

Machine tools — Mechanical presses — Safety

ICS 25.120.10

National foreword

This British Standard is the UK implementation of EN 692:2005+A1:2009. It supersedes BS EN 692:2005, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee MTE/1, Machine tools.

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

WARNING

BSI, as a member of CEN, is obliged to give EN 692:2005 the status of a British Standard. However, attention is drawn to the fact that during the development of this European Standard the UK committee consistently voted against its approval as a European Standard.

In the opinion of the UK committee, certain safety requirements in this standard are inadequate in respect of some state of the art machines currently in use in the UK. As a result, BS EN 692:2005 can be considered not to offer a presumption of conformity with 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 is claimed for it. The concerns of the UK committee specifically relate to the protection of personnel against access to the danger zone at manually loaded/unloaded machines as specified in Annex IV of the Directive.

The attention of users is drawn to clauses **5.3.2** and **5.3.3** in so far as the use of two-hand control device(s) is concerned. Where these devices are provided as the sole safeguard, it is the view of the UK committee that they do not adequately control the risk of serious crushing and shearing injuries to the upper limbs of workers other than the operator of the device.

Users of this standard are therefore strongly advised to implement this provision with caution.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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English Version

Machine tools - Mechanical presses - Safety

Machines-outils - Presses mécaniques - Sécurité

Werkzeugmaschinen - Mechanische Pressen - Sicherheit

This European Standard was approved by CEN on 22 July 2004 and includes Amendment 1 approved by CEN on 29 December 2008.

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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 CEN Management Centre has the same status as the official versions.

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 692:2005+A1:2009) 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 August 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2008-12-29.

This document supersedes A1 692:2005 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

This document 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).

A1 For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. A1

A1 Annexes A, B and G to this standard are normative, whereas Annexes C, D, E, F, ZA and ZB are informative. A1

Organisation contributing to the preparation of this European Standard include the European Manufacturer Association CECIMO.

NOTE The safety requirements related to the use of PES or PPS will be dealt with at its next revision.

The European Standards produced by CEN/TC 143 are particular to machine-tools and complement the relevant A and B standards on the subject of general safety (see introduction of EN 292-1:1991 for a description of A, B and C standards).

A1 *deleted text* A1

A1 EN 692:2005 A1 constitutes a revision of EN 692:1996 for which it has been technically revised : the main modifications are listed below :

- Withdrawal of mechanical presses with full revolution clutches,
- Tacking into account of some additive requirements about the use of closed tools and fixed' enclosing guard(s) as protective devices (sub clauses 5.3.4, 5.3.9, 5.3.10 and 5.4.5.3),
- Addition of requirements on the implementation of protective devices for powering on the machine,
- Redrafting in order to ensure the coherence with the requirements of EN 693.

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

Introduction

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

This document is a C-type standard as stated in EN ISO 12100-1.

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

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

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.

The requirements of this European Standard concern designers, manufacturers, suppliers and importers of machines described in the scope.

This standard also includes information to be provided by the manufacturer to the user.

1 Scope

1.1 This European Standard specifies technical safety requirements and measures to be adopted by persons undertaking the design, manufacture and supply of mechanical presses with part revolution clutch hereinafter called presses which are intended to work cold metal or material partly of cold metal.

NOTE The design of a machine includes the study of the machine itself, taking into account all phases of its “life”, i.e. construction, transport and commission (including assembly, installation and adjustment), use (including setting, teaching/programming or process changeover, operation, cleaning, fault finding and maintenance) and de-commissioning, dismantling and, as far as safety is concerned, disposal, and the drafting of the instructions related to all above-mentioned phases of the “life” of the machine (except construction), dealt with it in 6.5 of EN ISO 12100-2:2003.

1.2 This European 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 3.22 of EN ISO 12100-1:2003. This standard presumes access to the press from all directions, deals with the hazards during the various phases of the life of the machine described in clause 4, and specifies the safety measures for both the operator and other exposed persons.

1.4 This European Standard also applies to ancillary devices which are an integral part of the press. This standard also applies to machines which are integrated into an automatic production line where the hazards and risk arising are comparable to those of machines working separately.

