AS 4024.3002—2009

Australian Standard®

Safety of machinery

Part 3002: Materials forming and shearing—Hydraulic power presses

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- Department of the Premier and Cabinet, SA
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- WorkCover New South Wales

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Australian Standard®

Safety of machinery

Part 3002: Materials forming and shearing—Hydraulic power presses

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PREFACE

This Standard was prepared by the Standards Australia Committee SF-008 Guarding of Power Presses to supersede, in part, AS 1219—1994, *Power presses—Safety requirements*.

The Standard is one of a series dealing with the safety of power presses. It is based upon but not equivalent to EN 693:2001, *Machine tools—Safety—Hydraulic presses* in order to maintain consistency with AS 4024.1, *Safety of machinery* series of Standards.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

Page

STANDARDS AUSTRALIA

Australian Standard
Safety of machinery

Part 3002: Materials forming and shearing—Hydraulic power presses

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies technical safety requirements and measures for hydraulic presses that are intended to work cold metal or material partly of cold metal. In operations involving hot working and the use of tongs during the machine cycle, the principles given in AS 4024.1 should be considered, but may not be capable of being fully applied. This Standard should be read in conjunction with AS 4024.1 (series).

This Standard also covers presses whose primary intended use is to work cold metal, but are also used in a similar way to work other sheet materials (e.g. cardboard, plastic, rubber or leather), and metal powder.

The requirements in this Standard take account of the intended use of the power press. This Standard presumes access to the press from all directions, deals with the hazards (described in Section 2) and specifies safety measures for both the operator and other exposed persons.

The Standard also applies to ancillary devices that are integral to the press.

NOTE: For the safeguarding of integrated manufacturing systems using presses, see also ISO 11161.

This Standard does not cover machines whose principal designed purpose is—

(a) sheet metal or paper cutting by guillotine (see AS 1893);

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

(c) bending or folding by brake presses;

(d) straightening;

(e) turret punch pressing;

(f) extruding;

(g) drop forging, hot forging or drop stamping;

(h) compaction of metal powder;

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

(j) printing presses.

1.2 OBJECTIVE

The objective of this Standard is to enable designers, manufacturers, suppliers, employers and users of hydraulic power presses to reduce the risks to the safety of persons working with or near hydraulic power presses.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1657 Fixed platforms, walkways, stairways and ladders—Design, construction and installation

1893 Code of practice for the guarding and safe use of metal and paper cutting guillotines

2671 Hydraulic fluid power—General requirements for systems (ISO 4413:1998, MOD)

2788 Pneumatic fluid power—General requirements for systems (ISO 4414:1998, MOD)

4024.1 Safety of machinery (series)

4024.1201 Part 1201: General principles—Basic terminology and methodology

4024.1202 Part 1202: General principles—Technical principles

4024.1301 Part 1301: Risk assessment—Principles of risk assessment

4024.1501 Part 1501: Design of safety related parts of control systems—General principles for design

4024.1502 Part 1502: Design of safety related parts of control systems—Validation

4024.1601 Part 1601: Design of controls, interlocks and guarding—Guards—General requirements for the design and construction of fixed and movable guards

4024.1602 Part 1602: Design of controls, interlocks and guarding—Interlocking devices associated with guards—Principles for design and selection

4024.1603 Part 1603: Design of controls, interlocks and guarding—Prevention of unexpected start-up

4024.1801 Part 1801: Safety distances to prevent danger zones being reached by the upper limbs

4024.1803 Part 1803: Safety distances and gaps—Minimum gaps to prevent crushing of parts of the human body

4024.2601 Part 2601: Design of controls, interlocks and guarding—Two-hand control devices—Functional aspects and design principles

4024.2801 Part 2801: Safety distances and gaps—Positioning of protective equipment with respect to the approach speed of parts of the human body

60204 Safety of machinery—Electrical equipment of industrial machines

60204.1 Part 1: General requirements (IEC 60204-1, Ed.5 (FDIS) MOD)

60529 Degrees of protection provided by enclosures (IP Code)

62061 Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems

AS/NZS

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

4586 Slip resistance classification of new pedestrian surface materials

ISO

3746 Acoustics—Determination of sound power levels of noise sources using sound pressure—Survey method using an enveloping measurement surface over a reflecting plane

11161 Safety of machinery—Integrated manufacturing systems—Basic requirements

11202 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/TR
11688 Acoustics—Recommended practice for the design of low-noise machinery and equipment
11688-1 Part 1: Planning
11688-2 Part 2: Introduction to the physics of low-noise design

IEC
61496 Safety of machinery—Electro-sensitive protective equipment
61496-1 Part 1: General requirements and tests
61496-2 Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)

1.4 DEFINITIONS

For the purpose of this Standard, the following definitions apply.

1.4.1 Ancillary device

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

1.4.2 Cycle

1.4.2.1 *Automatic*

Operating mode where the slide or ram repeats continuously or intermittently, all functions achieved without manual intervention into the danger zone after initiation.

1.4.2.2 *Operating*

Movement of the slide or 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.

1.4.2.3 *Single*

Operating mode where each operating cycle of the slide or ram has to be positively actuated by the operator.

1.4.3 Dead centres

Points at which the tool, during its travel, is either—

(a) nearest to the die (generally it corresponds to the end of the closing stroke), known as the ‘bottom dead centre’ (BDC); or

(b) furthest from the die (generally it corresponds to the end of the opening stroke), known as the ‘top dead centre’ (TDC).

1.4.4 Die

The fixed part of the tools used in a press.

1.4.5 Die cushion

Accessory for a die that accumulates and releases, or absorbs, force as required in some press operations.

1.4.6 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.

1.4.7 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.

1.4.8 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 1.1 and 1.2).

1.4.9 Limited movement control device (inching device)

Control device whose actuation permits only a limited amount of travel of a machine element, thus minimizing risk as far as possible; further movement is precluded until there is a subsequent and separate actuation of the control.

1.4.10 Monitoring (M)

Safety function which ensures that a safety measure is initiated if the ability of a component of an element to perform its function is reduced, or if the process conditions are changed in such a way that hazards are generated.

1.4.11 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.

1.4.12 Overall system stopping performance (overall response time)

Time occurring from the actuation of the sensing function to the cessation of hazardous motion, or to the machine assuming a safe condition.

1.4.13 Part detector

Device that detects the workpiece or the correct position of the workpiece and which permits or prevents the initiation of the stroke.

1.4.14 Position switch

Switch that is operated by a moving part of the machine when this part reaches or leaves a predetermined position.

1.4.15 Redundancy (R)

Application of more than one device or system, or part of a device or a system, to ensure that, in the event of one failing to perform its function, another is available to perform that function.

NOTE: Where the term ‘redundant’ is used, provision of a redundancy feature or element is implied.

1.4.16 Restraint valve

Device that protects against a gravity fall of the slide or ram.

1.4.17 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.

1.4.18 Slide or ram

Main reciprocating press member that holds the tools.

1.4.19 Tool

The moving part of the tools used in a press.

1.4.20 Tool protective device

Device that protects the tool against damage by stopping the stroke or by preventing its start.

1.4.21 Tools

Term for the combination of tool and die.

1.4.22 Tools—closed

Tools designed and constructed to be inherently safe.

NOTE: An example of a closed tool is given in Appendix A.

1.4.23 Up-stroking press

Vertical press in which the press table moves upwards during the closing stroke (reciprocal to a down-stroking press).

