	Interfacing category	x	x		x
5.3.7	Protection on each side	x			x
5.3.8	“One-off” pressing	x	x		x
5.3.9	Closed tools	x	x	x	

Table 5 *(continued)*

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations/ Technical data (note 4)
5.3.10	Fixed enclosing guards	x	x	x	x
5.3.11	Interlocking guards and control guards	x	x	x	x
5.3.12	Control guards: stroke length ≤ 600 mm and table depth ≤ 1 000 mm	x		x	x
5.3.13 a)	Guards in 5.3.11 with guard locking	x	x		x
5.3.13 b)	Guards in 5.3.11 without guard locking	x	x	x	x
5.3.14	Early opening feature	x	x	x	x
5.3.15	ESPE using AOPD in the form of light curtain				
5.3.15 a)	Type 4	x			
5.3.15 b)	Possible access	x	x	x	
5.3.15 c)	Possible standing position	x	x	x	
5.3.15 d)	Initiation prevention	x	x		x
5.3.15 e)	Reset function	x	x		x
5.3.15 f)	Additional reflectors, safeguarding	x	x	x	
5.3.15 g)	Single/double break	x	x		x
5.3.15 g i)	Height: ≥ 750 mm, additional guards	x		x	
5.3.15 g ii)	Stroke length ≤ 600 mm and table depth ≤ 1 000 mm	x		x	
5.3.15 g iii)	Detection capability ≤ 30 mm	x	x	x	x
5.3.15 g iv)	Before first cycle reset function	x	x		x
5.3.15 g v)	Pre-set time ≤ 30 s		x	x	
5.3.15 g vi)	Cycle initiation by one AOPD only		x		x
5.3.15 h)	Indicator lights	x	x		x
5.3.16	Two-hand control devices				
5.3.16 a)	Type III C	x	x	x	
5.3.16 b)	One device for each operator	x	x		x
5.3.16 c)	Defeat	x	x	x	
5.3.17	Safety distance	x	x	x	x
5.3.18	Hold-to-run control devices with slow closing speed	x	x	x	x

Table 5 *(continued)*

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations Technical data (note 4)
5.3.19	Other requirements				
5.3.19.1	Tool securing	x	x		x
5.3.19.2	Fastenings	x			x
5.3.19.3	Adjustment locking	x	x		
5.3.19.4	Leading edge of a coil	x	x		x
5.3.19.4 a)	Hold-to-run control device and slow speed	x	x	x	x
5.3.19.4 b)	Inching device	x	x	x	x
5.3.20	Release of trapped persons	x	x		x
5.4	**THE CONTROL AND MONITORING SYSTEM**				
5.4.1	CONTROL AND MONITORING FUNCTIONS				
5.4.1.1	Re-actuation of controls	x	x		x
5.4.1.2	Manual reset functions	x	x		x
5.4.1.3	Fail-safe condition, redundant and monitored functions	x	x		x
5.4.1.4	Shock and vibration		x	x	
5.4.1.5	Two separate functioning systems	x	x		x
5.4.1.6	Power interlocking	x	x		x
5.4.2	MUTING				
5.4.2.1	All dangerous movement passed	x	x		
5.4.2.1 a)	Securing	x	x		x
5.4.2.1 b)	Additional hazards prevention	x	x	x	x
5.4.2.1 c)	Monitored signals	x	x		x
5.4.2.2	Position and pressure signal	x	x		x
5.4.2.3	Interlocking guard muting	x	x		x
5.4.3	PROGRAMMABLE SYSTEMS AND SAFETY RELATED FUNCTIONS				
5.4.3.2	Safety related functions	x	x		x
5.4.4	SELECTOR SWITCHES				
5.4.4.1	Isolation of circuits	x	x		x
	Positively operated contacts	x	x		