1.5 This European Standard does not cover mechanical presses with full revolution clutch.

1.6 This European 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.

1.7 This European Standard is not applicable to machines which are manufactured before the date of publication of this document by CEN.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 devices - Functional aspects - Principles for design.*

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 953:1997, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards.*

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 - The positioning of protective equipment in respect of approach speeds of parts of the human body.*

EN 1005-2:2003, *Safety of machinery - Human physical performance - Part 2: Manual handling of machinery and component parts of 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, *Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology.*

EN 1299:1997, *Mechanical vibration and shock - Vibration isolation of machines - Information for the application or source isolation.*

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

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

EN 61496-1:2004, *Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests (IEC 61496-1:2004, modified).*

CLC/TS 61496-2:2003, *Safety of machinery - Electrosensitive protective equipment - Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs) (IEC 61496-2:1997).*

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).*

EN ISO 4871:1996, *Acoustics - Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)* ^[A1]

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

EN ISO 12100-1:2003, *Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles (ISO 12100-2:2003)*

ISO 8540:1993, *Open front mechanical power presses - Vocabulary.*

3 Terms, definitions and abbreviations

For the purposes of this European Standard, the terms and definitions given in EN ISO 12100-1:2003 and EN ISO 12100-2:2003 and in relevant type A and type B standards, and the following apply.

3.1 Terms and definitions

3.1.1

band brake

brake (see 3.1.2) where a flexible band lined with friction material is arranged around the circumference of a drum

3.1.2

brake

mechanism (usually friction) intended to stop and hold the slide when the clutch, if provided, is disengaged

3.1.3

clutch

mechanism used to impart the movement of the flywheel to the slide

3.1.4

clutch - full revolution

type of clutch that, when tripped or actuated, cannot be disengaged until the slide has completed a complete stroke, e.g. most positive key clutches. It also includes clutches which can only be disengaged at certain positions in the operating cycle

3.1.5

clutch - part revolution

type of clutch that can be engaged or disengaged at any point in the stroke of the slide, e.g. most friction clutches

3.1.6

cycle - automatic

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

3.1.7

cycle - operating

movement of the slide 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

3.1.8

cycle - single

operating mode where each operating cycle of the slide has to be positively actuated by the operator

3.1.9

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)

3.1.10

die

fixed part of the tools used in a press

3.1.11

die cushion

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

3.1.12

direct drive

type of driving arrangement wherein no clutch is used: movement of the slide is accomplished by energising and de-energising the motor, possibly in conjunction with a brake

3.1.13

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

3.1.14

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

3.1.15

limited movement control device; inching device

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

[3.26.9 of EN ISO 12100-1:2003]

3.1.16

mechanical press

machine designed or intended to transmit energy from a prime mover to a tool by mechanical 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 transmitted by a flywheel and part revolution clutch or by means of a direct drive mechanism (see Figure 1)

3.1.17

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

3.1.18

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]

3.1.19

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

3.1.20

overrun

movement of the crankshaft past a defined stopping point, e.g. TDC

3.1.21

overrun monitoring device

device which provides a signal to inhibit further machine initiation when the overrun exceeds the pre-set limit(s)

3.1.22

position switch

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

3.1.23

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 60204-1:1997]

3.1.24

shut height

distance from the bed-plate surface to the slide surface measured with the maximum variable stroke, stroke down and slide adjustment up

[3.12 of ISO 8540:1993]

3.1.25

single stroke function

feature used to limit the motion of the tool to one operating cycle at each engagement of the clutch even if the stroke initiating means (e.g. a pedal) is held in the operating position

3.1.26

slide

main reciprocating press member which holds the tool

3.1.27

tool

moving part of the tools

3.1.28

tools

term for the combination of tool and die

3.1.29

tools - closed

tools designed and constructed to be inherently safe (see Figure D.1)

3.2 Abbreviations

M Monitoring (see 3.1.17)

R Redundancy (see 3.1.23)