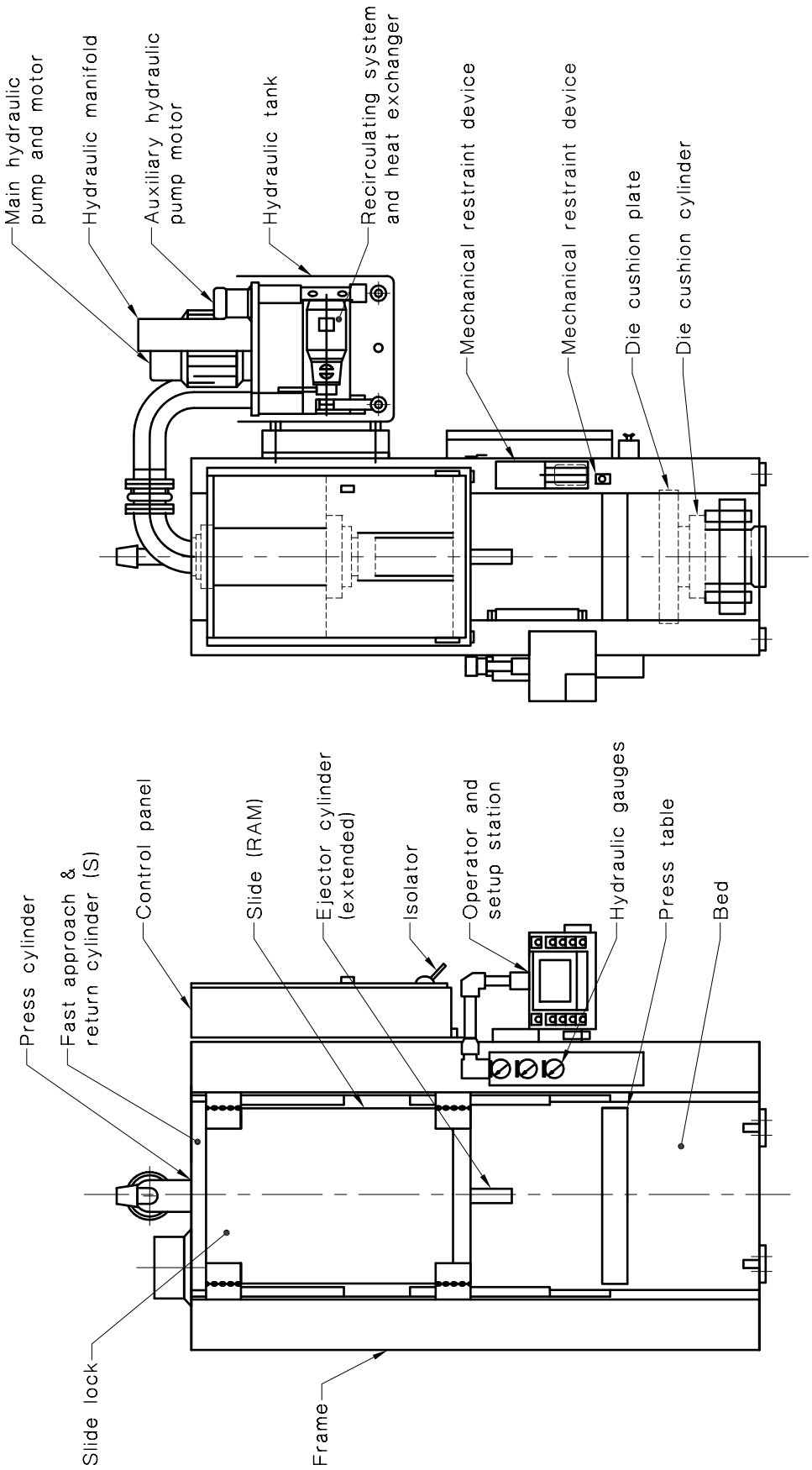


FIGURE 1.1 EXAMPLE OF BOX FRAME TYPE HYDRAULIC PRESS

NOTE: Tools area safeguards not shown.

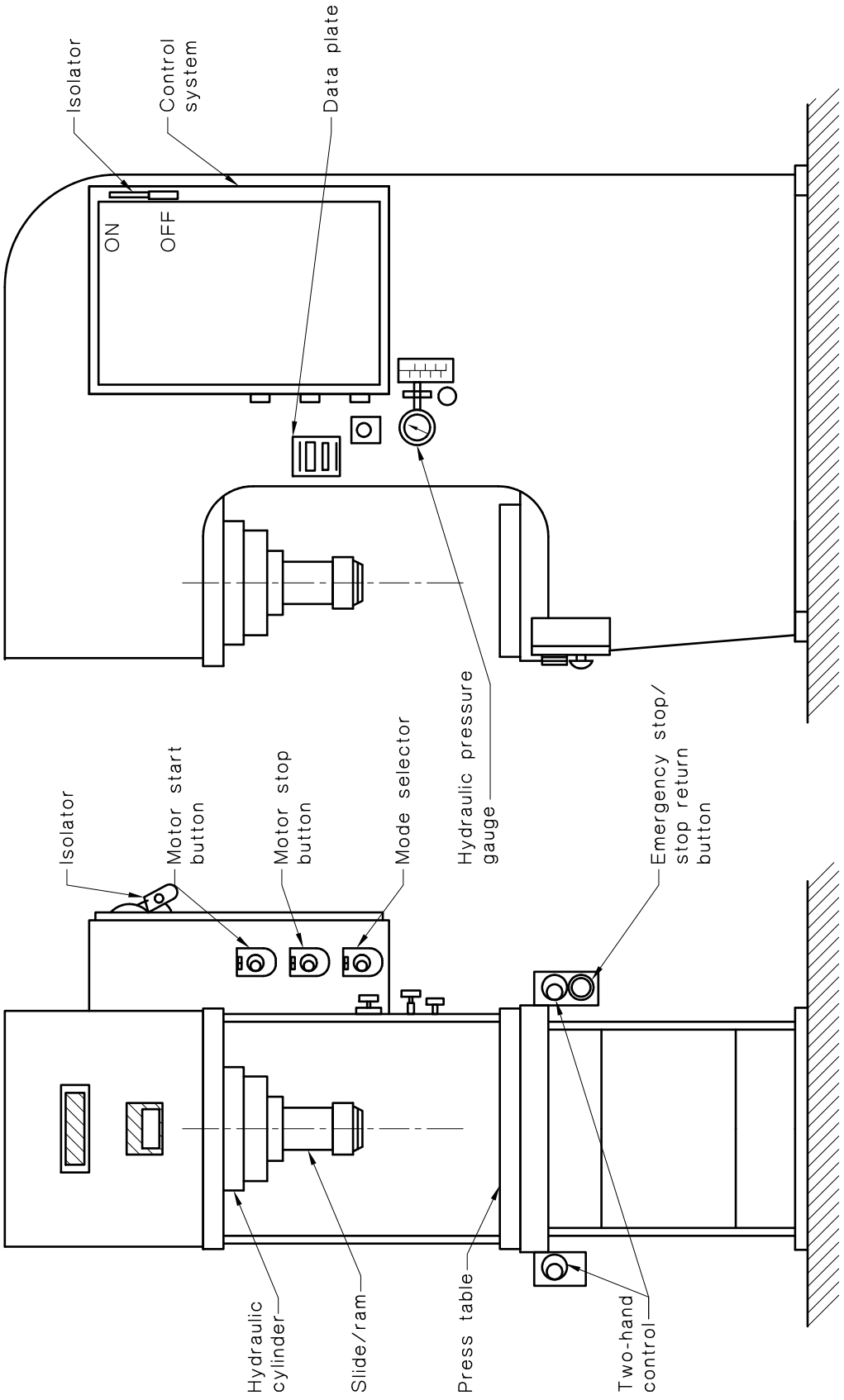


FIGURE 1.2 EXAMPLE OF OPEN FRONT PRESS

NOTE: Tools area safeguards not shown.

SECTION 2 HAZARDS

2.1 GENERAL

Table 2.1 lists significant hazards and their related danger zones normally associated with a hydraulic power press. It is derived from a risk assessment of hydraulic presses covered by the scope of this Standard. The risk assessment took into account foreseeable access from all directions, as well as overruns, unexpected and unintended strokes and gravity falls. Risks to operators and other persons who may have access to the danger zones were identified, taking into account all hazards that might occur during the life of the press. The assessment includes an analysis of the effect of failure in the control system.

The technical measures and information for use given in this Standard are based on this risk assessment and deal with the identified hazards by either eliminating them, or reducing the effects of the risks they generate.

AS 4024.1502 specifies conditions and procedures to be followed for the validation (by both analysis and testing) of safety functions and the category achieved by the safety related parts of the control systems. It should be used when validating the items chosen to make up the control systems for the press.

2.2 RISK ASSESSMENT

A risk assessment in accordance with AS 4024.1301 shall also be carried out. The risk assessment shall pay particular attention to—

(a) the intended use of the press including maintenance, tool setting and cleaning;

(b) foreseeable misuse of the press; and

(c) whether the list of hazards given in Table 2.1 is both exhaustive and applicable to the press under consideration.

