BRITISH STANDARD

BS EN 869:2006
+A1:2009

Safety of machinery — Safety requirements for pressure metal diecasting units

ICS 25.120.30

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 869:2006+A1:2009. It supersedes BS EN 869:2006 which is withdrawn.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〉.

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

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Safety of machinery - Safety requirements for pressure metal diecasting units

Sécurité des machines - Prescriptions de sécurité pour les chantiers de moulage des métaux sous pression

Sicherheit von Maschinen - Sicherheitsanforderungen an Metall-Druckgießanlagen

This European Standard was approved by CEN on 6 August 2006 and includes Amendment 1 approved by CEN on 1 March 2009.

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Foreword

This document (EN 869:2006+A1:2009) has been prepared by Technical Committee CEN/TC 202 “Foundry machinery”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2009-03-01.

This document supersedes [A1] EN 869:2006 [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]

An assessment of the foreseeable risks arising from the use of the machinery was carried out when this standard was drafted by CEN/TC 202/WG 1, comprising experts from the following countries: Germany, Italy, Spain, Sweden and Switzerland.

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

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document. When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

〈A1〉 Where for clarity an example of a preventative measure is given in the text, this should not be considered as the only possible solution. Other solutions can be used as far as they fulfil correctly the criteria expressed in the requirement.

This European Standard assumes, that the equipment is operated and maintained by trained personnel. 〈A1〉

1 Scope

This European Standard specifies the safety requirements for pressure metal diecasting units.

It applies to pressure diecasting machines and to the interfaces with the following ancillary equipment:

— die,

— melting, holding and dosing furnaces (see EN 746-1),

— metal feeding equipment,

— inserting and removal devices,

— spraying appliances,

— heat exchanger for the die.

This ancillary equipment itself is not covered.

Additional risks arising from the material being cast are not covered.

This standard does not apply to low pressure diecasting machines and/or gravity diecasting machines.

This standard deals with all significant hazards, hazardous situations and events relevant to pressure diecasting machines when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4). It provides the requirements to be met by the manufacturer to ensure the safety of persons and property during transport, commissioning, use, de-commissioning and maintenance periods, as well as in the event of foreseeable failures or malfunctions that can occur in the equipment.

This document is not applicable to pressure metal diecasting units/machinery which are manufactured before the date of its publication as EN.

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.

〚A1〛 *deleted text* 〚A1〛

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

〚A1〛 *deleted text* 〚A1〛

EN 574:1996, *Safety of machinery — Two-hand control devices — Functional aspects — Principles for design*

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

EN 614-2, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

〚A1〛 EN 842, *Safety of machinery — Visual danger signals — General requirements, design and testing* 〚A1〛

EN 894-1, *Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

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

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

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

〚A1〛 *deleted text* 〚A1〛

〚A1〛 EN 981, *Safety of machinery — System of auditory and visual danger and information signals* 〚A1〛

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

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

EN 999, *Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body*

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

EN 1265, *Noise test code for foundry machines and equipment*

EN 13861, *Safety of machinery — Guidance for the application of ergonomics standards in the design of machinery*

EN 1760-2, *Safety of machinery — Pressure sensitive protective devices — Part 2: General principles for the design and testing of pressure sensitive edges and pressure sensitive bars*

[A1] EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2006)* [A1]

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals* [A1] *(IEC 61310-1:2007)* [A1]

EN 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking* [A1] *(IEC 61310-2:2007)* [A1]

[A1] EN ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)* [A1]

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

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)*

[A1] EN ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)* [A1]

[A1] EN ISO 13849-1:2008, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)* [A1]

[A1] EN ISO 13850:2006, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)* [A1]

[A1] EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)* [A1]

EN ISO 14122-1, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of a fixed means of access between two levels (ISO 14122-1:2001)*

EN ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

[A1] ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas* [A1]

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003 and the following apply.

NOTE Definitions used in EN and ISO standards referred to in this document are also valid for this document.

3.1
casting
to cast a component/product by the use of pressure diecasting

3.2
diecasting
a process in which molten metal is injected into a die and held under pressure until complete solidification

3.3
diecasting machine
a machine that injects molten metal under high pressure into a parted die which is connected to the platens of the machine

3.4
diecasting unit
a diecasting machine, together with ancillary equipment, which form a complete production unit

3.5
ancillary equipment
devices which automatically carry out process functions additional to those of the diecasting machine itself, e. g., feeding the metal, removing the castings, spraying the die

3.6
metal
the material being cast

3.7
hot-chamber diecasting machine
diecasting machine having the shot sleeve and plunger submerged in the molten metal of the furnace (see Figure A.1)

3.8
cold-chamber diecasting machine
diecasting machine where molten metal is delivered to the shot sleeve in measured amounts from a separate furnace

3.9
horizontal cold-chamber diecasting machine
cold-chamber diecasting machine with the shot sleeve mounted horizontally (see Figure A.2)

3.10
vertical cold-chamber diecasting machine
cold-chamber diecasting machine with the shot sleeve mounted vertically (see Figure A.3)

3.11
die closing system
assembly which opens and closes the die and holds the die against the force exerted on the metal during injection and solidification

3.12
injection system
assembly which forces metal from the shot sleeve into the die and applies pressure to the metal during solidification

3.13
ejector system
assembly which ejects castings from the die cavity

3.14
core puller
assembly which controls movements of cores

3.15
automatic tie bar puller
device for automatically pulling tie bars in order to facilitate die set-up procedure

3.16
automatic ejector coupler
device for automatically coupling the ejector plate of the machine with the ejector device of the die

3.17
automatic die clamper
device for automatically clamping the die to the platens of the machine

3.18
fixed platen
platen to which the fixed die-half and the metal injection system are connected

3.19
moving platen
platen to which the moving die-half is connected

3.20
cylinder platen (also known as thrust platen, reaction platen, rear platen)
platen to which the die closing mechanism and the closing cylinder are connected

3.21
tie bar
bars which carry the locking load and guide the moving platen

3.22
injection drive
system, e. g., hydraulic, which moves the plunger and applies force to it

3.23
shot sleeve
cylindrical container of a cold-chamber diecasting machine in which pressure is applied to molten metal

3.24
plunger
piston which forces metal from the shot sleeve into the die and applies pressure to the metal during solidification

3.25
plunger rod
rod which joins the plunger to the injection drive

3.26
gooseneck (hot-chamber diecasting machine)
that part of an injection system (containing the shot sleeve and metal flow channel) which is submerged in molten metal

3.27
nozzle
connection between the gooseneck and the fixed die-half

3.28
slug
metal surplus which solidifies in the cold-chamber shot sleeve and is ejected with the casting

3.29
ejector plate
part which transmits movement to the ejector device of the die

3.30
ejector rod
part which joins the ejector plate of the machine to the ejector device of the die

3.31
die area
area between fixed platen and moving platen

3.32
die closing mechanism area
area between moving platen and cylinder platen

3.33
injection drive area
area between fixed platen and shot cylinder

3.34
closing safety device
device, actuated by the movable guard, which prevents the die from closing if a failure occurs in the control system

3.35
setting
operating mode where any step in the process can be selected and hand operated in any sequence (e. g., to perform individual steps of the process (not necessarily in operating cycle sequence), e. g., like changing a die)

3.36
manual
operating mode where the individual steps in the machine cycle are hand initiated in a predetermined order (e. g., to perform individual steps of the process (only in the sequence which is fixed by the program), e. g., like to finish the casting cycle or to run the casting cycle in order to examine or to look for faults)

3.37
semi-automatic
operating mode where each cycle is hand initiated but thereafter automatically proceeds to completion (e. g., to produce castings in which at least one of the steps of the process which is performed outside the machine is executed by the operator)

3.38
automatic
operating mode where the completion of a casting cycle initiates the next casting cycle (e. g., to continuously produce castings with any external process steps being automatically carried out by ancillary device)

3.39
machine-setter
designated person, trained and skilled to carry out setting and starting-up the diecasting process

3.40
operator
designated person, trained and skilled to run the diecasting machine

4 List of significant hazards

4.1 General

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

If, because of the special design of a diecasting machine and/or its ancillary equipment, additional hazards can be present, then an additional risk assessment shall be made.

4.2 Mechanical hazards

Mechanical hazards at diecasting machines and at their ancillary equipment can occur because of the design of the machine (e. g., risk of stumbling and striking) and because of dangerous movements (e. g., crushing, shearing).

Dangerous movements include:

— movement of the die;

— movement of the core pullers;

— movement of the ejectors;

— movement of the ancillary equipment;

— movement of the injection system;

— movement of the power operated guards;

— movement of the toggles and holding-up devices;

— movement of the tool clamping devices;

— movement of the tie bar pulling devices.