Table 5 *(continued)*

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations/ Technical data (note 4)
	Redundant and monitored hardware	x	x		x
	Intermediate position	x	x		
	Blocking device	x	x		X
5.4.4.2	Selection of safeguarding modes	x	x		
	Operation/safeguarding linking	x	x		
5.4.4.3	Closed tools/fixed enclosing guards	x	x		x
	Indication	x	x		
5.4.4.4	Two-hand control devices selected	x	x		x
5.4.4.5	Key operated selector switches	x	x		
5.4.5	POSITION SWITCHES				
	Relationship	x	x	x	x
5.4.6	CONTROL DEVICES				
5.4.6.1	Adequate shrouding	x	x	x	
5.4.6.2	Stopping of all dangerous movements	x	x		x
5.4.6.3	Emergency stop buttons location	x	x	x	X
5.4.6.4	Portable start buttons	x	x		
5.4.7	VALVES				
	No manual override on restraint valves	x			
	Tool for manual override on other valves	x	x		x
5.5	**TOOLSETTING, 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	x			x
5.5.2 a)	Two-hand control device	x	x	x	
5.5.2 b)	Slow speed and hold-to-run control device	x	x	x	
5.5.2 c)	Inching device	x	x	x	

Table 5 *(continued)*

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations/ Technical data (note 4)
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
	Positive opening switch	x	x		
	Interfacing	x	x		x
5.5.7	Two-hand control devices of type II	x	x		x
	Defeat	x	x	x	
5.5.8	Hold-to-run control devices and inching devices	x	x		x
5.5.9	Inching movement limitation: time control or distance control	x	x	x	x
5.5.10	Control devices for toolsetting	x	x	x	
5.5.11	Interfacing	x	x		x
5.5.12	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	x	x	x	x
5.6.2	Delayed unlocking	x	x	x	x
5.6.3	Interlocking devices of category 1	x	x		x
5.6.4	Ancillary devices interlocking	x	x		x
5.6.5	Ejection hazards	x	x		x

Table 5 *(concluded)*

Subclause	Safety requirements and/or measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations/ Technical data (note 4)
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**				
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**				
7.1	MARKING	x	x		
7.2	INSTRUCTION HANDBOOK	x			
Annex A	SAFETY DISTANCES	x	x	x	x
Annex B	RESPONSE TIME OF THE HYDRAULIC SYSTEM		x	x	

NOTE 1: Visual inspection will be used to verify the features necessary for the requirement by visual examination of the components supplied.

NOTE 2: A performance check/test will verify that the features provided perform their function in such a way that the requirement is met.

NOTE 3: Measurement will verify by the use of instruments that requirements are met, to the specified limits.

NOTE 4: Drawings/calculations/technical data will verify that the design characteristics of the components provided meet the requirements.

7 Information for use

7.1 Marking

7.1.1 The general requirements laid down in 5.4 and 1.7.3 of annex A of EN 292-2:1991/A1:1995 shall be followed and EN 61310-2 shall be taken into consideration.

7.1.2 The press shall be marked with the following:

a) name and address of the manufacturer and, where applicable, of the supplier;

b) year of construction;

c) designation of series or type;

d) serial number;

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

f) lifting points for transportation and installation purposes;

g) nominal force;

h) maximum tool dimensions and mass;

i) closing and working speed; minimum and maximum if variable speed range;

j) maximum stroke length;

k) supply data for electrical, hydraulic and pneumatic systems;

l) overall response time and corresponding safety distance(s). See annex A;

m) any limitation on the type of protective device(s) and mode of operation, e.g. closed tools, for which the press is suitable.

Protective devices supplied with the press shall also be marked with identification data.

7.2 Instruction handbook

7.2.1 The general requirements laid down in 5.5 and 1.7.4 of annex A of EN 292-2:1991/A1:1995 shall be followed.

7.2.2 The instruction handbook shall include the following information:

a) a repeat of the information with which the press is marked (see 7.1.2);

b) a reference to this standard and any other standard used in the design of the press;

c) copies of any EC certification documents and reports on pressure vessel or control system tests from the Technical Construction File;

d) instructions for safe installation (floor conditions, services, anti-vibration mountings, etc.);

e) 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;

f) 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;

g) information on noise levels generated during the noise test (see 5.8.4.4);

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

i) information on the protective measures against materials generating hazardous substances, e.g. exhaust ventilation;

j) instructions for safe use; selecting 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 may control the press); setting, trial strokes; maintenance; repair; cleaning and programming (where required) on avoidance of danger from all hazards, including ejection hazards created by workpieces, tools or parts of them, fluids, etc.;

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

- press mechanisms;
- the maintenance of fluid quality and filter changes;
- protective devices;
- accident causation and prevention;
- the work of the toolsetter;
- tool design;
- the use of closed tools and fixed enclosing guards (see 5.3.4, 5.3.9 and 5.3.10);

l) details of any pre-production inspection of the guard or protective device required after toolsetting or adjustment of the tools;

m) specification for any fluid to be used in hydraulic systems and for filters, lubrication, transmission system;

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

o) instructions for any test or examination necessary after replacement of components which affects the safety functions;

p) instructions for periodic maintenance, test and examination of the press, guards and protective devices, including maintenance, testing and examination intervals. The periodic maintenance shall be possible with widely available tools or with tools or equipment delivered with the press;

q) instructions for the use of the means for releasing trapped persons (see 5.3.20).