TABLE 2.1

TYPICAL HAZARDS, DANGERS AND PREVENTIVE MEASURES

Hazards	Danger zone	Preventive measures: Reference
Mechanical hazards		
Crushing	Tools area:	Clauses 3.2 to 3.5
Shearing	—between moving tools	Appendices C, D and E
Cutting or severing	—moving slide	
Entanglement	—moving die cushions	
Drawing-in or trapping	—workpiece ejectors	
	—guards	
	—workpieces and off cuts	
Impact	Moving parts of electrical, hydraulic and pneumatic equipment	
	Motor and drive machinery	Clause 3.6
	Mechanical handling device	Clause 3.6
	Ancillary equipment	

(*continued*)

TABLE 2.1 (*continued*)

Hazards	Danger zone	Preventive measures: Reference
Ejection	Machine components Workpieces and tools	Clause 3.6.4 Clause 3.2.1
High pressure fluid ejection	Hydraulic systems	Clauses 3.2.3 and 3.2.4
Slip, trip or fall	All work at heights Floor area around the press	Clause 3.7
Electrical hazards		
Direct contact	Electrical equipment	Clauses 3.8.1 and 3.2.6
Indirect contact Thermal radiation (burns)	Electrical equipment Parts made live by electrical equipment under fault conditions	Clauses 3.8.1 and 3.2.6
Thermal hazards resulting in burns and scalds to persons	Parts of the hydraulic system	Clause 3.8.2
Hazards generated by noise resulting in hearing loss	Any area at the press where there is a risk to hearing	Clause 3.8.4
Hazards generated by vibration	Parts of the press where the risk occurs, e.g. the workstation(s)	Clause 3.8.5
Hazards generated by materials and substances processed, used or exhausted by machinery, e.g. resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	Hydraulic systems; pneumatic systems and their controls; toxic work materials	Clause 3.8.6
Fire or explosion	Exhaust ventilation and dust collection equipment	Clause 3.8.6.2
Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities) e.g. caused by poor posture or excessive efforts	The working position and controls for operators and maintenance staff handling tools	Clause 3.8.7

SECTION 3 SAFETY REQUIREMENTS AND MEASURES

3.1 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 Section as follows:

(a) Basic design considerations for major press components or systems (see Clause 3.2).

(b) Safeguarding against mechanical hazards in the tools area under different modes of production (see Clause 3.3 and Tables 3.1, 3.2 and 3.3).

(c) Protection against hazards due to control system or control component failures (see Clause 3.4).

(d) Safeguarding against hazards that can occur during toolsetting, trial strokes, maintenance and lubrication (see Clause 3.5).

(e) Safeguarding against other hazards (see Clauses 3.6 to 3.8).

3.2 BASIC DESIGN CONSIDERATIONS

3.2.1 Prevention of unintended gravity fall during production

3.2.1.1 *General*

Where there is a risk of injury, measures shall be provided to prevent an unintended gravity fall of the slide or ram in the production mode with manual or automatic feed or removal, see Tables 3.1 and 3.2.

NOTE: 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—

(a) a mechanical restraint device (see Clause 3.2.1.3);

(b) a hydraulic restraint device (see Clause 3.2.1.3); or

(c) a combination of a single valve hydraulic restraint device and a mechanical restraint device.

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

3.2.1.2 *Mechanical restraint device*

Where a mechanical restraint is used, it shall be capable of supporting the slide or ram. Typical mechanical restraint devices include a solid steel prop located between the tool and die.

3.2.1.3 *Hydraulic restraint device*

Where a hydraulic restraint device is fitted, it shall consist of either—

(a) two separate hold-up or return cylinders, each with a hydraulic restraint valve and capable of independently holding the slide or 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 or ram.

3.2.1.4 *Minimum restraint devices*

A single valve hydraulic restraint device, or a mechanical restraint device, shall be provided as a minimum on a press made solely for—

(a) automatic operation;

(b) use with closed tools;

(c) use with fixed enclosing guards; or

(d) use with slow closing speed and hold-to-run controls (see Clause 3.3.16).

3.2.1.5 *Checking of restraint function*

There shall be a means for automatically checking that the restraint system is functioning correctly, and no press stroke shall be possible after any of the systems have failed (see Clause 3.4.1.2).

NOTE: See also Appendix B.

3.2.1.6 *Prevention of unintended stroke*

See Clauses 3.4.1.2 and 3.4.2.1 on the control system requirements to prevent unintended strokes.

3.2.2 Prevention of gravity fall during maintenance or repair

3.2.2.1 *Mechanical restraint device*

Where there is a risk of injury from a gravity fall of the slide or ram, a mechanical restraint device 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).

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 or ram is retained in the upper position (see AS 4024.1603).

NOTE: The risk of injury will not occur between the tools of an upstroking press, but can occur below the moving tool.

3.2.2.2 *Large presses*

On presses with an opening stroke length greater than 500 mm and a depth of table greater than 800 mm, the restraint device shall be permanently fixed and integrated with the press. If, when active, an integrated device cannot easily be seen from the operator's position, an additional clear indication of the position of the device shall be provided.

3.2.2.3 *Additional restraint devices*

Where the gravity restraint device is mechanically linked to a main guard that has to be removed for maintenance purposes, additional mechanical restraint devices (which can be manually positioned where necessary) shall be provided.

3.2.3 Hydraulic and pneumatic systems—Common features

3.2.3.1 *General*

The general requirements in AS 2671 and AS 2788 shall be taken into consideration during the design of hydraulic and pneumatic systems. Hydraulic and pneumatic systems shall comply with the specific requirements in Clauses 3.2.3, 3.2.4 and 3.2.5.

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

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

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

All piping, pipe fittings, passages, surge or storage tanks and cored or drilled holes, shall be free from burrs or foreign matter that might cause damage to the system.

3.2.3.2 *Piping*

The following requirements apply to piping:

(a) Each run of piping shall be continuous from one piece of apparatus to another.

(b) Precautions shall be taken to prevent damage by thermal expansion.

(c) Rigid piping shall be securely supported at frequent intervals to avoid vibration or movement.

(d) Care shall be taken to avoid kinking of flexible pipes used to carry fluids.

NOTE: Such kinking can cause traps which prevent the fluid exhausting.

3.2.3.3 *Pressure drop*

Where a drop in pressure could lead to unintended dangerous motion of the slide or ram, flexible piping shall not be used; pipes and pipe connections shall be chosen to prevent such a loss of pressure.

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 the welding of two fitted surfaces.

3.2.3.4 *Support of valves*

Operating valves shall not depend on connected piping for support.

NOTE: This is to avoid undesirable effects from vibration, affecting both valves and piping.

Control valves and other control components (e.g. regulators and manometers) shall be mounted in positions that provide accessibility and avoid damage.

3.2.3.5 *Valve return*

Where valves are manually or mechanically (as distinct from electrically) operated, arrangements for restoring the valves shall be positive, i.e. when the valve actuator is released, the valve shall automatically move to the safe position (see Clause 3.4.8).

3.2.4 Hydraulic systems

3.2.4.1 *Gravity descent*

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 or ram shall be passed through the main control valve or valves in a redundant and monitored system (R and M in Tables 3.1, 3.2 and 3.3).

3.2.4.2 *Accumulators*

Hydraulic systems that include accumulators shall, where technically possible, 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.

Where this is not technically possible, the parts of the circuit that are maintained under pressure shall be supplied with a manual discharge valve in addition to the other devices required concerning accumulators (e.g. relief valves, pneumatic gauges, etc.) and bear a plate or notice warning of the hazard.

3.2.4.3 *Circuit protection*

The circuit shall be protected by pressure-limiting valves. They shall be set at a pressure that is less than the design pressure and no more than 10% higher than the maximum operating pressure.

These valves shall not be capable of alteration without the use of a tool.

3.2.4.4 *Protection on downstroking presses*

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.

Any 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 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 to maintain the function of the relief valve. The components protected by the relief valve shall be designed to sustain the pressure at which the valve is set.

3.2.5 Pneumatic systems

3.2.5.1 *Lubrication*

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 a suitable form.

3.2.5.2 *Silencers*

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.

Water separators shall be provided.

NOTE: The use of incompatible components can affect back-pressure, which can affect the efficiency or safety of the press.

3.2.6 Electrical systems

3.2.6.1 *General*

The electrical system shall comply with AS 60204.1.

The designer of a press should consider the limits of the electrical supply, the physical environment and the operating conditions of components.

3.2.6.2 *Emergency stop*

The emergency stop shall immediately remove power to the machine actuators i.e. an uncontrolled stop (Category 0 of AS 60204.1).

3.2.6.3 *Two-hand controls*

Two-hand control devices shall conform to Clause 3.3.16 and Table 3.1 for the mode of production (single cycle, manual feed or removal) and Clause 3.5.7 for tool-setting, maintenance and lubrication (see AS 4024.2601).