Some principal examples of mechanical hazards and danger zones are shown in Figure A.4.

The bursting of reservoirs, pipelines and flexible hoses containing pressurised fluids can cause hazards.

4.3 Electrical hazards/control system

4.3.1 Electrical hazards at diecasting machines can occur, e. g., by:

— electrical contact, direct or indirect;

— external influences on electrical equipment;

— damage by thermal radiation or other phenomena such as projection of molten metal particles.

4.3.2 Failures which cause unexpected machine movements can occur in the electric/electronic control system and/or in the hydraulic or pneumatic control system.

4.4 Thermal hazards

〚A1〛 Thermal hazards which can occur at diecasting machines by: 〈A1〉

— spraying or flowing out of molten metal, e.g.,

  — out of the parting-line of the die (see Figures A.5, A.6 and A.7); or

  — between shot sleeve and plunger (see Figures A.5 and A.6);

  — between nozzle and die (see Figure A.7);

— bursting of slugs;

— contact with structural components of the machine which are heated by the process;

— contact with ancillary equipment which are used to heat the working substances or dies;

— release of hot operating fluids;

— heat radiated from furnaces.

4.5 Fire hazards

Fire hazards result from the presence of a combination of molten metal, heating devices, hot surfaces and combustible material, e. g., flammable greases, flammable hydraulic fluids and pressurized combustible release agents in case of a line break.

4.6 Noise hazards

Noise generated by pressure metal diecasting units can result in:

— permanent hearing loss;

— tinnitus;

— tiredness, stress etc.;

— other effects such as loss of balance, loss of awareness;

— interference with speech communication;

— inability to hear acoustic warning signals.

4.7 Hazards caused by gases, vapours, fumes and dusts

Hazards caused by dangerous gases, vapours, fumes and dust can occur at diecasting machines, e. g.,

— by use of lubricants;

— by use of release agents;

— by fumes, vapours and dust given off when melting and holding some types of metal, e. g., lead alloys;

— during cleaning.

4.8 Hazards generated by neglecting ergonomic principles in machinery design

Health can be impaired by neglecting ergonomic principles. Possible causes of injury are:

4.8.1 incorrect lifting of heavy loads due to the design of the machine, e. g., during

— setting up the diecasting machine;

— maintenance of the diecasting machine;

— manual removing of the castings.

4.8.2 work with repetitive motion, e. g.,

— manual feeding of molten metal;

— manual removing of the castings.

4.8.3 poor working postures due to, e. g.,

— wrong height of operating panel;

— wrong position of operating panel;

— poor access for maintenance and setting-up.

4.9 Setting-up the diecasting machine

The deactivation of some protective devices which can be necessary in order to allow setting-up to be carried out can give rise to additional hazards.

4.10 Falls from heights

This hazard can occur at diecasting machines when people work above ground level or over pits either during normal operation, setting-up or for maintenance purposes.

4.11 Particular hazards with regard to cold-chamber diecasting machines

4.11.1 Bursting of slugs

Slugs can burst, if they are not sufficiently solidified before being ejected from the shot sleeve.

4.11.2 Injection drive area

In the case of cold-chamber diecasting machines metal flashing and mechanical hazards can occur in the injection drive area between shot sleeve and plunger.

The principal danger areas for spraying metal are shown in Figures A.5 and A.6.

4.12 Particular hazards of diecasting machines with vertical closing movement

Hazards can occur on diecasting machines with a vertical closing movement because the die can fall under its own weight.

4.13 Particular hazards with regard to hot-chamber diecasting machines

4.13.1 Nozzle

Metal spraying can occur if the nozzle is not firmly sealed to the die or to the gooseneck.

The principal danger zones for hazards caused by metal spraying are shown in Figure A.7.

4.13.2 Initiation of the casting process due to a fault in the control system

Metal spraying can occur if a fault causes metal to be injected with the die open.

4.14 Hydraulics and pneumatics

Hazards due to the presence of hydraulic and pneumatic pressure can occur.

5 Safety requirements and/or protective measures

5.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause.

In addition, the machine shall be designed according to the principles of EN ISO 12100-2 for relevant but not significant hazards which are not dealt with by this document.

For application of type B standards such as ⟦A1⟩ EN ISO 13857 ⟨A1⟧, EN 349, ⟦A1⟩ EN ISO 13850 ⟨A1⟧, EN 574, EN 60204-1, the manufacturer shall carry out an adequate risk assessment to establish the requirements of that standard which are to be applied (as far as the choice is not made in the requirements of this clause).

NOTE The requirements of this standard and the described solutions are considered to offer an acceptable safety level. This does not exclude that other solutions can be acceptable if they offer an equivalent level of safety.

The manufacturer of the pressure diecasting machine shall make provisions necessary for the integration of the ancillary equipment required for the intended use of the pressure diecasting unit.

5.2 Mechanical

5.2.1 General

Guards and protective devices shall be designed according to EN ISO 12100 parts 1 and 2 and EN 953. The safety distances shall be in accordance with Table 2 and Table 4 of ⟦A1⟩ EN ISO 13857:2008 ⟨A1⟧, EN 349 and EN 999. Guards and protective devices shall be designed so that they do not themselves cause hazards.

⟦A1⟩ Fixing systems of fixed guards shall remain attached to the guards or to the machine when the guards are removed. ⟨A1⟧

If a guard is power operated it shall not create a trap. Either the power provided shall be insufficient to cause injury in the event of trapping, or the guards shall be provided according to EN 1760-2 with a trip device at its leading edge to prevent injury. Actuation of the trip device shall stop or reverse the direction of movement of the movable guard. ⟦A1⟩ The part of the control system related to the trip device shall comply with at least performance level PL=c with use of category 1 as defined in EN ISO 13849-1:2008. ⟨A1⟧

5.2.2 Guards and protective devices for die area (see also 5.4.1)

5.2.2.1 Access from front and back of the machine to the die area, shall be prevented by movable guards and, if necessary, with supplementary fixed guards in order to avoid injuries caused by movements, e. g., of the die, the core pullers and die sprayers (see Figure A.8). Persons shall be prevented from staying between the guard and the machine frame when the guards are closed.

Suitable measures are (see Figure A.8):

a) reduction of the distance between movable guards and the machine frame to max. 100 mm. The protective effect shall be achieved by the shape of the lower part of the guard itself over the whole length of the guard (see Item 1 in Figure A.8) or by shaping the front edge of the guard so that during opening and closing never the distance of 100 mm is exceeded;

or

b) movable guards and supplementary protective devices which shall protect the area between the guard and the machine frame against persons getting behind the guard, if the distance between the guards and the machine frame exceeds 100 mm (see left-hand side of Figure A.8).

   ▌A1⟩ The supplementary protective device, which protects persons getting behind the guard, can for example be a type 4 electro-sensitive protective device according to EN 61496-1 or an electromechanical or hydraulic-mechanical trip device with self-monitoring, in which case the related part of the control system shall comply with performance level PL=e with use of category 4 according to EN ISO 13849-1:2008. ⟨A1▌.

   If electro-sensitive protective devices are used as a supplementary protective device they shall be designed and arranged so that

   1) the devices shall be operational as long as the diecasting machine is operational;

   2) the devices shall not act as control devices with a start function;

   3) the devices shall not be easily adjustable either in the vertical or in the horizontal direction by the operator;

   4) the devices are interlocked with dangerous movements of the diecasting machine and its ancillary equipment.

If, for technical reasons (mainly for big-sized machines), the options a) and b) cannot be fulfilled, the closing of a powered guard shall only be possible with a hold-to-run control device located at a position with a good view of the die area.

5.2.2.2 Whole-body access to the die area

Diecasting machines with a clear vertical distance between the tie bars greater than 1 200 mm, where it is reasonably foreseeable that persons will enter the die area without complete shut-down of the machine, shall have measures taken for preventing the closing of the die when a person is in the die area (see also 7.2.1 d)). Suitable measures are

a) a lockable control device mounted close to the access door(s). This device shall bring the machine to a special access mode where no initiation of a closing movement is possible,

   or

b) lockable devices to prevent unexpected closing movement of the die by switching off the power supply for the closing valves, in accordance with 5.4 of [A1] EN 60204-1:2006 [A1]. These devices shall be located on both sides of the machine, inside the fence in case a distance guard safeguards the machine and its ancillary equipment and at a location with a good view on the die area. Switching on the device shall not by itself initiate any movement,

or

c) a mechanical restraint device in the die area, automatically or manually operated, preventing the closing of the die. This device shall be interlocked with the closing movement,

or

d) a mechanical restraint device preventing the closing of the guard,

or

e) a device for switching-off the hydraulic pump in accordance with 5.4 of [A1] EN 60204-1:2006 [A1]. The device for switching-off shall be located close to the access door.