S Single channel

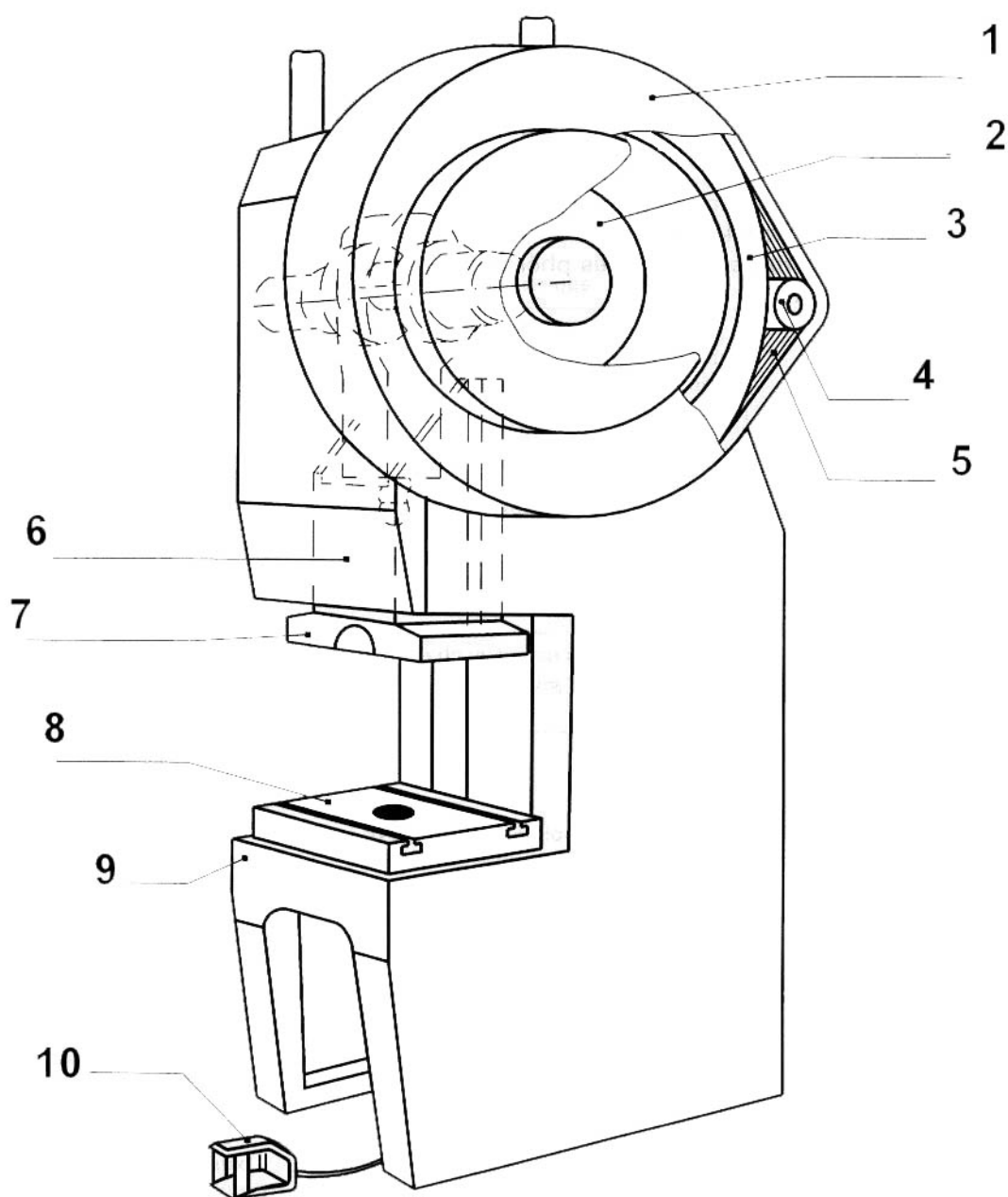
BDC Bottom dead centre (see 3.1.9)

TDC Top dead centre (see 3.1.9)

PES Programmable electronic system PPS Programmable pneumatic system

AOPD Active opto-electronic protective device

ESPE Electro-sensitive protective equipment



Key

- | | |
|------------------|-----------------------------|
| 1 Flywheel guard | 6 Slide |
| 2 Clutch/brake | 7 Slide flange, tool holder |
| 3 Flywheel | 8 Bed-plate/bolster |
| 4 Motor pulley | 9 Bed |
| 5 Belt | 10 Pedal |

Figure 1 — Example of mechanical power press (tools area safeguards not shown)