3.2.6.4 *Enclosure protection*

The minimum degree of protection for the operator interface and press-mounted control devices shall be of at least IP 54 (see AS 60529).

Enclosures of control gear shall provide a degree of protection of at least IP 54 (see AS 60529).

3.2.6.5 *Wiring*

Wiring shall be in accordance with AS/NZS 3000.

3.3 MECHANICAL HAZARDS IN THE TOOLS AREA

3.3.1 General

The major danger zone at hydraulic presses is the tools area and preventive measures shall be taken to deal with the relevant hazards. Clauses 3.3 to 3.5 indicate how the danger zone at the tools and associated areas, e.g. moving die cushions, blanking holders and workpiece ejectors, shall be safeguarded.

Tables 3.1, 3.2 and 3.3 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 as follows:

(a) Single cycle: manual feed or removal (Table 3.1).

(b) Automatic cycle: manual feed or removal (Table 3.2).

(c) Automatic cycle: solely automatic feed and removal (Table 3.3).

3.3.2 Safeguards

Safeguarding measures described in AS 4024.1201 and AS 4024.1202, appropriate to the safeguarding of any operator at the tools, are listed below.

Safeguarding methods that reduce the risks as far as possible shall be selected, considering the significant hazards (see Table 2.1) and the mode of production (see Tables 3.1, 3.2 and 3.3).

The selected combination of safeguards 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 Clause 2.1.

Guidance on methods of safeguarding is given in AS 4024.1601 and AS 4024.1602.

Examples of safeguards are as follows:

(a) Closed tools (see AS 4024.1801 and AS 4024.1803).

(b) Fixed enclosing guards (see AS 4024.1601 and AS 4024.1801).

(c) Interlocking guards with or without guard locking (see AS 4024.1601 and AS 4024.1603).

(d) Control guards with or without guard locking (see AS 4024.1201 and AS 4024.1601).

(e) Early opening interlocking guards with or without guard locking (see AS 4024.1601).

(f) Electro-sensitive protective equipment using opto-electronic protective devices.

(g) Two-hand control devices.

(h) Hold-to-run control devices with a slow closing speed (less than or equal to 10 mm/s, see Clause 3.3.16) principally for toolsetting (see Clause 3.5).

3.3.3 Manual loading

Where a hydraulic press is capable of being manually loaded 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 Clause 4.2).

3.3.4 Control system category

The control system of the press shall be in the same category as the guards and protective devices, as a minimum. Safety-related parts of the control systems should be maintained to the appropriate level of safety integrity in accordance with AS 4024.1501 and AS 4024.1502.

3.3.5 Access from more than one side

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 from which access is possible.

3.3.6 Single use operation

Where a very large press may be used for special 'one-off' pressing of large components, e.g. pressure vessel ends, and use of a guard is impracticable, provision shall be made as necessary for allowing a safe method of work to be applied by the user, e.g. provision of controls to be moved to a safe position with a good view of the tools and workpiece and if necessary additional audible warnings or visual danger signals. If this press is not exclusively dedicated to this work, Clauses 3.3.2 to 3.3.7 shall apply.

3.3.7 Closed tools

Closed tools shall be inherently safe. Their openings and the corresponding safety distances shall meet the requirements set out in AS 4024.1801 or not exceed 6 mm. Any additional crushing hazard outside the closed tools shall be avoided (see AS 4024.1803).

3.3.8 Fixed guards

Fixed enclosing guards shall comply with AS 4024.1601. They shall be firmly secured to the machine, another rigid structure or the floor. The feed opening shall comply with AS 4024.1.

3.3.9 Interlocking and control guards

Interlocking guards and control guards shall comply with AS 4024.1601 and shall 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 is closed. The associated interlocking devices shall be designed and constructed in accordance with AS 4024.1602 and the safety related parts of its control system shall conform to AS 4024.1501. Control guards shall also comply with AS 4024.1201 and AS 4024.1202.

3.3.10 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 be—

(a) an active opto-electronic protective device; or

(b) a fixed guard kept in place permanently (e.g. by welding); or

(c) an interlocking guard in accordance with AS 4024.1602.

Except when the control guard is controlled by a hold-to-run control device, control guards shall only be used when the opening stroke length is less than or equal to 600 mm and the depth of the press table is less than or equal to 1000 mm.

The control guard(s) shall be securely held open (e.g. by spring or counterweight) to avoid gravity fall that could cause unintended cycle initiation.

3.3.11 Guard locking

The guards given in Clause 3.3.9 shall be provided either—

(a) with guard locking, to prevent the opening of the guard until any dangerous movement in the tools area has ceased; or

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

3.3.12 Early opening

Where an interlocking guard or a control guard has an early opening feature, it shall function as an early opening interlocking guard (see Clause 1.4.6).

3.3.13 Electro-sensitive protective equipment

Electro-sensitive protective equipment using an active opto-electronic protective device in the form of a light curtain shall comply with the following:

(a) It shall conform to IEC 61496-1 and IEC 61496-2.

(b) Access to the danger zone shall only be possible through the detection zone of the electro-sensitive protective equipment. Additional safeguarding shall prevent access to the danger zone from any other direction.

(c) Where it is possible to stand in a position between electro-sensitive protective equipment and the danger zone of the press, additional means (e.g. further beams) shall be provided to detect a person standing there. The maximum permissible undetected gap shall be calculated from AS 4024.2801

NOTE: Appendix C illustrates the use of opto-electronic protective devices.

(d) Access to the hazardous area during any movement of the ram shall be permitted only for machine setting or essential maintenance purposes and not for production purposes.

(e) The means of resetting shall be positioned so that there is a clear view of the danger zone from the resetting device position. There shall not be more than one reset control device on each detection zone. If the press is safeguarded by means of side and rear electro-sensitive protective equipment, a reset control device shall be provided on each detection zone.

(f) Where the electro-sensitive protective equipment 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 IEC 61496-2) to be undetected by the electro-sensitive protective equipment 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 electro-sensitive protective equipment is also used for cycle initiation, either single or double break, the following applies:

  (i) The height of the press table shall be equal to or greater 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. the use of a fixed guard, 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 less than or equal to 600 mm and the depth of the press table shall be less than or equal to 1000 mm.

  (iii) The detection capability shall not exceed 30 mm (see Appendix D).

  (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 active opto-electronic protective device 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 electro-sensitive protective equipment shall be required to be manually reset, if the pre-set time has been exceeded.

(vi) If there is more than one electro-sensitive protective device safeguarding the press, only one of them at the front shall be selected for cycle initiation at any one time.

(h) Switching off the electro-sensitive protective equipment by the selector switch shall also switch off the indicator lights.

3.3.14 Two-hand controls

Two-hand control devices shall comply with the following:

(a) They shall be in accordance with type IIIC as set out in AS 4024.2601.

(b) The number of two-hand control devices in operation shall correspond to the number of operators indicated at the selection system on the press control console.

(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.

(d) Additional safeguarding shall prevent access from the sides and the rear and a risk assessment shall be used to decide whether additional safeguarding is required at the front.

3.3.15 Guards without guard locking

Interlocking guards without guard locking, control guards without guard locking, early opening interlocking guards without guard locking, electro-sensitive protective equipment 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 Appendix D).

3.3.16 Hold-to-run controls

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 3.1, 3.2 and 3.3) allow higher speed than 10 mm/s, then the slow speed shall be manually selected by operating a selector switch that activates the hold-to-run control device and simultaneously sets slow speed.

The speed shall not be limited by adjustment of variable parameters.

3.3.17 Other requirements

3.3.17.1 *Securing tools*

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.

3.3.17.2 *Fastenings*

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

3.3.17.3 *Manual adjustment*

Where manual adjustment of a press can create a hazard (e.g. to the stroke or slide or ram adjustment, or speed change), the means of manual adjustment shall have a reliable locking device that only allows adjustment by means such as a tool, key or electronic password.

3.3.17.4 *Handling device*

On automatically running presses with handling devices that are an integral part of the press, the leading edge of the coil should be automatically guided into progression tools. If the leading edge of the coil cannot automatically be guided during loading through the handling device and the progression tools, the press shall be provided with either—

(a) a hold-to-run control device with three (3) positions and slow speed (less than or equal to 10 mm/s); or

(b) an inching device (see Clause 3.5.9).

3.3.18 Hold-to-run controls for handling device

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

The hold-to-run control device shall consist of a single button having the following positions:

(a) Position 1 .....Stop.

(b) Position 2 .....Run.

(c) Position 3 .....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.

3.3.19 Release of trapped persons

Means shall be provided to release any person trapped at the tools area (see Clause 4.2(r)).