[A1] Related parts of the control system shall be in accordance with performance level PL=e with use of category 4 according to EN ISO 13849-1:2008. [A1].

Where ancillary equipment can be dangerous for a person present in the die area, the measures taken shall also prevent the functioning of these equipment.

5.2.2.3 The interlocking of the movable guards for the die area shall use a combination of:

a) a positive and non-positive mode association of mechanically actuated position detectors in accordance with 5.4.1 of EN 1088:1995,

and

b) an additional closing safety device in accordance with 5.3.6.

The mechanically actuated detectors can be replaced with non-mechanically operated detectors if the safety achieved is not less than obtained with mechanical detectors, in accordance with 6.3.1 of EN 1088:1995.

5.2.3 Guards for the die closing mechanism area

Access to the die closing mechanism area shall be prevented by interlocking movable guards. The movable guards shall either

[A1] a) be interlocked with the power supply for the dangerous movements (e.g. switch off the hydraulic pump and release the pressure of the accumulators). The relevant part of the control system shall have at least a performance level PL=c with use of category 1 according to EN ISO 13849-1:2008. Restarting the machine shall only be possible if the guard for the closing mechanism area is closed; [A1]

or

[A1] b) be interlocked with the control system. Opening of the guards shall stop all dangerous movements. The relevant part of the control system shall have at least a performance level PL=d with use of category 3 according to EN ISO 13849-1:2008. Restarting the dangerous movement shall only be possible if the guard for the closing mechanism area is closed. Movements of the ejector system with guard open are allowed, if,

1) for machines with a clear vertical distance between the tie bars up to 1 200 mm, the dangerous movements are restricted as stated in 5.9.2;

2) for machines with a clear vertical distance between the tie bars greater than 1 200 mm, the conditions of 1) shall be fulfilled and additionally the speed of the ejector shall be reduced to 30 mm/s. The parts of the control system related to the speed reduction shall be at least performance level PL=b with use of category B according to EN ISO 13849-1:2008. ⟨A1⟩

Fixed guards can be used for the die closing mechanism area if no frequent access is required (e. g., access less than once a shift, according to EN 953:1997; 6.4.3.1).

5.2.4 Additional requirements for movable guards and access doors

5.2.4.1 General

Movable guards and access doors, see 5.2.5, shall be interlocked with the control system in such a manner that

5.2.4.2 Closing movements of the die and positioning movements of core pullers can only be initiated if the movable guards for the die area and for the die closing mechanism area and the access doors are closed.

The opening movement of the platen with the die area guard open shall only be possible if it is impossible to reach in these conditions the crushing and shearing points behind the moving platen.

5.2.4.3 Ejector movement shall only be possible with the guards for the die area closed.

⟨A1⟩ **5.2.4.4** Deviations from the requirements of 5.2.4.2 and 5.2.4.3 are allowed and the ejectors and core pullers may be operated with guards for the die area open provided that: ⟨A1⟩

a) the ejectors and core pullers have no shearing or crushing areas

or, if there are shearing or crushing areas,

b) a lockable mode selector switch (or equivalent access code in case of numerical control) is provided so that operation with the guard open can be selected.

5.2.4.5 Any opening of the guard protecting the die shall immediately stop the die closing movement.

5.2.4.6 The casting process shall only take place when the movable guards of the die area, or the access doors are closed and the die is closed and locked.

NOTE In case of machines with toggle actuation the die closing movement is completed when the die is closed and locked by the toggle in stretch position.

In the case of machines with hydraulic closing actuation the die closing movement may not be completed when the closing cylinder is applying full locking force. Additional measures are necessary to ensure that the die is adequately closed.

5.2.4.7 Starting the next cycle after guards have been opened in automatic mode.

Starting the next cycle shall be initiated by an intentional start command (see also 5.2.2.1).

If, for machines with a tie-bar distance up to 1 200 mm, because of technological requirements, the guard is closed automatically, e. g., on a time basis (see 5.2.4.8) the next cycle shall be initiated by an intentional command within a time limit of 10 s. After exceeding this time limit the guard shall open. Additionally, if the clear distance between the tie bars does not exceed 650 mm, the next cycle can be started automatically by closing the interlocking guard for the die area.

5.2.4.8 Whenever the guards close automatically on a time base because of technological requirements, e. g., material properties like cooling rate, stability of die temperature, the re-closing time of the guards shall be defined taking into account the ergonomic aspects (stress of the operator). The re-closing time shall be set by a system whereas the access to this system is restricted to certain categories of persons (e. g. with a password restricted to persons in charge of machine setting).

5.2.4.9 The devices for intentional starting the cycle shall be positioned in such a way, that the operator using them has a good view of the die-area and the area between the die-area and the guard.

5.2.5 Diecasting units

When the interaction between the diecasting machine and the ancillary equipment (e. g., a robot take-off-unit) prevents the use of a movable guard as defined in 5.2.2.1, a distance guard shall be provided (see Figure A.9).

NOTE This requirement does neither define the safety requirements of ancillary equipment nor the requirements for the interlocking of enclosures for these devices. Higher levels may be required in some circumstances.

Within the distance guards emergency stop devices (according to ⟦A1⟩ EN ISO 13850 ⟨A1⟧) shall be installed at suitable places. The emergency stop devices shall be adapted to the local conditions, e.g., permanently connected movable or fixed devices.

Accesses (doors) in distance guards shall be designed so that they do not open inwards. Doors shall be connected with the control system of the diecasting machine and its ancillary equipment by two mechanical limit switches. Instead of mechanical limit switches safety devices operating on different principles are allowed if they at least fulfil the same level of safety (according to 6.3.1 of EN 1088:1995).

In case of two mechanical limit switches when the door is closed, one limit switch shall be actuated positively by the door and the other limit switch shall be released. The coupling of the limit switches shall be in such a manner that it shall only be possible to start the diecasting machine and its ancillary equipment after the door is closed and a reset command has been given. The reset device shall be installed near to the door outside the danger area in such a manner that it can only be actuated from outside the distance guards.

5.3 Electric equipment and control systems

5.3.1 Electric equipment

The electric equipment of the diecasting machine shall comply with EN 60204-1.

5.3.2 Safety related parts of the control system: General

⟦A1⟩ Unless otherwise stated in this document, the performance level PL with use of category of the parts of the control system operating safety functions shall be determined by the manufacturer on the basis of his risk assessment according to EN ISO 13849-1. The performance level shall be at least PL=c with use of category 1 according to EN ISO 13849-1:2008. See examples in Figures A.10 to A.15. ⟨A1⟧

5.3.3 Emergency stop functions

⟦A1⟩ The emergency stop function shall conform to stop category 0 or 1 according to EN ISO 13850:2006 and shall be in conformity with 9.2.5.4 of EN 60204-1:2006 and EN ISO 13850. ⟨A1⟧

5.3.4 Safety related control system of the dangerous movements of the die

⟦A1⟩ The parts of the control system of diecasting machines related to dangerous movements of the die, shall be designed according to 5.3.5 or according to performance level PL=e with use of category 4 according to EN ISO 13849-1:2008. ⟨A1⟧.

5.3.5 Safety related control system of the dangerous movements with closing safety device

5.3.5.1 A closing safety device shall prevent the closing of the die even in case of a failure in the normal interlocking system. This device shall consist of a supplementary hydraulic valve that will stop the hydraulic flow for the closing movement, or release the hydraulic fluid to the tank when the guard (or the access door in the distance guard) is open. When the guard is opened, this hydraulic valve shall go to the safety position for example by one of the following solutions:

a) direct action of the guard (see Figure A.10);

b) direct action of the guard on a pilot valve (see Figure A.11);

c) direct action of the guard on a dedicated electrical position detector controlling a pilot valve (see Figures A.12 and A.13). This solution requires that the signals from the dedicated position detector are independent of the electric/electronic machine control system. The electrical system of the position detector shall:

   1) operate the limit switch by electric cables which are separate to and independent of the cables of the electric/electronic control system;

   2) be hardwired and act directly to the hydraulic supplementary valves;

   3) act with positively guided contacts.

〈A1〉

d) signal of the normal interlocking according to performance level PL=e with use of category 4 according to EN ISO 13849-1:2008 (see Figures A.14 and A.15). 〈A1〉

5.3.5.2 Closing safety devices shall be automatically monitored in their function and on their action at each cycle of the machine or at least at each cycle of the movable guard. This means that in the case of a hydraulic closing safety device the monitoring of the position of the valves shall be achieved by position switches. If the position switch according to 5.3.5.1 c) controls the hydraulic supplementary valve of the closing safety device by a relay, the contact of the relay shall be monitored.