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

Annex A (normative)

Calculation of minimum safety distances

A.1 The minimum distance at which:

- interlocking guards without guard locking;
- control guards without guard locking;
- early opening interlocking guards without guard locking;
- ESPE using AOPDs;
- two-hand control devices;

shall be placed from the danger zone is to be calculated according to the general formula laid down in clause 5 of EN 999:1996, and namely

$$S = (K \times t) + C$$

where:

a) S is the minimum distance in millimetres, from the danger zone to the detection point, line, plane or zone not less than 100 mm with a detection capability equal to or less than 14 mm;

b) K is a parameter in millimetres per second, derived from data on approach speeds of the body or parts of the body;

c) t is the overall system stopping performance (overall response time) in seconds;

d) C is the additional distance in millimetres, based on the intrusion towards the danger zone prior to actuation of the protective device.

In the case of hydraulic presses,

$$t = t_1 + t_2 + t_3 + \Delta t$$

where:

- t_1 is the stopping time of the press itself (including the response times of the hydraulic and electrical control systems, see annex B);
- t_2 is the response time of the safeguarding system;
- t_3 is the sum of all other remaining measurable response times;
- Δt is the uncertainty in the measuring method.

A.2 In order to determine K, an approach speed of 1 600 mm/s shall be used for horizontally arranged AOPDs and for two-hand control devices. For vertically arranged AOPDs, an approach speed of 2 000 mm/s shall be used if the minimum distance is equal to or less than 500 mm. An approach speed of 1 600 mm/s can be used if the minimum distance is greater than 500 mm.

A.3 In order to determine C for ESPE using AOPDs, see A.6. For unshrouded two-hand control devices, C shall be equal to at least 250 mm. For shrouded two-hand control devices and early opening interlocking guards without guard locking, C can be zero.

A.4 When calculating the overall system stopping performance, the following features shall be taken into account under the severest normal conditions:

a) the highest slide/ram speed on the closing stroke;
b) the influencing temperature of the relevant parts of the system;
c) the tool mass resulting in the longest stopping time;
d) the pressure condition resulting in the longest stopping time;
e) the wear of the relevant parts of the stopping function.

A.5 When the position of the protective devices which are mechanically linked to the press 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.

A.6 With regard to the detection capability of the AOPD, the following additional distance C at least shall be used when calculating the minimum distance S:

Table A.1 — Additional distance C

Detection capability mm	Additional distance C mm	Cycle initiation by the AOPD
≤ 14 $> 14 \leq 20$ $> 20 \leq 30$	0 80 130	Allowed
$> 30 \leq 40$ > 40	240 850	Not allowed

Annex B (normative)

The response time of the hydraulic system

B.1 For each machine, a check of the difference in the response time of the valves in the hydraulic system shall be made during the construction of the press. This verifies that the redundant function of the hydraulic system operates as intended. The measurements shall be repeated to verify the accuracy of the stopping performance.

B.2 The response time of each channel shall be measured at least 10 times. The highest measured value or the mean plus 3 times the standard deviation, whichever is the greater, shall be used in the calculation of the safety distance.

B.3 The difference in time measured for each channel shall be included in the information provided to the user [see 7.2.2 p)].

B.4 An example of how the stopping time measurement equipment can be connected is given in annex G.