3.4 CONTROL AND MONITORING SYSTEM

3.4.1 Control and monitoring functions

3.4.1.1 *Safety functions*

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; or

(g) after removal of an interlocked mechanical restraint device.

3.4.1.2 *Resetting of control function*

In the event of an intervention of a safety system (interlocking guard or electro-sensitive protective equipment), separate manual reset functions are required to restore the normal intended operation if—

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

(b) electro-sensitive protective equipment used for cycle initiation is not interrupted in a pre-set time;

(c) electro-sensitive protective equipment is interrupted during any dangerous movement in the cycle; or

(d) electro-sensitive protective equipment 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 the requirements for at least a single system with monitoring.

3.4.2 Specific protective devices

3.4.2.1 *Scope*

This Clause applies to presses fitted with any protective device of the following types:

(a) Electro-sensitive protective equipment using active opto-electronic protective devices.

(b) Interlocking guards (see also Clause 3.4.2.3) and control guards.

(c) Two-hand control devices used for normal operation.

This Clause does not apply to presses used solely for automatic feed or removal, working in automatic cycle and fitted with an interlocking guard with guard locking (see Table 3.3).

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

(i) an unintended start-up shall not be possible;

(ii) the safe functioning of the protective device shall be maintained;

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

(iv) the control system shall immediately stop the machine during the dangerous phase of the closing stroke or, in other cases, no later than the end of the operating cycle (see Note); and

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

NOTE: Examples of this are where a fault occurs in one channel of a two channel control system, so that the other channel remains operative, and where a fault occurs during parts of the cycle other than the dangerous phase of the closing stroke.

In order to meet these requirements, the safety related parts of the control systems shall conform to category 4 of AS 4024.1501. The start and stop functions in the safety related parts of the press control system shall be hardwired, redundant and monitored.

3.4.2.2 *Press control*

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

3.4.2.3 *Power interlocking*

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 AS 4024.1602.

NOTE: Appendix B provides examples of interlocking devices associated with guards.

3.4.3 Muting

3.4.3.1 *General*

Muting (see Clause 1.4.11) may be provided for electro-sensitive protective equipment 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 minimized, e.g. by fixed guards; and

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

3.4.3.2 *Mute point setting*

The means of 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.

3.4.3.3 *Guard muting*

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.

3.4.4 Programmable electronic systems, programmable pneumatic systems and safety related functions

The use of programmable electronic systems and programmable pneumatic systems shall not reduce any level of safety laid down in this Standard.

Where a press is controlled by a programmable electronic system or a programmable pneumatic system, the safety related functions shall not rely solely on the programmable electronic system or a programmable pneumatic system.

AS 4024.1202 should be consulted for requirements for safety functions implemented by programmable electronic control systems. AS 62061 should also be consulted as it provides requirements and recommendations for the specification, design and validation of safety-related electrical control systems for machines that are not portable by hand.

3.4.5 Selector switches

3.4.5.1 *Provisions of selector switches*

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.

3.4.5.2 *Single selector*

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 Clause 3.3.2). 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.

3.4.5.3 *Additional selector switches*

If a press is also intended to be used with closed tools or fixed enclosed guards 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.

3.4.5.4 *Multiple operators*

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.

3.4.5.5 *Selectors for safety function*

Selector switches for safety related functions shall be key operated. The selection shall be visible and clearly identifiable.

3.4.6 Position switches

The means of operation of a position switch (see Clause 1.4.14) 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.

3.4.7 Control devices

3.4.7.1 *Shrouding*

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.

3.4.7.2 *Emergency stop*

Emergency stop buttons shall on actuation stop all dangerous movement by immediately removing power from machine actuators, i.e. a Category 0 stop (see AS 60204.1).

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.

3.4.7.3 *Start button on pedestals or pendants*

In order to avoid unintended start up, portable pedestals or pendants incorporating start buttons shall be designed having regard to stability and support.

3.4.8 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.

3.5 TOOLSETTING, TRIAL STROKES, MAINTENANCE AND LUBRICATION

3.5.1 General

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.

3.5.2 Slide or ram movement

Facilities shall be provided to allow the movement of the slide or ram during toolsetting, maintenance and lubrication to be carried out with guards and protective devices in position and operational (see Clause 3.3.2). Where this is not technically achievable, at least one of the following facilities shall be provided:

(a) Two-hand control device in accordance with Clause 3.5.7 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 to or less than 10 mm/s, limited movement.

(b) Slow speed (equal or less than 10 mm/s) and a hold-to-run control device.

(c) Using an inching device.

3.5.3 Trial strokes

All trial strokes (single operating cycle) after toolsetting or adjustment are considered to be production strokes, and the safeguarding shall meet the requirements laid down in Clause 3.3.

3.5.4 Manually adjustable feeders

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

3.5.5 Using protection devices

Unless the protective devices used in normal production can be retained in use, control devices shall be provided 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, there will be more than one person on a side, additional devices (e.g. enabling devices, selector switches, warning signals) shall be provided.

3.5.6 Movable guard

If a movable guard has to be opened only for toolsetting or maintenance, it shall be an interlocking guard in accordance with AS 4024.1601. The minimum standard of interlocking is a switch of the positive operation type and complying with AS 4024.1602. The interface to the safety related parts of the control system shall not rely on a single relay.

3.5.7 Two-hand controls

Two-hand control devices shall comply with the following:

(a) Two-hand control devices shall at least comply with the requirement for a type II device of AS 4024.2601.

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

Reference should also be made to AS 60204.1.

3.5.8 Hold-to-run devices

Hold-to-run control devices and inching devices shall be hardwired and the safety related parts of the control system shall conform to at least Category 2 of AS 4024.1501.

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.

3.5.9 Inching

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 or ram movement shall not exceed 6 mm per inching step.

3.5.10 Interface

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

3.5.11 Maintenance

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.

3.6 OTHER MECHANICAL HAZARDS

3.6.1 Power transmission

Drive and transmission machinery, and ancillary devices that 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;

(b) movable guards interlocked with the control system, where access is required more than one per shift; or

(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.

Guarding is not required if the danger zone is out of reach in accordance with AS 4024.1801 and access is not required for regular maintenance (e.g. lubrication, setting or cleaning).

3.6.2 Unlocking

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

3.6.3 Ancillary device

Ancillary devices that 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.

3.6.4 Ejection hazards

Ejection hazards created by machine components (or parts of them) shall be eliminated by design or by additional shielding, both capable of withstanding the foreseeable forces in relation to workpieces and tools.

3.7 SLIPS, TRIPS AND FALLS

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 AS 1657).

The press shall be designed, constructed and supplied to minimize the risk of slips, trips and falls in the press area (see AS/NZS 4586).

3.8 PROTECTION AGAINST OTHER HAZARDS

3.8.1 Electrical hazards

All electrical equipment shall be designed and constructed to prevent electrical shock hazards (see AS 60204.1).

3.8.2 Thermal hazards

Means such as shielding or insulation shall be provided to prevent burns from accessible parts of the press, e.g. parts of the hydraulic system.

3.8.3 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 arising from a failure in the flexible piping system.

3.8.4 Hazards generated by noise

3.8.4.1 *Design and construction*

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 and ISO/TR 11688-2 should be followed.

3.8.4.2 *Sources of noise*

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 may 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.

The measurement and declaration of noise emission values shall be made according to ISO 3746 and ISO 11202, as appropriate.

3.8.4.3 *Information*

The minimum information relating to the measurement of airborne noise emission that should be provided is as follows:

(a) *Machine data*

The machine data required are—

(i) name and address of the manufacturer;

(ii) year of construction;

(iii) designation of series or type;

(iv) serial/prototype number of the press under test;

(v) nominal force; and

(vi) closing and working speed; both minimum and maximum if a variable speed range is used.

(b) *Operating conditions during measurement*

The operating conditions to be provided are—

(i) closing and working speed;

(ii) number of strokes per minute;

(iii) stroke length;

(iv) installation and mounting conditions;

(v) force applied in kN;

(vi) pressure applied in MPa during retraction;

(vii) tooling details; and

(viii) type and thickness of the material used.

(c) *Measurement*

The noise measurement data are—

(i) location of the press under test, with respect to the reflecting plane;

(ii) measurement procedure;

(iii) measurement positions; and

(iv) measurement time.