The function of the limit switches according to 5.2.2.1 and 5.3.5.1 shall be monitored at each cycle of the machine or at least at each cycle of the movable guard, so that a failure at one of the limit switches will automatically be detected so that the next cycle cannot be initiated.

The following requirements for the monitoring circuit shall be achieved:

a) the correct logic correlation of the signals of the limit switches shall be monitored;

b) the enabling signal for the control circuit shall be created;

c) the monitoring circuit shall not create a control signal for the supplementary hydraulic valves.

Examples of safety related control systems with closing safety device are shown in Figures A.10 to A.15.

5.3.6 Control of ancillary equipment

The parts of the control system of ancillary equipment which are connected with parts of the control system according to 5.3.3 and 5.3.4 and which influence the safety shall be designed in such a manner that the safety function is always performed if a failure occurs.

The movements of ancillary equipment are allowed with the guard open, if their dangerous movements are interlocked with other protective devices, e. g., electro-sensitive protective devices. If appliances for removing products and/or spraying devices are used, e. g., from the backside or the upper side of the machine, the movable guard on the operator side shall only open if the ancillary equipment have left the area of the die and are not reachable by the operator.

5.4 Measures against thermal hazards

5.4.1 Spurting of molten metal

The required guards according to 5.2.2 and 5.2.5 shall be made in such a manner that injuries caused by spraying metal are prevented taking into account the temperature, velocity and quantity of the spraying metal (see Figures A.5, A.6 and A.7).

5.4.2 Contact with hot surfaces

The manufacturer shall consider design measures for reducing the hazards due to contact with high temperatures, so that the burn threshold is not exceeded for the contact time and material as specified in [A1] EN ISO 13732-1 [A1]. Where these limits cannot be adhered, protection against the residual risk is necessary, e. g., by instruction about safe working procedures and the use of personal protective equipment.

5.5 Hydraulics, pneumatics, combustible fluids

5.5.1 Hydraulics, pneumatics

Hydraulic equipment shall comply with EN 982. Pneumatic equipment shall comply with EN 983.

5.5.2 Pressure fluids

Hydraulic systems in diecasting units shall be built in such a manner that fire resistant fluids as defined in ISO 7745 can be used. The fluids used in the hydraulic circuits shall be "low flammable", e. g., waterglycol.

Pipe lines shall be designed to withstand the expected mechanical and thermal loads and be located so that they are protected against accidental mechanical or thermal damage. Hydraulic pipelines and hydraulic joints shall be suitable for use with low flammable hydraulic fluids.

5.5.3 Spray systems for release agents

If the machine is intended to be used with pressurized combustible release agents, protective measures shall be taken which automatically prevent spraying of fluid if a pipe breaks. Examples of suitable measures are pump shut-off devices and line break safety devices.

If spraying devices of the injector type are used, no additional measures against uncontrolled discharge of spraying agents are necessary.

5.5.4 Heat exchanger media

Connection joints and pipe lines for heat exchanger shall be designed, installed or covered in such a manner that the heat exchanger media cannot ignite if leakage occurs.

5.6 Noise

5.6.1 Noise sources

Sources of noise at pressure diecasting machines are, for example,

— the casting process;

— the moving parts of the machinery and their power sources;

— the manner in which the machine has been installed;

— spraying the die.

NOTE EN ISO 11688-2 gives useful information on noise generation mechanisms in machinery.

5.6.2 Noise reduction as a safety requirement

When designing a machine, technical measures for reducing noise at source at the design stage shall be considered according to EN ISO 11688-1. Particular considerations shall be given to:

a) selecting low noise level pumps rather than enclosing the pumps;

b) releasing of pneumatic energy. To conserve energy unnecessary releases should be avoided. Silencers or exhaust filters should be considered;

c) stabilizing vibrating pipelines by special fastenings to reduce noise created by such movements;

d) preventing vibration of panels by fitting stiffening strips or noise attenuating materials to reduce the radiation of noise;

e) placing noise producing equipment away from the operator position whenever practicable;

f) applying full and partial acoustic enclosures to limit the radiation of noise into the environment.

The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values (see EN 1265) in relation to other machines of the same family.

5.6.3 Noise emission measurement and declaration

A noise emission measurement and declaration shall be made according to the noise test code EN 1265.

5.7 Gases, vapours, fumes and dusts

If the intended use concerning the specific materials to be processed and the auxiliary products to be used is known by the manufacturer, the design shall include measures against the possible harmful emissions of gases, vapours, fumes and dusts [1)] that can be caused (including specific information for use, see Clause 7).

If the manufacturer has no information about the specific use[2] and, therefore, is not able to include in his design appropriate measures against the possible emissions of gases, vapours, fumes and dusts, he shall at least formulate the general principles to be observed in the information for use (see Clause 7).

5.8 Ergonomic aspects

〈A1〉 The machine shall be designed taking into account 4.8 of EN ISO 12100-2:2003, the guidelines of EN 13861 as well as the ergonomic principles in accordance with EN 614-1.

The manual controls of a semi-automatic operating diecasting machine shall be designed under ergonomic principles, if applicable, according to EN 894-1, EN 894-2 and EN 894-3.

The diecasting machine shall be designed so that setting-up and maintenance can be carried out in good working postures, if applicable, according to EN 1005-1, EN 1005-2 and EN 1005-3. 〈A1〉

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[1] In general, if a good ventilation of the place of use is ensured and if the appropriate auxiliary products are used, the risks due to emissions will be very low.

[2] This is in general the case for the machines covered by the scope.

The installation of lifting equipment, metal feeding devices, and devices for removing castings shall be considered, if applicable, according to EN 614-1 and EN 614-2.

5.9 Protective measures when setting-up diecasting machines, inserting and removal appliances, tie bar pulling devices, and other ancillary equipment

5.9.1 Setting-up without protective devices for the die area

If, for technical reasons, the protective devices according to 5.2.2, 5.2.3 and 5.2.5 cannot be used when setting-up and the mode "setting-up without protective devices" is activated, then their coupling with the control system can be switched off by a key lockable mode selector switch, provided that the casting process cannot be initiated and

a) the closing speed of the die is limited to a maximum of 30 mm/s and closure is activated by a hold-to-run control;

or

b) two hand control according to type III B of EN 574:1996 is used and the closing speed of the die is limited to a maximum of 60 mm/s;

or

c) when speed is not limited then the movement is initiated by a hold-to-run control button that allows inching of the moving platen in steps not exceeding 5 mm.

The machine–setter has to check that nobody is in the danger area of the die. If unnoticed access is possible other safety measures (e. g., closing of the operators opposite guard) shall be implemented (see 7.2.1 d)).

5.9.2 Movement of core pullers and ejectors

When the mode select switch is positioned to setting-up mode, movements of core pullers and ejectors shall only be started by a hold-to-run control start device.

5.9.3 Movement of tie bar pulling devices

Tie bar pulling devices at diecasting machines shall be designed so that when setting-up the positioning speed for bar movements does not exceed 30 mm/s at least 300 mm before entrance into the bore. This limit may be exceeded if the danger areas are outside the safety distances according to [A1] EN ISO 13857 [A1]. The pulling and removing shall be initiated by a hold-to-run control device.

5.9.4 Movement of the plunger of cold chamber machines

In die-setting mode with injection area guards open, the movement of the injection piston can be possible only by a hold-to-run control at reduced speed of maximum 200 mm/s.

5.10 Elevated working places

Suitable work platforms and access ladders in accordance with EN ISO 14122-1 to -3 shall be provided to safeguard against falls during normal operation, setting-up and maintenance.

5.11 Additional protective measures for cold-chamber diecasting machines

5.11.1 Bursting and removal of slugs

For cold-chamber diecasting machines there shall be a provision for adjusting the time the die is kept closed after casting within a range compatible with the intended use of the machine. Design measures shall be taken against unintended change of the time setting.

At cold-chamber diecasting machines with horizontal shot sleeves the movable guards for the die area shall be interlocked with the control system in such a manner that guard opening is only possible if the die has moved at least $^1/_3$ of its opening stroke.

In case slug is stuck inside the shot sleeve or the plunger is jammed into the shot sleeve, high force up to a maximum can be applied to the injection cylinder with die open as long as no access to the die area is possible.