Annex C (informative)

Closed tools

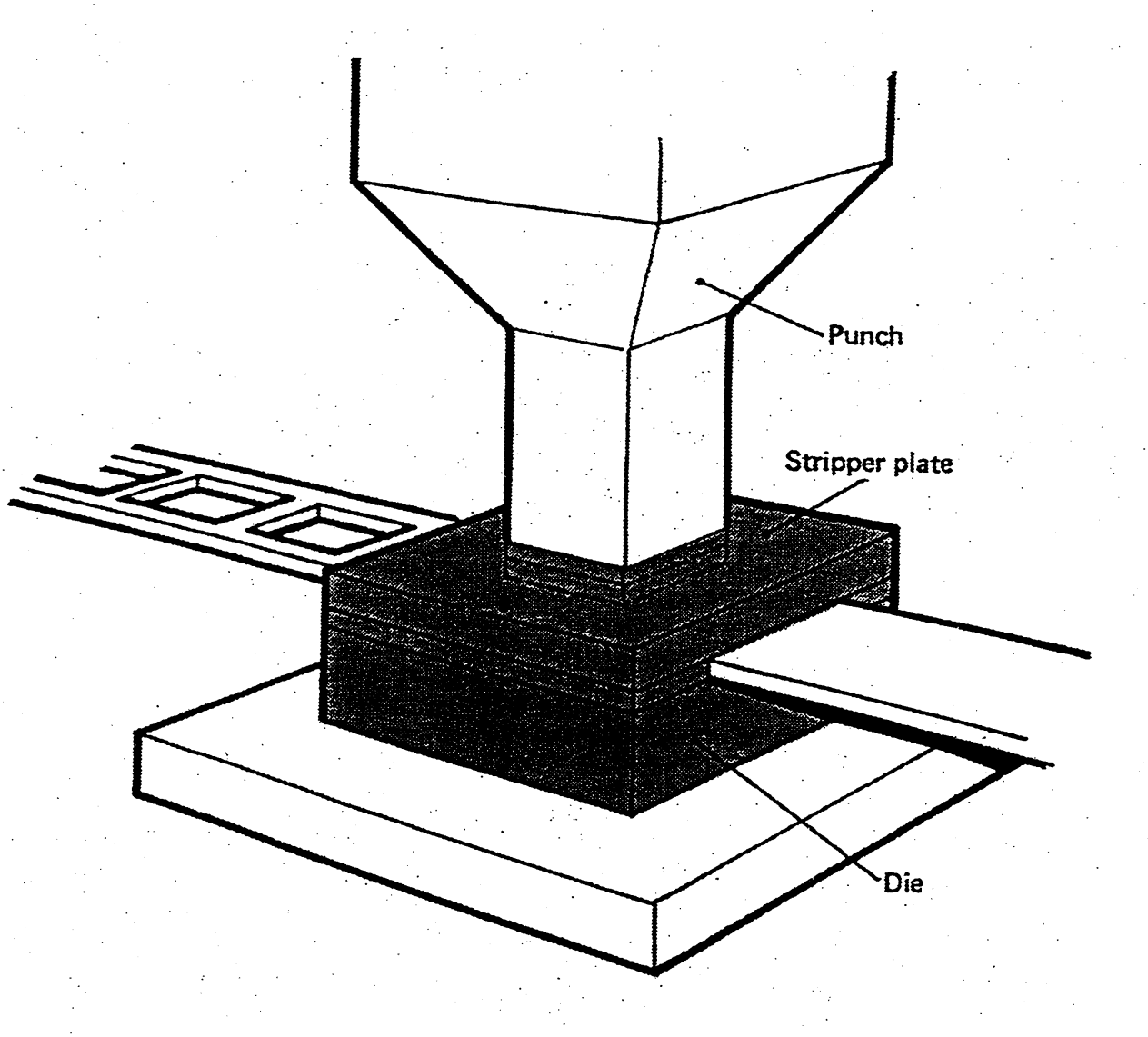


Figure C.1 — Closed tools at a hydraulic press

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 5.3.4 and 5.3.9.

Annex D (informative)

Interlocking devices associated with guards

D.1 Figure D.1 illustrates an example of interlocking by means of two cam-operated switches, one operating positively and one negatively in conjunction with a redundant and monitored hydraulic circuit. The positive mode switch, when actuated, is held in the shut-off position by a cam attached to the guard whenever the guard is in any position other than fully closed. The final closing movement of the guard releases the switch, allowing the supply to connect to the output by the action of the return spring. When the guard is opened, the supply is cut off and the output returned to tank by action of the cam. In the negative mode switch, the final closing movement positively operates the switch, connecting the supply to the output and allowing the machine to be set in motion. When the guard is opened, the switch is reversed by the action of a spring when the operating mechanism is released, the switch cutting off supply.