(d) *Results*

The test result data are—

(i) the background sound pressure levels, if the correction factor is required;

(ii) the equivalent continuous A-weighted sound pressure level in the operator's position;

(iii) the peak C-weighted instantaneous sound pressure level in the operator's position; and

(iv) the sound power emitted where the equivalent continuous A-weighted sound pressure level exceeds 85 dB(A).

NOTES:

1 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.

2 Information on the conditions for noise measurement of hydraulic presses is given in Appendix E.

3.8.5 Hazards generated by vibration

The design of the press shall be such that vibration that can cause injury is avoided, e.g. by isolation of the press from the floor foundations.

3.8.6 Hazards generated by materials and substances

3.8.6.1 *Hazardous substances*

Hazardous substances shall not be used wherever possible in the construction of the press, and the use of materials that can cause injury or damage to health shall be eliminated.

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.

3.8.6.2 *Processing hazardous substances*

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.

Design measures for exhaust ventilation and dust collection equipment shall include features to minimize the risk from fire and explosion.

3.8.7 Hazards generated by neglecting ergonomic principles

3.8.7.1 *Posture*

The press and its controls shall be designed to provide a good work posture that does not cause fatigue.

3.8.7.2 *Controls*

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.

3.8.7.3 *Lighting*

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 avoided.

3.8.7.4 *Manual handling*

Parts of the press that need to be lifted with a lifting device shall include necessary attachments to accommodate the fitting of a lifting device.

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

TABLE 3.1

REQUIREMENTS FOR THE OPERATOR SAFEGUARDING OF TOOLS FOR DIFFERENT MODES OF OPERATION—SINGLE CYCLE, MANUAL FEED OR REMOVAL

Operator safety system (Note 1)	Cycle initiation	Start and stop function (Note 2)		Muting option (Note 3)	Remarks
		Electrical	Hydraulic		
Closed tools	Any	S	S	No	See Clause 3.3.3 and 3.3.7
Fixed enclosing guard	Any	S	S	No	See Clauses 3.3.3 and 3.3.8
Interlocking guard with guard locking	Any other than the guard itself	R & M	S & M	No	See clauses 3.3.5 and 3.3.11 Direct power interlocking of the hydraulic circuit may be provided as an alternative to R & M (see Clause 3.4.2.3)
Interlocking guard without guard locking	Any other than the guard itself	R & M	R & M	No	See Clauses 3.3.9, 3.3.11 and 3.3.15
Control guard with guard locking	Guard itself	R & M	S & M	No	See Clauses 3.3.9 to 3.3.11
Control guard without guard locking	Guard itself	R & M	R & M	No	See Clauses 3.3.9 to 3.3.11 and 3.3.15
Early opening interlocking guard	Any	R & M	R & M	Yes	Either use of appropriate safety distance (see Clause 3.3.15) or guard locking which is effective during the dangerous movement of the tools (see Clauses 3.3.11 and 3.3.12)
Electro-sensitive protective equipment	Any, but see remarks 2 and 3	R & M	R & M	Yes	See Clause 3.3.13 (a) Use of appropriate safety distance (see Clause 3.3.15). (b) Where there is a gap between tools large enough to be fully entered, a separate stroke initiation device shall be provided. (c) Restrictions using single or double break (see Clause 3.3.13).
Two-hand control device	Two-hand control device	R & M	R & M	Yes	See Clause 3.3.14 Use of appropriate safety distance (see Clause 3.3.15)
Hold-to-run control device and slow closing speed	Hold-to-run control device	S	S	Yes	(a) Principally for toolsetting (see Clause 3.5). (b) Maximum slow closing speed: 10 mm/s (see Clause 3.3.16).

LEGEND:
M = monitoring
R = redundancy
S = single system

NOTES:

1 For toolsetting, see Clause 3.5.

2 See Clause 3.4.1 for the requirements of the control system.

3 See Clause 3.4.3.

TABLE 3.2

REQUIREMENTS FOR THE OPERATOR SAFEGUARDING OF TOOLS FOR DIFFERENT MODES OF OPERATION—AUTOMATIC CYCLE, MANUAL FEED OR REMOVAL

Operator safety system (Note 1)	Cycle initiation	Start and stop function (Note 2)		Muting option (Note 3)	Remarks
		Electrical	Hydraulic		
Closed tools	Any	S	S	No	See Clause 3.3.3 and 3.3.7
Fixed enclosing guard	Any	S	S	No	See Clauses 3.3.3 and 3.3.8
Interlocking guard with guard locking	Any other than the guard itself	R & M	S & M	No	See Clauses 3.3.9 and 3.3.11 Direct power interlocking of the hydraulic circuit may be provided as an alternative to R & M (see Clause 3.4.2.3)
Interlocking guard without guard locking	Any other than the guard itself	R & M	R & M	No	See Clauses 3.3.9, 3.3.11 and 3.3.15
Electro-sensitive protective equipment	Any, other than the device itself	R & M	R & M	Yes	See Clause 3.3.13 Use of appropriate safety distance (see Clause 3.3.15).

LEGEND:

M = monitoring
R = redundancy
S = single system

NOTES:

1 For toolsetting, see Clause 3.5.

2 See Clause 3.4.1 for the requirements of the control system.

3 See Clause 3.4.3.

TABLE 3.3

REQUIREMENTS FOR THE OPERATOR SAFEGUARDING OF TOOLS FOR DIFFERENT MODES OF OPERATION—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
		Electrical	Hydraulic		
Closed tools	Any	S	S	No	See Clause 3.3.3 and 3.3.7
Fixed enclosing guard	Any	S	S	No	See Clauses 3.3.3 and 3.3.8
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 Clauses 3.3.9 and 3.3.11.
Interlocking guard without guard locking	Any other than the guard itself	R & M	R & M	No	See Clauses 3.3.9, 3.3.11 and 3.3.15
Electro-sensitive protective equipment	Any, other than the device itself	R & M	R & M	No	See Clause 3.3.13 Use of appropriate safety distance (see Clause 3.3.15).

LEGEND:

M = monitoring
R = redundancy
S = single system

NOTES:

1 For toolsetting, see Clause 3.5.

2 See Clause 3.4.1 for the requirements of the control system.

3 See Clause 3.4.3.

SECTION 4 USER INFORMATION

4.1 MARKING

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; both minimum and maximum if a variable speed range is used.

(j) Maximum stroke length.

(k) Supply data for electrical, hydraulic and pneumatic systems.

(l) Overall response time and corresponding safety distance(s).

(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.

4.2 INSTRUCTION HANDBOOK

An instruction handbook shall be provided with the machine and shall include the following information:

(a) The information that is marked on the press (see Clause 4.1).

(b) A reference to any Standard used in the design of the press.

(c) Copies of any certification documents and reports on pressure vessel or control system tests.

(d) Instructions for safe installation, e.g. floor conditions, services, anti-vibration mountings.

(e) Instructions for how the initial test and examination of the press and guarding system are to be carried out before first use and being put into service.

(f) Instructions on control systems, including circuit diagrams for electrical, hydraulic and pneumatic systems. Where a programmable electronic system or programmable pneumatic system is provided, the circuit diagrams shall show the clear relationship at the interface between any hardwired part and the programmable electronic system or programmable pneumatic system.

(g) Information on noise levels generated during the noise test (see Clause 3.8.4.3).

(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, including—

  (i) selecting of modes of operation, initiation and the operator's protective system (in particular where closed tools of fixed enclosing guards are allowed or several operators may control the press);

  (ii) setting, trial strokes;

  (iii) maintenance;

  (iv) repair;

  (v) cleaning;

  (vi) programming (where required); and

  (vii) 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—

  (i) press mechanisms;

  (ii) the maintenance of fluid quality and filter changes;

  (iii) protective devices;

  (iv) accident causation and prevention;

  (v) the work of the toolsetter;

  (vi) tool design;

  (vii) the use of closed tools and fixed enclosing guards (see Clauses 3.3.3, 3.3.7 and 3.3.8); and

  (viii) replacement parts.

(l) Details of any pre-production inspection of the guard or protective device required after toolsetting or adjustment of the tools.

(m) Specification of any fluid to be used in hydraulic systems as well as for filters, lubrication and transmission systems.

(n) Specifications for consumables and components, taking into account compatibility and continued safe operation of the press.

(o) Descriptions of foreseeable failure modes and advice on detection, prevention and correction by periodic maintenance.

(p) Instructions for any test or examination necessary after replacement of components that affects the safety functions.

(q) Instructions for periodic maintenance, test and examination of the press, guards and protective devices, including maintenance, testing and examination intervals. Periodic maintenance shall be possible with widely available tools or with tools or equipment delivered with the press.