5.11.2 Guards for the plunger area with vertical shot sleeve

At cold-chamber diecasting machines with vertical shot sleeves, dangerous areas between the shot sleeve and plunger shall be guarded with a movable guard. This shall be interlocked with the control system in such a manner that a movement of the plunger can only be initiated if the guard is in its closed position.

The movement of the plunger can be initiated by the guard reaching its closed position.

The movable guard shall remain locked at least 3 s after the slug has been ejected.

5.11.3 Guards for the plunger area with horizontal shot sleeve

The area of sleeve and plunger shall be guarded to prevent personnel from being injured by metal flashing by additional protective devices (e. g., fixed and/or movable guard). Movable guards shall be interlocked with the injection system by a position switch.

5.12 Additional protective measures for diecasting machines with vertical closing movement

The control system of diecasting machines in which a die movement can occur by gravity shall be designed so that a die closing movement caused by failure of energy or by switching-off the control system is prevented by a hydraulic circuit, e. g., that shown in Figure A.16 and by a mechanical restraint device.

The mechanical restraint devices shall be designed so that it reaches automatically the restraining position if a guard is opened.

This mechanical restraint device can also be used as a closing safety device in accordance with 5.3.5, if it is designed for the foreseeable pressure supply of the machine and the control system is designed according to 5.3.4 or 5.3.5.

Restraint devices shall be interlocked with the control system in such a manner that a power operated movement of the die cannot be started if these devices are in the holding position. The locked state shall be clearly identifiable.

5.13 Additional protective measures for hot-chamber diecasting machines

5.13.1 Metal spraying between nozzle and die

At hot-chamber diecasting machines the operator shall be protected by at least a fixed guard against the injuries due to spraying of metal between nozzle and die.

5.13.2 Movement of the injection piston

There shall be at least two switching elements, independent from the point of view of safety (e. g., hydraulic and/or mechanical elements) in the control circuit for activating the movement of the injection piston so that the movement cannot take place if one failure occurs in the control system. At least one of the elements shall be interlocked with the movable guard of the die area, see 5.2.4.6.

6 Verification of the safety requirements and/or protective measures

Verification of the safety requirements and/or measures detailed in Clause 5 and 7 of this standard shall be carried out as shown in Table 1.

Table 1 — Methods of verification

Clause	Visual inspection	Functional testing [a]	Measure-ment	Design validation [b]
5.2.1	X	X	X	X
5.2.2.1	X	X	X	X
5.2.2.2	X	X	X	X
5.2.2.3	X	X		X
5.2.3	X	X	X	X
5.2.4.2		X		X
5.2.4.3		X		X
5.2.4.4	X	X		X
5.2.4.5		X		X
5.2.4.6		X		X
5.2.4.7		X	X	X
5.2.4.8		X	X	X
5.2.4.9	X			
5.2.5	X	X		X
5.3.1		X		X
5.3.2	X	X		X
5.3.3	X	X		X
5.3.4		X		X
5.3.5.1	X	X		X
5.3.5.2	X	X		X
5.3.6	X	X		X
5.4.1	X			X
5.4.2	X		X	X
5.5.1	X	X		X
5.5.2	X			X
5.5.3	X	X		X
5.5.4	X			X
5.6	X		X	X
5.7				X

Table 1 *(continued)*

Clause	Visual inspection	Functional testing [a]	Measure-ment	Design validation [b]
5.8	X			X
5.9.1		X	X	X
5.9.2		X		X
5.9.3		X	X	X
5.9.4		X	X	X
5.10	X			X
5.11.1		X	X	X
5.11.2	X	X	X	X
5.11.3	X	X		X
5.12	X	X		X
5.13.1	X			X
5.13.2	X	X		X
7.2	X			
7.3.1	X			
7.3.2	X			
7.4	X			

[a] Functional testing includes the verification of the function also in case of a failure and efficiency of the guards and safety devices on the basis of

— descriptions given in the information for use;

— safety related layouts and circuit diagrams;

— the requirements given in Clause 5 of this standard.

[b] Design validation means verification that the design meet the safety requirements of this standard.

7 Information for use

7.1 General

Information for use shall be provided in accordance with Clause 6 of EN ISO 12100-2:2003 and the following clauses.

7.2 〈A1〉 Warning devices and safety signs

Where hazards can not be sufficiently reduced by design or safeguarding, the manufacturer shall provide warning devices and/or safety signs warning for the residual hazards of the machine.

Warning devices and safety signs according to EN 61310-1 and EN 61310-2 shall be used.

Graphical symbols shall be in accordance with ISO 3864-1 and/or ISO 7000.

Danger signals shall be in accordance with EN ISO 7731 and/or EN 842 and/or EN 981.

Warning signs shall be affixed so that they are visible from outside the danger zone.

The manufacturer shall not rely upon warning devices and safety signs alone to reduce hazards in case of significant risks. 〈A1〉

7.3 Accompanying documents

7.3.1 Instruction handbook

The information for use supplied with the machine shall include an instruction handbook (covering also all ancillary equipment) in accordance with 6.5 of EN ISO 12100-2:2003 and the following elements:

NOTE The following points describe examples of the structure and content of an instruction handbook and should be completed or extended in consideration of the specific machine.

a) machine specification, especially

   1) manufacturer, type of machine, year of manufacturing, serial number (if any) etc.;

   2) technical documents (circuit diagrams, parts list, data sheets, information/reference for spare parts etc.);

   3) for intended use with details to interfaces of additional/optional machines and equipment;

   4) for foreseeable non-intended use (e. g., prohibition of specific materials for casting, forbidden use of specific ancillary equipment);

   5) description of ancillary equipment/systems and integration into control of these (e. g., emergency stop, effect to the safety devices).

b) details about transport, setting up/installation, especially

   1) lifting instructions (e. g., transport rig, ring bolt);

   2) transportation weight;

   3) transport safety devices and removal of these before commissioning;

   4) plant layout/installation conditions (foundation plan, building requirements);

   5) reference to installation/assembly of the machine or single parts of the machine;

   6) reference to overturn protection and falls from high areas.

c) details about commissioning and de-commissioning, especially

   1) details about provision of energy (electric, hydraulic, pneumatic);

   2) details about fluid capacities, specific fluids (e. g., low flammable high pressure fluids);

   3) details about fitting of special devices (e. g., tempering units);

   4) details about starting, operation and shut-down;

   5) details about inspection of safety devices before commissioning and prohibition of unauthorized reconstruction and modification;

   6) reference for de-commissioning (e. g., disposal of high pressure fluids, emptying instructions).

d) operating instructions, in particular

   1) details about the available safety devices;

2) details about regular inspection of safety devices;

3) details about characteristic hazards (e. g., electrical, hydraulic, special reference to setting up and recommissioning after setting-up);

4) references for processes which could generate gas, fume or dust hazardous to human health. Reference to the user, that ventilation systems can be required in that case and information how they could be connected to the machine shall be given;

5) description of safety related control systems;

6) operator and/or machine-setter

   i) references about the necessary qualification of operators and/or machine-setters;

   ii) introduction of the operator how to operate the machine;

   iii) introduction of the machine-setter how to operate and set the machine;

7) introduction to safety devices and the approach if an accident occurs;

8) action in the event of failures or irregularities and abnormal operation;

9) references for preventing hazardous conditions by instruction for the user, such as explosions caused by reaction between wet material and molten metal;

10) references using devices to remove hot casting parts and reference to use personal protection equipment;

11) references to residual hazards like

   i) vibration;

   ii) radiation;

   iii) hot surfaces in the tool area and in the area of melting furnaces and feeding of material;

   iv) handling and storage of hot die parts in respect of surrounding conditions and protection of persons;

   v) flying off of material parts;

12) references to particular hazards in case of access on special occasions (e. g., maintenance, trouble-shooting) shall be pointed out in the instruction handbook and on the machine by markings/symbols (according to EN 61310-1) referring to the nature of hazard. If the protective devices are not available during this action the applicable measures shall be described in accordance with 5.9.1;

13) references to hazards due to

   i) non-relieved pressures;

   ii) malfunction of programmable electronic systems;

   iii) temperature;

   iv) fire;

14) references to manual handling in accordance with 5.8;

15) the material being cast;

e) maintenance manual

1) The maintenance manual shall contain instructions for the testing to be carried out and instructions for maintenance and repair work including the protective measures against hazards mentioned in Clause 4. It shall also give advice for those maintenance activities that require special knowledge or qualification and it shall provide lists of spare parts with reference to drawings and circuit diagrams.

2) The maintenance manual shall contain instructions for the safety measures to be taken before maintenance work and similar interventions including reliable disconnection of energy sources, measures against reconnection, neutralising residual energy, testing of safe state.