D.2 Figure D.2 illustrates an example of direct power interlocking (see Tables 2, 3 and 4).

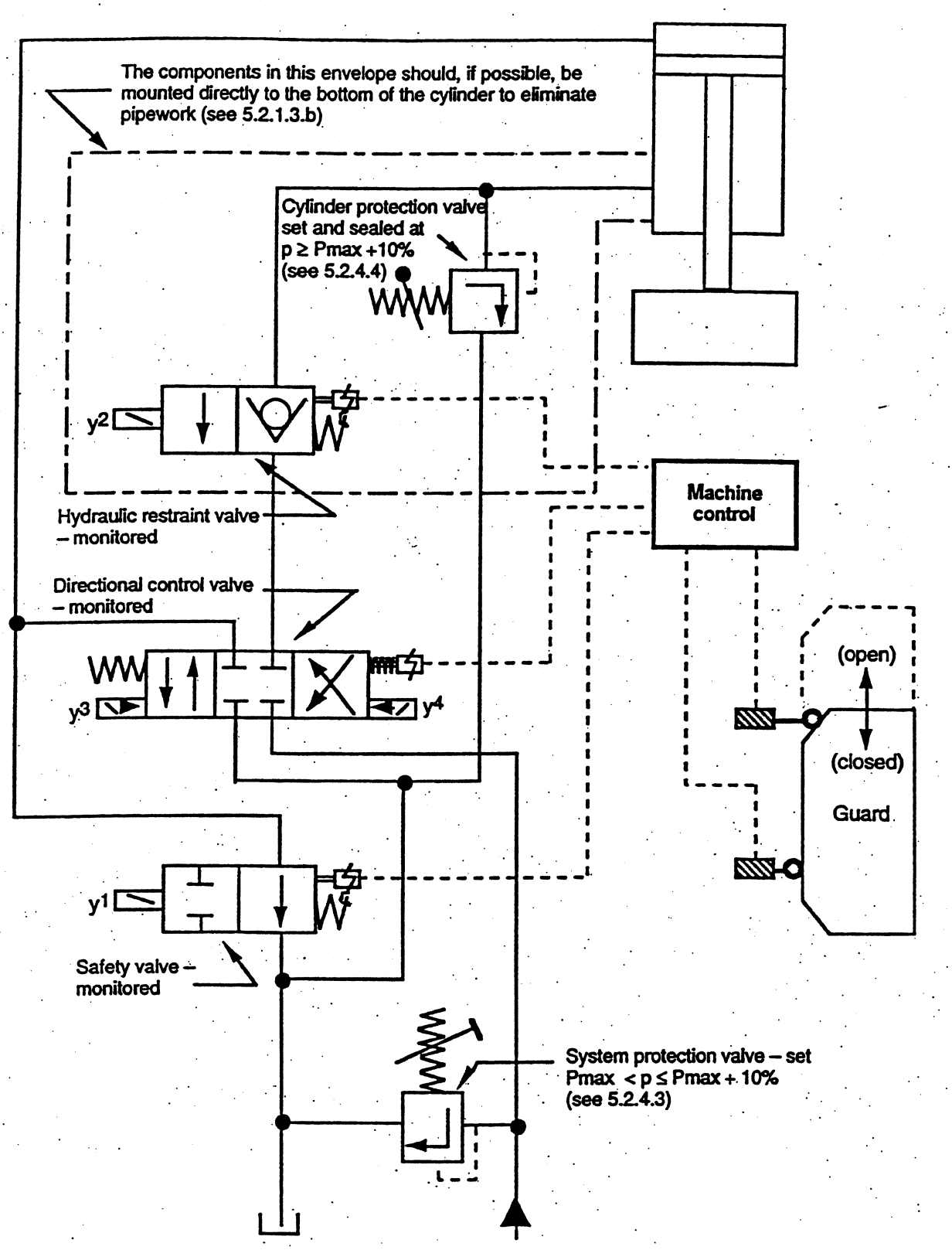


Figure D.1 — Example of a redundant and monitored hydraulic control circuit for a downstroking press
(R and M in Tables 2, 3 and 4)
(redundancy and monitoring in the electrical circuit not shown)