(r) Instructions for releasing any trapped persons (see Clause 3.3.19).

NOTE: It is recommended that check lists be prepared for the operations covered by Items (e), (i) and (q). In particular, safety examinations should contain a specific check list that can be signed by the examiner.

APPENDIX A

CLOSED TOOLS

(Informative)

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.

Figure A1 depicts an example of the use of closed tools.

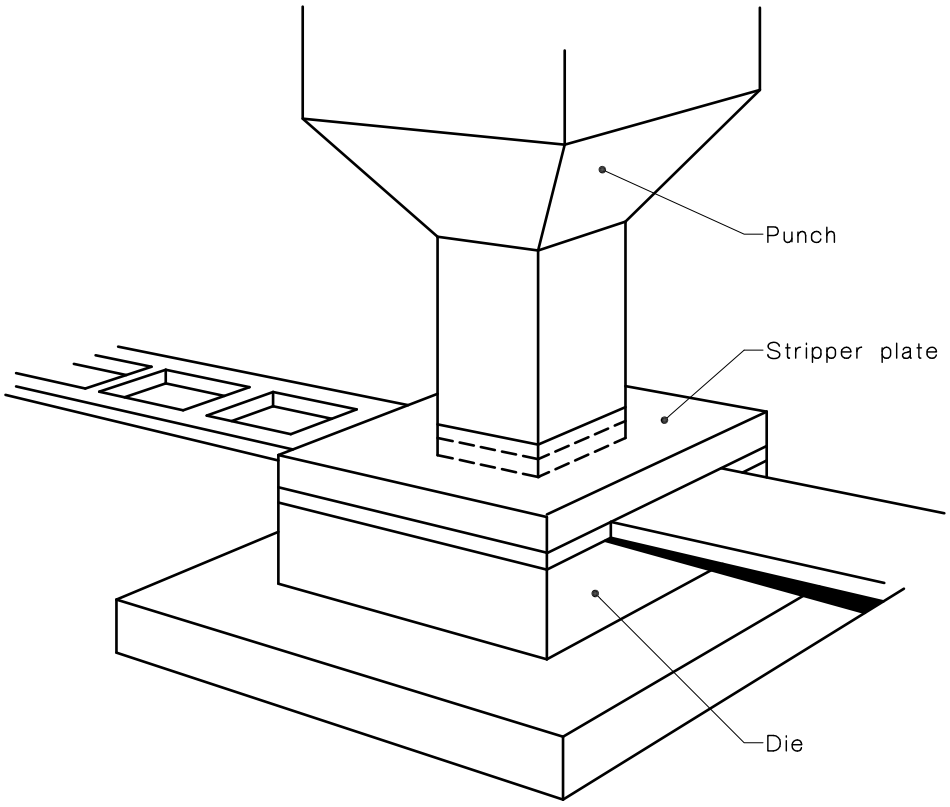


FIGURE A1 CLOSED TOOLS AT A HYDRAULIC PRESS

APPENDIX B

INTERLOCKING DEVICES ASSOCIATED WITH GUARDS

(Informative)

B1 GENERAL

This Appendix provides guidance on means of interlocking, and interlocking devices.

B2 INTERLOCKING

Figure B1 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.

B3 POWER INTERLOCKING

Figure B2 illustrates an example of direct power interlocking (see Tables 3.1, 3.2 and 3.3).

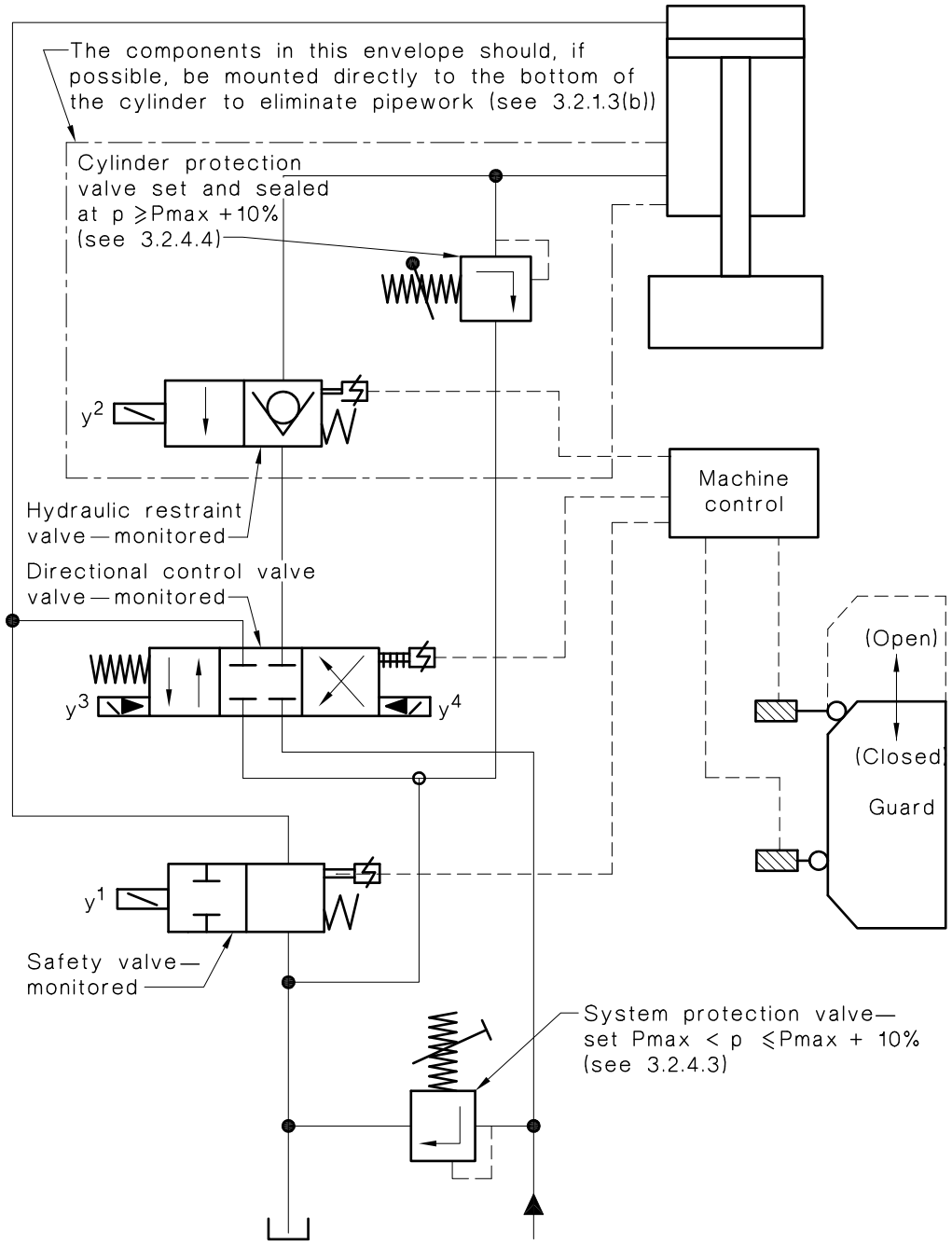
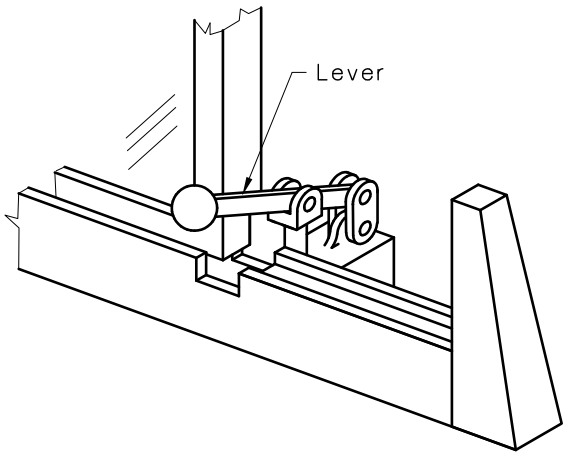
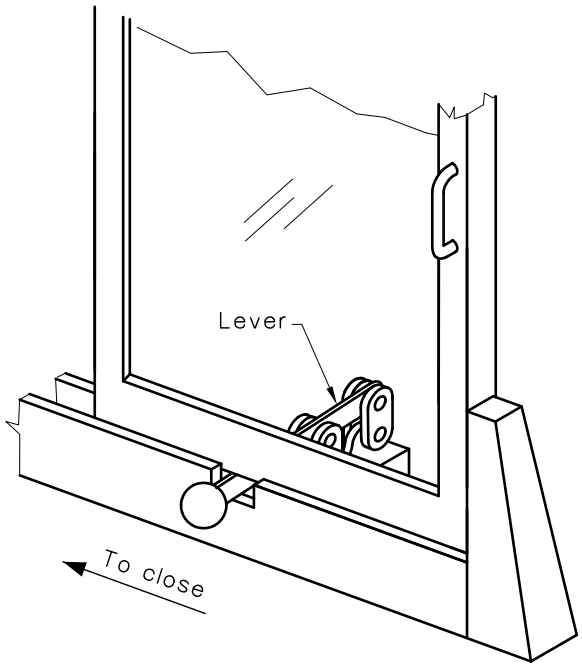