4 List of significant 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 mechanical presses covered by the scope of this standard. The technical measures and information for use contained in Clauses 5 and 7 and Annexes A, B, C, E and F 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 Risk assessment assumes foreseeable access from all directions, as well as overruns, unexpected and unintended strokes or gravity falls. Risks to both the operators and other persons who can have access to the danger zones are identified, taking into account all hazards which can 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, tool-setting 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 mechanical power 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 ISO 12100-1:2003
Mechanical hazards			
Crushing hazard Shearing hazard Cutting or severing hazard Entanglement hazard Drawing-in or trapping hazard	Tools area: - between moving tools - moving slide - moving die cushions - work-piece ejectors - guards	5.3 to 5.5 Annexes A, B, C, D and E	4.2.1
Impact hazard	Moving parts of electrical, hydraulic and pneumatic equipment Motor and drive machinery Mechanical handling device During installation, setting operation, maintenance.	5.6.1 to 5.6.3 5.6.1 to 5.6.4	4.2.1
Ejection hazard	Machine components Work-pieces 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	4.10
Electrical hazards			
Direct contact hazard	Electrical equipment	5.8.1	4.3
Indirect contact hazard	Electrical equipment Parts made live by electrical equipment under fault conditions	5.8.1	4.3
Thermal radiation hazard (burns)			
Thermal hazards resulting in burns and scalds, by a possible contact of persons	Brakes, clutches, 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
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 5.8.6.4	4.8
Fire or explosion hazards	Exhaust ventilation and dust collection equipment	5.8.6.5	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/or measures

5.1 Introduction

Mechanical presses covered by this standard range in size from small high speed machines with a single operator producing small work-pieces to large relatively slow speed machines with several operators and large complex work-pieces.

The methods or measures to be implemented to eliminate the significant hazards are specified in Table 1. The methods and measures for reducing associated risks are as follows:

- basic design considerations for major press components or systems (see 5.2);
- safeguarding against mechanical hazards in the tools and associated 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 tool-setting, trial strokes, maintenance and lubrication (see 5.5);
- safeguarding against other hazards (see 5.6 to 5.8).

Presses shall comply with the safety requirements and/ or measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100-1 for hazards relevant but not significant which are not dealt with by this standard (e.g. sharp edges).

5.2 Basic design considerations

5.2.1 Brakes and clutches

5.2.1.1 Fluid or air pressure shall not be used to apply a brake unless means are provided to ensure that, in the event of loss of fluid or air pressure, the integrity of the brake is maintained and the clutch is disengaged. Diaphragms shall not be used to apply a brake.

5.2.1.2 The designer shall ensure that:

- a) the springs used for applying the brake or disengaging the clutch are of compression type;
- b) multiple spring assemblies are used;
- c) all the springs are closely uniform in dimension, quality and rating;
- d) the means of loading the springs are such that, when adjusted, the spring anchorages can be locked to prevent slackening back;
- e) the arrangements for spring housing and guiding, and of guide pins, are such as to minimize binding;
- f) the brake can function even if 50 % of the spring assembly has failed.

5.2.1.3 The engagement and disengagement of the clutch and brake shall not affect their safe function.

NOTE Combined clutch and brake units are recommended so as to reduce the possibility of the overlapping of their engagement.

5.2.1.4 The brake and the clutch shall be designed so that failure of component e.g. for power transmission or screws do not stress other components in such a way that rapid consequential dangerous failure is possible.

5.2.1.5 Any heat generated which can cause a hazardous situation shall be dissipated.

5.2.1.6 Effective arrangements shall be made to prevent penetration of lubricants to the brake friction surfaces, when this is not intended by the brake design.

5.2.1.7 The clutch and brake shall be designed in such a way that any moisture, dust or lubricating oil, which breaks or corrodes packing material (e.g. gaskets and seals), cannot influence the required function adversely, e.g. by obstructing an air channel or otherwise affecting their efficiency.

5.2.1.8 The design shall be such that the accumulation of dust, fluid or debris is minimized in areas likely to give rise to inefficient brake performance and broken or loose components shall not cause brake failure.

5.2.1.9 Band brakes shall not be used on mechanical presses for the purpose of stopping the slide.

5.2.2 Presses with part revolution clutches (friction clutches)

5.2.2.1 Clutches shall be of a capacity capable of engaging and disengaging the stroke in the correct position, without excessive temperature rise, under conditions of maximum use of the clutch.

5.2.2.2 Sufficient working clearances shall be provided so as to ensure that, under the severest conditions of operation, friction drag leading to undesired movement of the driven members will not take place.

5.2.2.3 Arrangements shall be made to prevent the accumulation of debris evolved from frictional surfaces in places where it can give rise to inefficient clutch performance, and for its effective dispersal.

5.2.2.4 The clutch and its control system shall be designed so that, in the event of failure of pneumatic, hydraulic or electrical supply, the clutch is disengaged and the brake is immediately applied.

5.2.2.5 If diaphragms are used in a clutch system, measures shall be taken to avoid damage by the cutting effect of sharp edges or wearing by rough surfaces. Evacuation of air shall not be prevented due to slackening of the diaphragm, e.g. due to material fatigue.