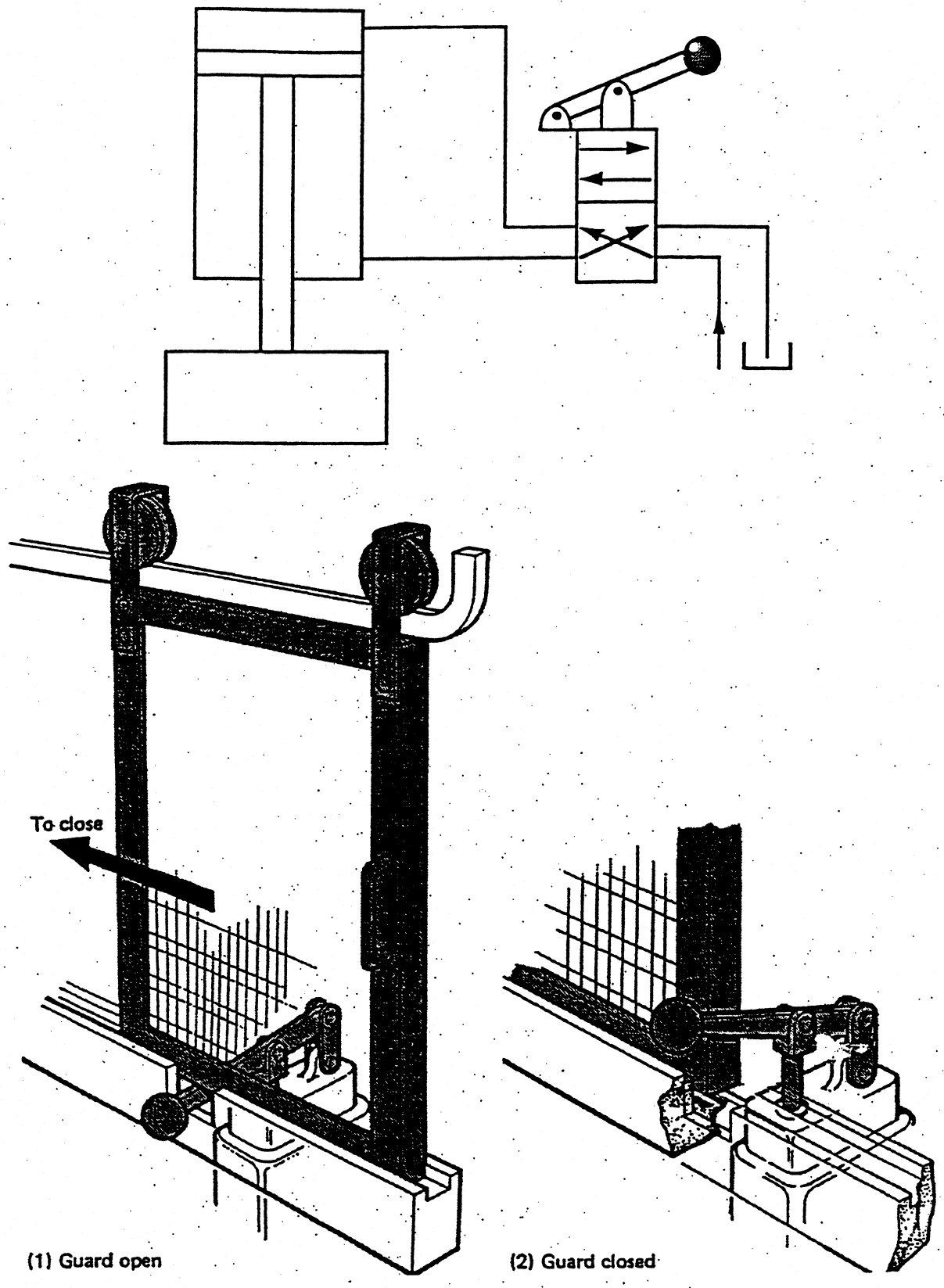