3) The operation of the safety devices shall be subject of a periodical inspection programme. The frequency of these thorough inspections shall be defined at the design stage according to the reliability and the nature and importance of the device and could be modified during the operational process.

4) Particularly the following instructions shall be considered in the maintenance manual:

i) instructions about de-commissioning in accordance with 7.3.1 c);

ii) instructions to preventative measures (replacement of wearing parts, lubrication etc.);

iii) instructions to lists of wearing parts;

iv) instructions about error messages of the control system and the resulting actions from this;

v) failure lists with specifications of causes of trouble and measures;

vi) instructions which parts of the system(s) shall be switched-off during repair work;

vii) where necessary, instructions about existing residual energy and reduction (hydraulic reservoir etc.) of those.

f) information dealing with noise

1) a noise emission declaration according to EN 1265,

2) if necessary, a reference to use personal hearing protection.

7.4 Marking

[A1] The following information shall be attached clearly and durably to diecasting machines:

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

b) designation of machinery;

c) designation of series or type, if any;

d) mandatory marking[3)];

e) serial number/machine number, if any;

f) year of construction, that is the year in which the manufacturing process is completed;

g) nominal locking force;

[3)] [A1] For machines and their related products intended to be put on the market in EEA, CE marking as defined in the European applicable directive(s), e.g. Machinery. [A1]

h) weight;

i) electrical characteristics, according to 16.4 of EN 60204-1:2006.

The auxiliary electrical equipment shall be fitted with durable plates containing data, in accordance with 16.4 of EN 60204-1:2006 including casing protection grade. 〈A1〉

Annex A
(informative)

Examples

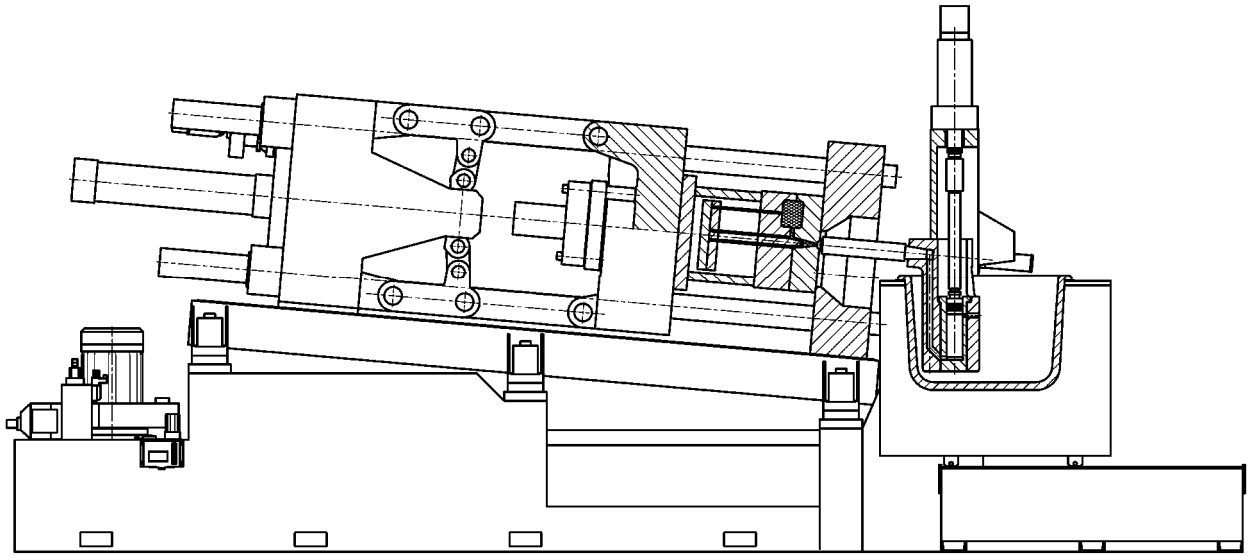


Figure A.1 — Example of a hot chamber diecasting machine (can be manufactured with a horizontal or a vertical die closing system)

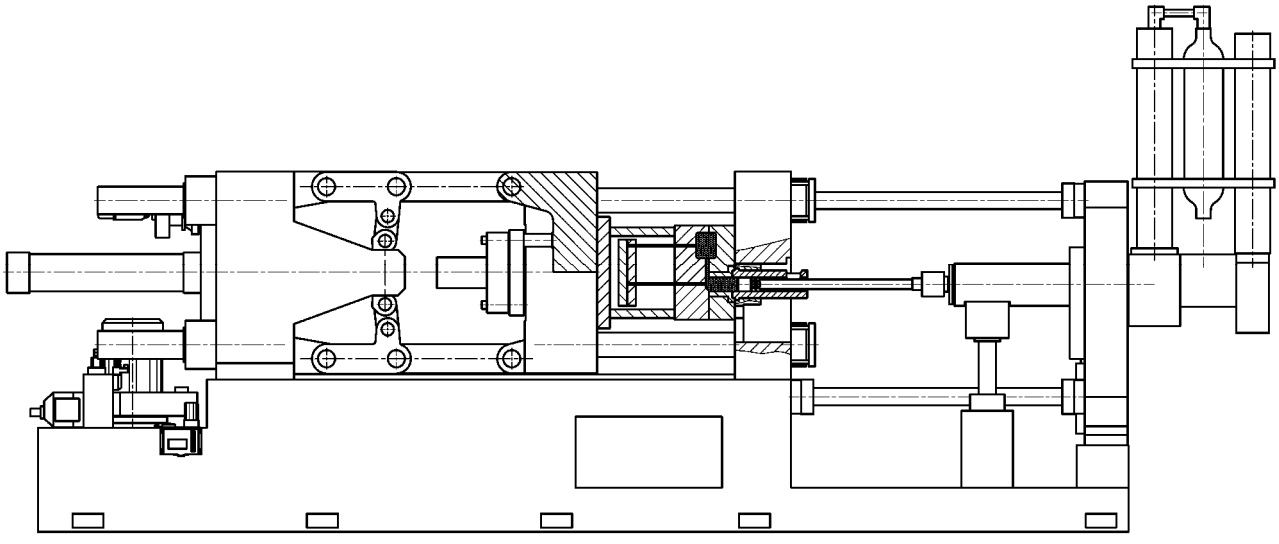


Figure A.2 — Example of a horizontal cold-chamber diecasting machine (can be manufactured with a horizontal or a vertical die closing system)