FIGURE B1 EXAMPLE OF A REDUNDANT AND MONITORED HYDRAULIC CONTROL CIRCUIT FOR A DOWNSTROKING PRESS



'Start/stop' lever prevents the guard being opened

(a) Guard closed



Guard prevents lifting 'start/stop' lever, thus preventing restoration of circuit continuity

(b) Guard open

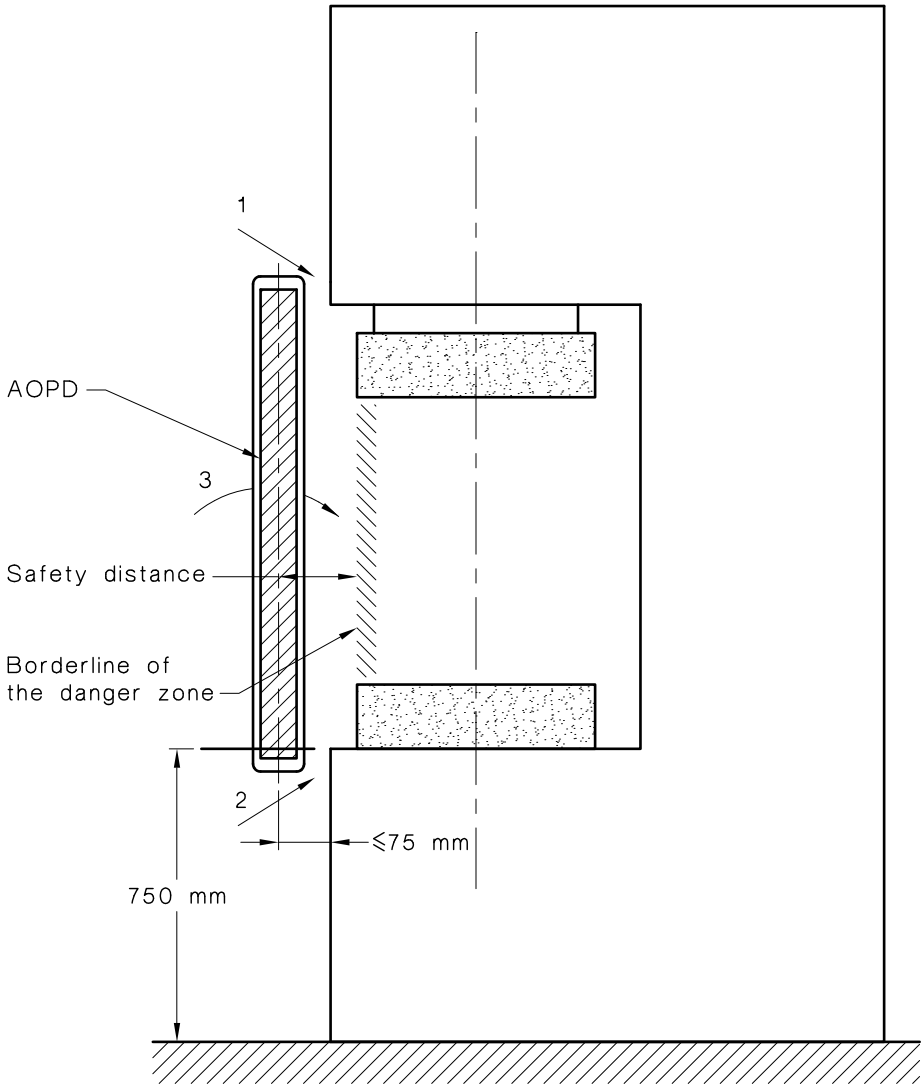
FIGURE B2 EXAMPLE OF POWER INTERLOCKING

APPENDIX C

ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT

(Informative)

This Appendix illustrates the typical use of active opto-electronic protective devices on a manually fed press. Some guarding at the sides of the press has been omitted for clarity.



NOTE: Values to prevent reaching over (1), reaching under (2) and reach around (3) are in accordance with AS 4024.1801 calculated in accordance with AS 4024.2601.

FIGURE C1 APPLICATION OF ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT, USED FOR CYCLE INITIATION, TO A MANUALLY FED PRESS

APPENDIX D

CALCULATION OF MINIMUM SAFETY DISTANCES

(Normative)

D1 GENERAL

This Appendix sets out the means of determining the minimum safety distance for use with hydraulic power presses.

D2 MINIMUM DISTANCE

The minimum distance at which the following guards or protective devices are placed from the danger zone, shall be calculated according to Equation D1 (see also AS 4024.2801):

(a) Interlocking guards without guard locking.

(b) Control guards without guard locking.

(c) Early opening interlocking guards without guard locking.

(d) Electro-sensitive protective equipment using an active opto-electronic protective device.

(e) Two-hand control devices.

$$S = (K \times T) + C \quad \ldots \text{D1}$$

where

S = 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

K = approach speed of the body or parts of the body, in millimetres per second

T = the overall system stopping performance, in seconds

C = the intrusion of the body or parts of the body towards the danger zone before to actuation of the particular equipment, in millimetres

And

$$T = t_1 + t_2 \quad \ldots \text{D2}$$

where

t_1 = stopping time of the press itself (including the response times of the hydraulic and electrical control systems, in seconds

t_2 = response time of the safeguarding system, in seconds

The response time of the hydraulic system shall be determined in accordance with Appendix F.

D3 DETERMINATION OF *K*

In order to determine K, an approach speed of 1600 mm/s shall be used for horizontally arranged active opto-electronic protective devices and for two-hand control devices.

For vertically arranged active opto-electronic protective devices, an approach speed of 2000 mm/s shall be used if the minimum distance is equal to or less than 500 mm.

An approach speed of 1600 mm/s may be used if the minimum distance is greater than 500 mm.

D4 DETERMINATION OF C

For unshrouded two-hand control devices, *C* shall be at least 250 mm.

For shrouded two-hand control devices and early opening interlocking guards without guard locking, *C* can be zero.

When using electro-sensitive protective equipment, the minimum additional distance *C* is dependent upon the detection capability of the electro-sensitive protective equipment.

The minimum value of *C* shall be selected from Table D1.

TABLE D1

ADDITIONAL DISTANCE *C*

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

APPENDIX E

CONDITIONS FOR NOISE MEASUREMENT OF HYDRAULIC PRESSES

(Informative)

E1 GENERAL

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.

E2 PRESS LOCATION

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.

E3 OPERATING CONDITIONS

The recommended operating conditions are as follows:

(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:

  (i) 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 Item (d)).

  (ii) 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 Item (d)).

(d) The material used should be mild steel for blanking, thickness of the material should correspond with the required force calculated.

E4 ALTERNATIVE OPERATING CONDITIONS

Operating conditions, and in particular those listed in Paragraph E3(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:

(a) The force applied should be at least 80% of the nominal force.

(b) 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.

E5 PROCEDURE

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 ISO 11202.

E6 MEASUREMENT POSITIONS

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 Clause 3.8.4.3(c)(i).

E7 MEASUREMENT TIME

Under the operating conditions recommended in Paragraph E3(a) and (b) or Paragraph E4, 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

(b) if continuous cycle mode is not available when running in single cycle mode at the intended number of operating cycle per minute.

APPENDIX F

RESPONSE TIME OF THE HYDRAULIC SYSTEM

(Normative)

F1 GENERAL

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.

F2 PROCEDURE

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.

F3 INFORMATION PROVIDED TO USER

The difference in time measured for each channel shall be included in the information provided to the user.

NOTE: One way of connecting the stopping time measurement equipment is described in Appendix G.

APPENDIX G

CONNECTION OF STOPPING TIME MEASUREMENT EQUIPMENT

(Informative)

In Figure B1, 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.

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 should be added to the measured time.

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.

In the example shown in Figure B1, 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.

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