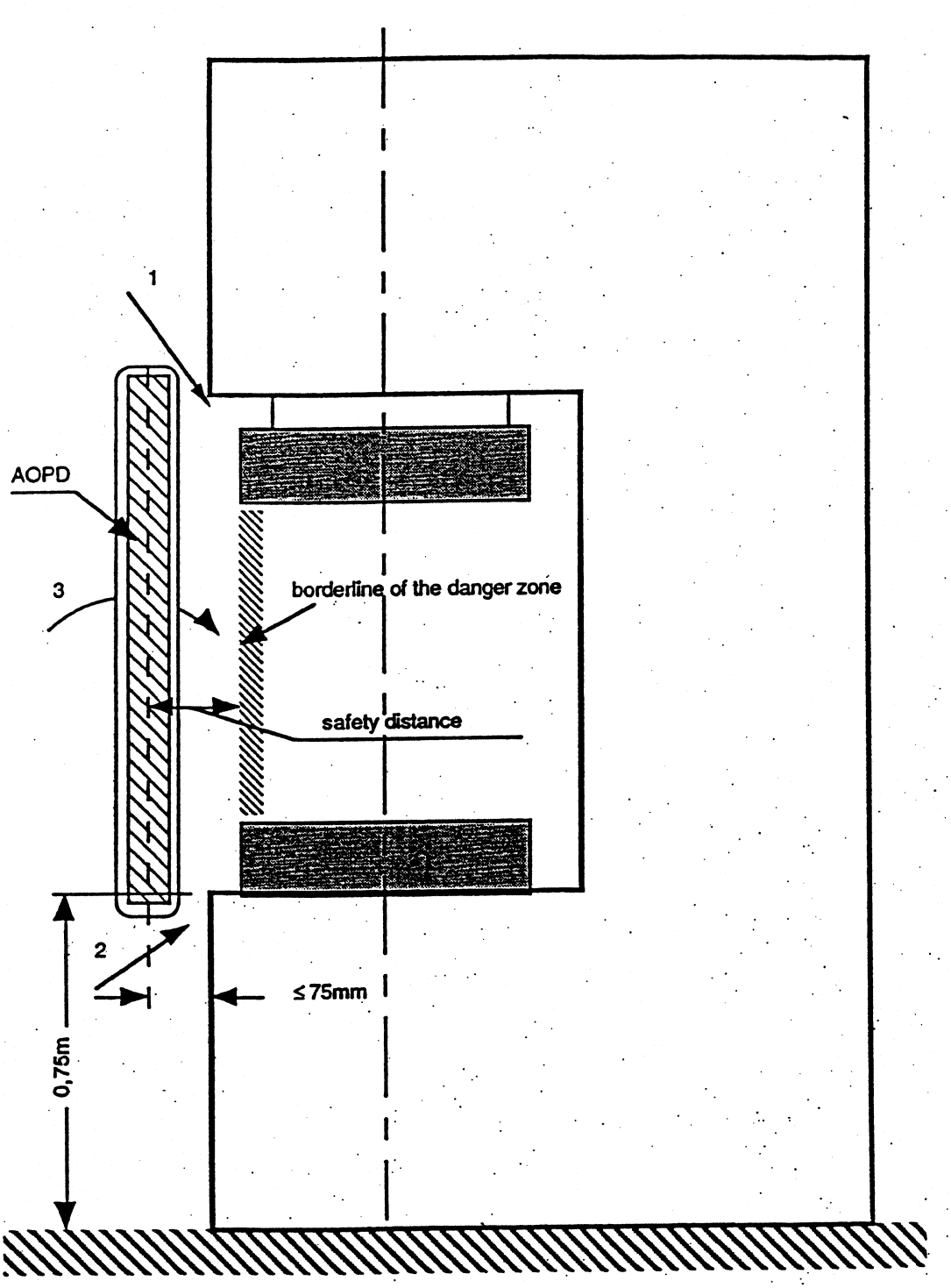