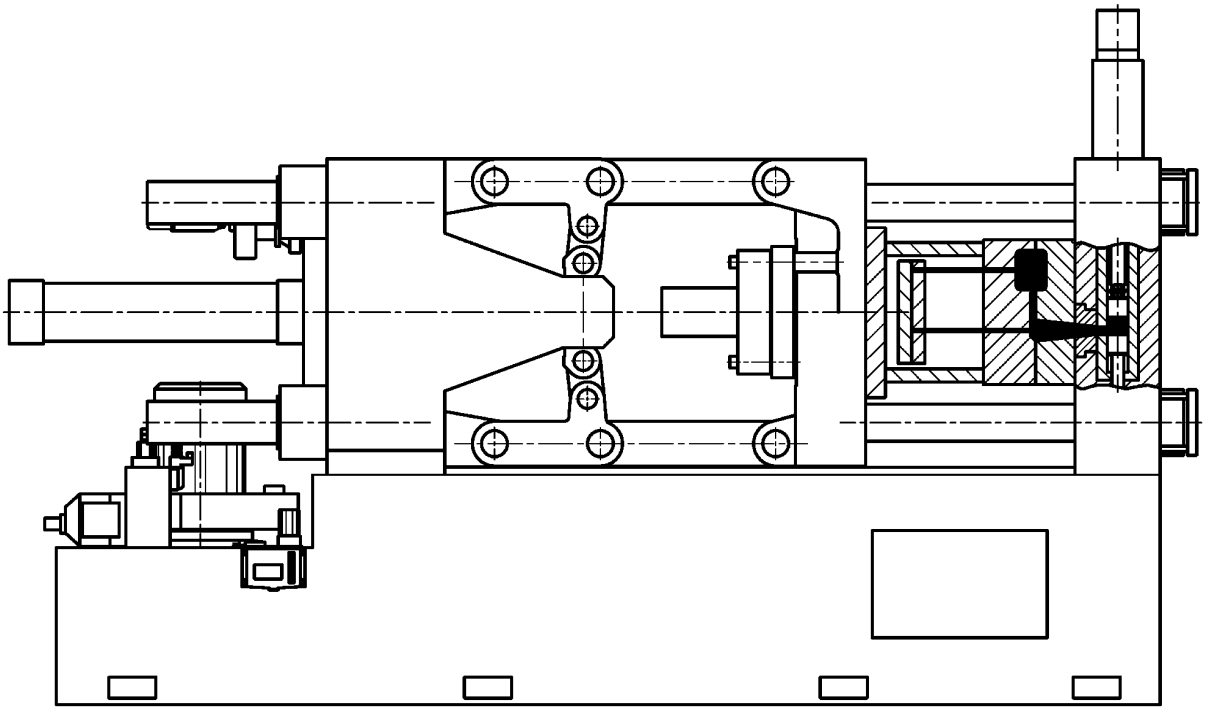
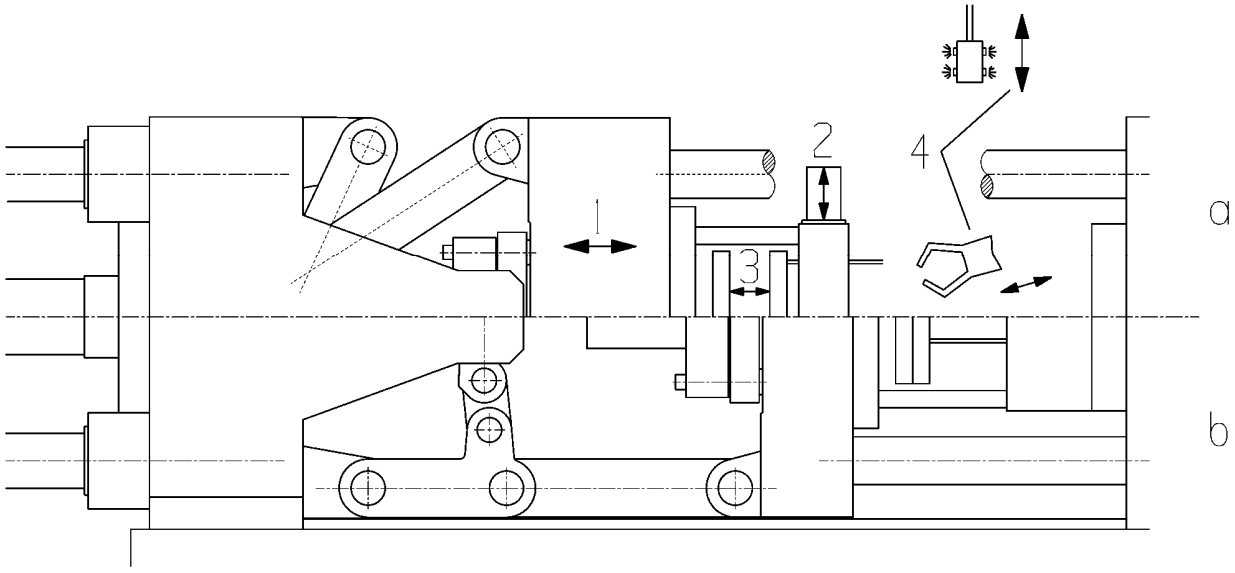


Figure A.3 — Example of a vertical cold-chamber diecasting machine with vertical shot-end (can be manufactured with a horizontal or a vertical die closing system)

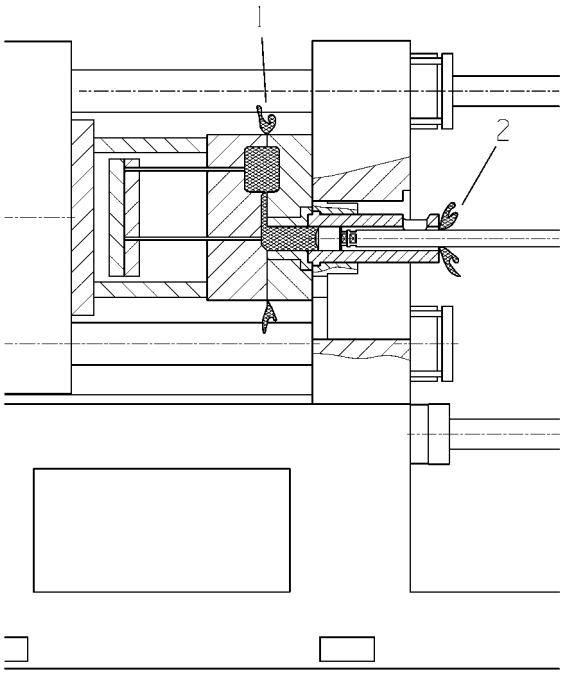


Key

1 closing travel of the die
2 movement of core pullers
3 movement of ejector
4 movement of supplementary devices

a die open
b die closed

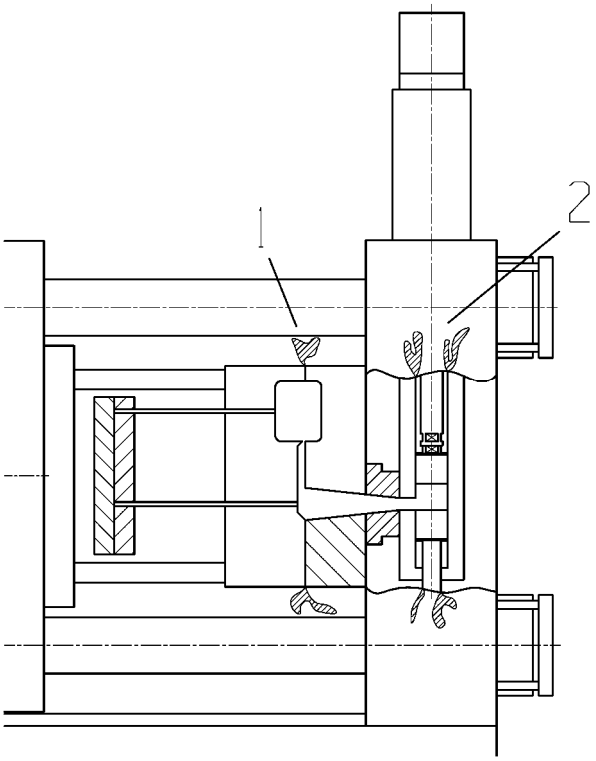
Figure A.4 — Examples of mechanical hazards and danger zones



Key

1 parting line of the die
2 between shot sleeve and plunger

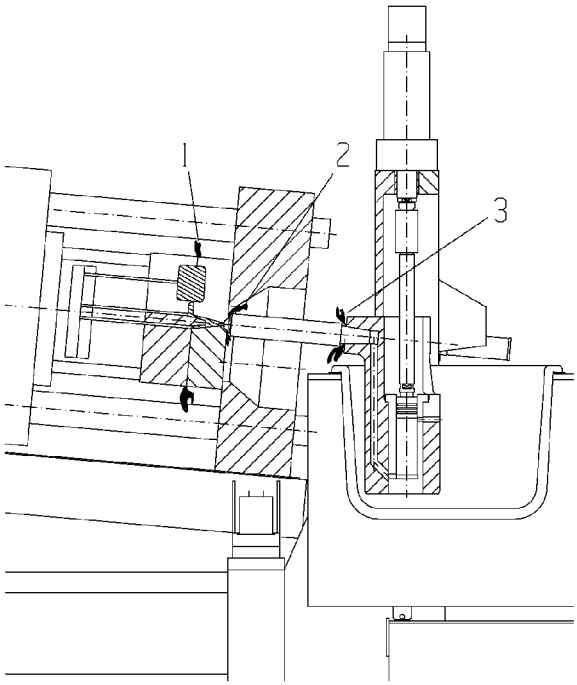
Figure A.5 — Examples of danger zones for metal spraying at horizontal cold-chamber machines



Key

1 parting line of the die
2 between shot sleeve and plunger

Figure A.6 — Examples of danger zones for metal spraying at vertical cold-chamber machines with vertical shot-end

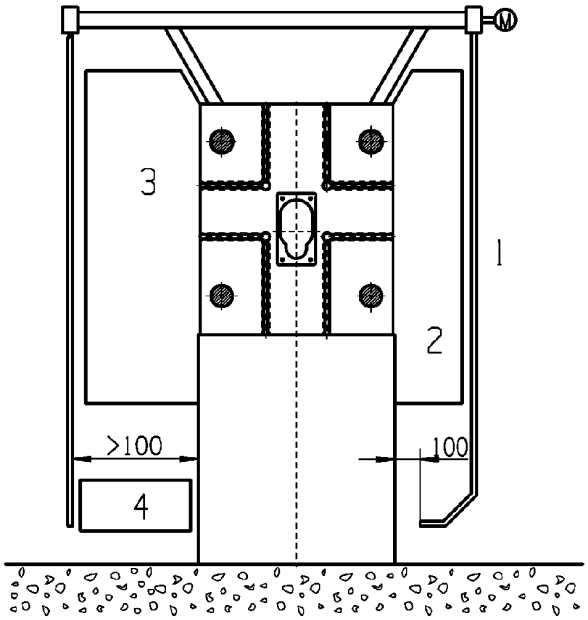


Key

1 parting line of the die
2 between the nozzle and the die
3 between gooseneck and nozzle