5.2.3 Hydraulic and pneumatic systems - Common features

5.2.3.1 The requirements in EN 982 and EN 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 Bowls of glass and 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 can cause damage to valves or clutch and brake operating parts. See 5.3.4.2 of EN 982:1996 and 5.5.3.2 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. This applies particularly to piping feeding the running joint of the clutch and brake.

5.2.3.7 Where a drop in pressure can lead to unintended dangerous motion of the slide, 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 can affect both valves and piping.

5.2.3.9 Operating valves shall be so designed as to ensure that, when in the non-operating position, leakage past the inlet valve will escape sufficiently freely to prevent build-up of pressure in the clutch operating cylinder.

5.2.3.10 Operating valves shall be so designed that it is not possible for both the inlet port and the exhaust ports to remain closed at the same time.

5.2.3.11 Exhaust ports and piping between clutch operating cylinders and valves shall be of sufficient capacity to ensure prompt release of fluid from clutch operating cylinders. Precautions shall be taken to ensure that the exhaust ports of operating valves are of adequate size to prevent residual pressure in the cylinder. The valve shall be selected so that the pressure ratio between clutch and brake is such that the residual pressure in the cylinder will not become excessive in the event of a valve fault.

NOTE Normally, a ratio of at least 3,5 to 1 between spring pressure in the brake and residual pressure in the cylinder is satisfactory.

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

5.2.3.13 Where valves are manually or mechanically (as distinct from electrically) operated, the arrangements for restoring the valves to the position of clutch disengagement at the end of the cycle shall be positive in character (i.e. when the actuator of the valve is released the valve shall automatically move to the safe position). See also 5.4.9.

5.2.4 Pneumatic systems

5.2.4.1 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.

5.2.4.2 Where silencing systems are fitted, they shall be provided and installed in accordance with the valve manufacturer's instructions for use in safety systems, shall not affect safety function and their effect on braking performance shall be taken into account. Only non-clogging direct to atmosphere silencers are permissible.

5.2.4.3 Water separators shall be provided.

5.2.5 Hydraulic systems

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

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

5.2.5.3 Hydraulic systems which include accumulators shall allow the fluid pressure to fall when the pressure generating unit is stopped. 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.

5.2.6 Slide adjustment and stroke adjustment

5.2.6.1 Provision shall be made to ensure that a slide adjustment motor cannot be set in motion while the clutch control circuit is energised. This requirement shall not apply when the slide adjustment motor is operable in presses for automatic cycle and programmable control systems to compensate, for example, for wear of the tools during the press operation.

5.2.6.2 The means of controlling the slide adjustment shall be clearly identified.

5.2.6.3 The slide adjustment shall be limited by suitable means.

5.2.6.4 Means shall be provided for securing, e.g. by locking, the slide adjustment and the stroke adjustment in the set position during production.

5.2.6.5 Securing means shall be provided to prevent a stroke being made while the powered stroke adjustment motor is in operation.

5.3 Mechanical hazards in the tools area

5.3.1 The major danger zone at mechanical 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 and work-piece ejectors, shall be safeguarded. Tables 2, 3 and 4 list the safeguarding methods including mode of production/mode of operation and the requirements for the design of the control and monitoring system:

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

5.3.2 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). Safeguarding measures described in EN ISO 12100-1 and EN ISO 12100-2 which are appropriate for the protection of any operator at the tools are listed below:

- a) closed tools (see EN 294, EN 349, 5.3.9 and Annex D);
- b) fixed enclosing guards (see EN 294, EN 953 and 5.3.10);
- c) interlocking guards with guard locking (see EN 953, EN 954-1, EN 1088, 5.3.11 and Annex A);
- d) control guards with guard locking (see 5.3.2.5 of EN ISO 12100-2:2003, EN 953, EN 954-1, EN 1088 and 5.3.11);
- e) early opening interlocking guards (see EN 953, EN 954-1, EN 999, EN 1088, 5.3.11, 5.3.15 and Annex A);
- f) electro-sensitive protective equipment (ESPE) using active opto-electronic protective devices (AOPDs) (see EN 999, EN 61496-1, CLC/TS 61496-2, 5.3.13, 5.3.15 and Annex C);
- g) two-hand control devices (see EN 574, EN 999, 5.3.14 and 5.3.15);
- h) hold-to-run control devices (see 3.26.3 of EN ISO 12100-1:2003) with a slow closing speed (equal or less than 10 mm/s) principally for tool-setting (see 5.5).