Figure D.2 — Example of power interlocking (see 5.4.1.6)

Annex E (informative)

Electro-sensitive protective equipment (ESPE) using active opto-electronic protective devices (AOPDs)



NOTE: Values against reaching over (1), reaching under (2) and reaching around (3) in accordance with EN 294.

Figure E.1 — Example of a typical application of an AOPD, used for cycle initiation, to a manually fed press (side guards omitted for the purpose of this illustration) [see also 5.3.13 g)]

Annex F (informative)

Conditions for noise measurement of hydraulic presses

F.1 The installation and mounting conditions should be representative of the typical or normal use of the press, and should be the same for both sound power levels and emission sound pressure levels.

F.2 The location of the press under test should be indicated by means of a sketch giving the position and details of any reflecting surfaces likely to influence the noise emission values obtained.

F.3 The recommended operating conditions are the following:

a) the speed in strokes per minute should be at least 80 % of the maximum;

b) the force applied should be at least 80 % of the nominal force;

c) tooling details:

- if the press is capable of carrying out blanking operations, this should be a blanking tool with simple shear surfaces, of specified dimensions to give the recommended force on a given material [see d)];

- if the press is capable of carrying out forming, drawing and coining operations, this should be a forming tool with simple forms, of specified dimensions to give the recommended force on a given material [see d)];

d) material used: this should be Fe P01 mild steel (see EN 10130); for blanking, thickness of the material should correspond with the required force calculated.

F.4 Operating conditions, and in particular those listed in F.3 b), c) and d) are subject to the availability of representative tools and material with respect to the intended use.

If it is not reasonable to make a representative set of tools and material available for the noise measurement, it should be carried out under load in the following conditions:

- the force applied should be at least 80 % of the nominal force;
- cycle initiations and stops at least as frequent as 80 % of the maximum permissible number of strokes per minute.

This test is intended to highlight the noise emission from the press itself, without the variable influence of different tools.

F.5 The noise measurement procedure used for obtaining the noise emission values should be described by indicating the measurement procedure and the microphone positions chosen from the options listed in EN ISO 11202.

F.6 A sketch of all measurement positions indicating those at which sound pressure/power levels have been recorded, and the normal position of the operator(s) should be included. It may be combined with the description of the press location mentioned in 5.8.4.4 p).

F.7 Under the operating conditions recommended in F.3 a) and b) or F.4, the measurement time should last until the A-weighted value of the equivalent sound pressure level has stabilized within 1 dB:

a) when running in continuous cycle mode;
or, if continuous cycle mode is not available

b) when running in single cycle mode at the intended number of operating cycles per minute.

Annex G (informative)

The connection of the stopping time measurement equipment

G.1 In Figure D.1, the protective device operates on y^1, y^2 and y^4. Thus a normal safety stop is achieved by deactivating y^1, y^2 and y^4.

G.2 The normal stopping time is measured by connecting the stopping time equipment to the protective device. If the measurement equipment is connected to the protective device output, the device internal response time shall be added to the measured time.

G.3 Since the response time of the valves can vary within a wide range, the stopping time may be prolonged if a fault in one valve occurs. For this reason, it is necessary to check the individual response time of each hydraulic stopping function.

G.4 In the example shown in Figure D.1, the first stopping function is achieved by $y^1 + y^2$, and the second by y^4 alone. Therefore, the measurement equipment is first connected to y^1 and y^2 only, and the stopping time is noted. Secondly, the equipment is connected only to y^4, and this stopping time is also noted.

Annex ZA (informative)

Relationship of this document with EC Directives

Clauses of this European standard addressing essential requirements or other provisions of EC Directives.

This European standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports the essential requirements of EC Directives 'Machinery' 98/37/EC dated 22–06–98, amended by Directive 98/79/EC.

Warning: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

The clauses of this standard are likely to support the requirements of the Machinery Directive.

Compliance with the clauses of this standard provide one means of conforming to the specific essential requirements of the Directives concerned and associated EFTA regulations.

Bibliography

The following informative references refer to work items of CEN Technical Committees where standards are in preparation but not yet publicly available. Their titles and texts are therefore subject to change.

[1] prEN ISO 14122:1999, *Safety of machinery — Means of permanent access to machines and industrial plants —*

Part 1: Choice of a fixed means of access between two levels.

Part 2: Fixed ladders with or without safety cages and means of barring access to such ladders.

Part 3: Stairways, stepladders and guard rails.

Part 4: Working platforms and gangways.

[2] prEN ISO 14738:2000, *Safety of machinery — Human body measurements — Ergonomic requirements for the design of workplaces at machinery — Standing and sitting postures.*

[3] prEN 1005-4:1998, *Safety of machinery — Evaluation of working postures in relation to machinery.*

[4] prEN 12464, *Lighting applications — Artificial lighting — Workspace lighting.*

[5] ISO/CD 230-5, *Test code for machine tools — Part 5: Determination of the noise emission.*

[6] EN 10130, *Cold rolled low carbon steel flat products for cold forming — Technical delivery conditions.*

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