The above methods of safeguarding shall also protect against risks at ancillary loading and unloading devices which are an integral part of the machine.

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

5.3.4 Where a mechanical 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 7.2.2 j) and k)).

5.3.5 The requirements of the safety measures listed in 5.3.2 are given in 5.3.9 to 5.3.15 and shall be met in addition to those established by the relevant standards (see Clause 2).

5.3.6 The guards and protective devices provided 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, as specified in Annexes A, D and C.

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 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/work-piece and if necessary additional audible warning or visual danger signals according to EN 842. If this press is not exclusively dedicated to this work, 5.3.2 to 5.3.6 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 D.

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 openings shall comply with Table 4 of EN 294:1992

5.3.11 Interlocking guards, early opening 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 the control system shall conform to category 4 of EN 954-1:1996. See Annex B. Control guards shall also conform to 3.25.6 of EN ISO 12100-1:2003 and 5.3.2.5 of EN ISO 12100-2:2003.

5.3.12 When 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 6.2.1 of EN 1088:1995.

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.

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.

Early opening interlocking guards can also be control guards without guard locking.

5.3.13 ESPE using AOPDs in the form of light curtain shall comply with the following:

- a) AOPDs shall conform to type 4 of EN 61496-1:2004 and be designed and constructed according to CLC/TS 61496-2:2003;
- 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 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 CLC/TS 61496-2:2004) 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: 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 fitted close to the press table. 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 B.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 curtain shall be limited to a period commensurate with a single normal cycle, the pre-set time;
 - vi) this pre-set time shall not exceed 30 s starting from the end of the previous operating cycle. The AOPD shall be required to be reset, if the pre-set time has been exceeded. Normal means of initiating the press motion shall be provided for occasions when it is not automatically initiated within that limited period;
 - vii) if there is more than one AOPD safeguarding the press, only one of them 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.

See Annex E.

5.3.14 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.

5.3.15 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 B.

5.3.16 Conditions of interlocking the motor and the clutch

Reverse running shall only be possible in the setting mode. It shall not be possible to start the motor if the press clutch is engaged or to engage it or leave it engaged if the motor is stopped, except under various setting conditions.

5.3.17 Single stroke devices

Where a press is used in single cycle mode, a single stroke device shall be fitted. This device shall prevent a subsequent stroke even if the control device is continuously actuated. A further stroke shall require the release of the control device and a new initiation.

5.3.18 Prevention of gravity fall during maintenance or repair

5.3.18.1 Where there is a risk of injury (weight of the moving components exceeding 150 N from a gravity fall of the slide) 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. Where the device is not capable of absorbing the entire press force, it shall be interlocked to the press control so that a stroke cannot be performed while the device is in position, and the press slide is retained in the upper position according to EN 1037:1995.

5.3.18.2 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 within 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.

5.3.19 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 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 part revolution clutches and 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 positions and slow speed (equal or less than 10 mm/s).

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

- 1st for stop;
- 2nd for run;
- 3rd for 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 5.5.11).

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 tool area (see also 7.2.2) e.g. auxiliary drive, provision of slot to rotate flywheel by hand.

5.4 The control and monitoring system

5.4.1 Control and monitoring functions

5.4.1.1 General

This sub-clause 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 60204-1:1997 shall be followed for the design of electrical systems and EN 954-1:1996 for the safety related parts of electrical, hydraulic, pneumatic and mechanical systems.

5.4.1.2 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.

5.4.1.3 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 & M).

5.4.1.4 This sub-clause applies to presses fitted with protective devices of the following types, namely:

- ESPE using AOPDs;
- early opening interlocking guards and control guards;
- two-hand control devices used for normal operation.

This sub-clause does not apply to presses 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 ¹⁾, 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 & M).

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

- a) 4.12.1 of EN ISO 12100-2;
- b) 5.2.1 of EN 982:1996;
- c) 5.2 of EN 983:1996;
- d) 12.1 of EN 60204-1:1997.

5.4.1.6 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.

5.4.2 Part revolution clutch presses: redundancy and monitoring of clutch/brake control systems, and overrun monitoring for single cycle use

See Tables 2, 3 and 4.

5.4.2.1 Redundancy and monitoring of clutch/brake control systems, and overrun monitoring shall be provided to protect an operator in all cases in which the safeguarding system does not prevent access to the danger zone before the slide has stopped, e.g., for:

- a) ESPE;
- b) early opening interlocking guards;

¹⁾ 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.