Figure A.7 — Examples of danger zones for metal spraying at hot-chamber machines

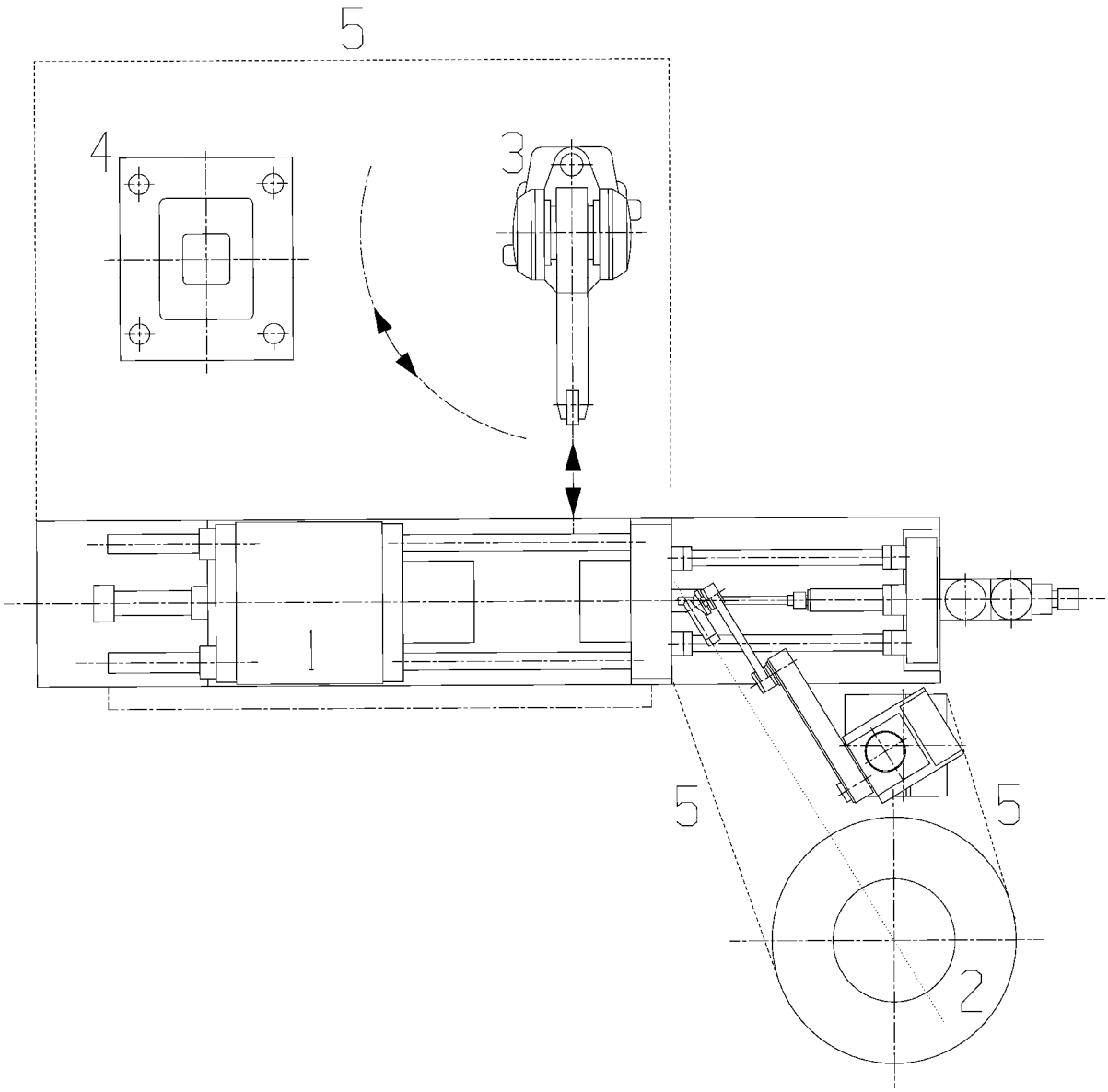
Dimensions in millimetres



Key

1 movable guard, power operated
2 additional fixed guard
3 additional fixed guard
4 additional protective device

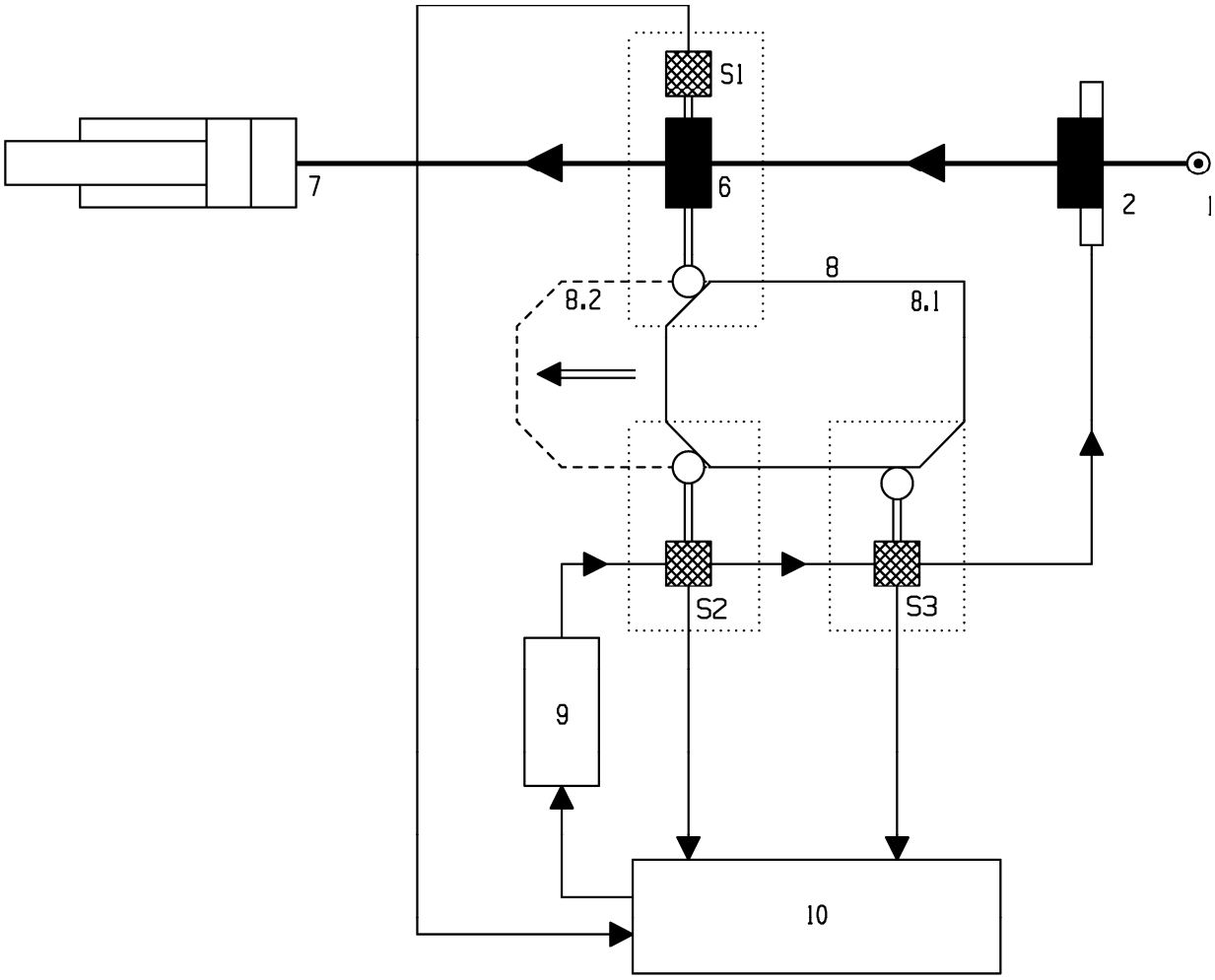
Figure A.8 — Distance between the guard and machine frame according to 5.2.2.1



Key

1 diecasting machine
2 metal feeding device
3 handling equipment (e. g., robot)
4 trimming press
5 distance guard

Figure A.9 — Example of guarding the hazardous area of a diecasting cell

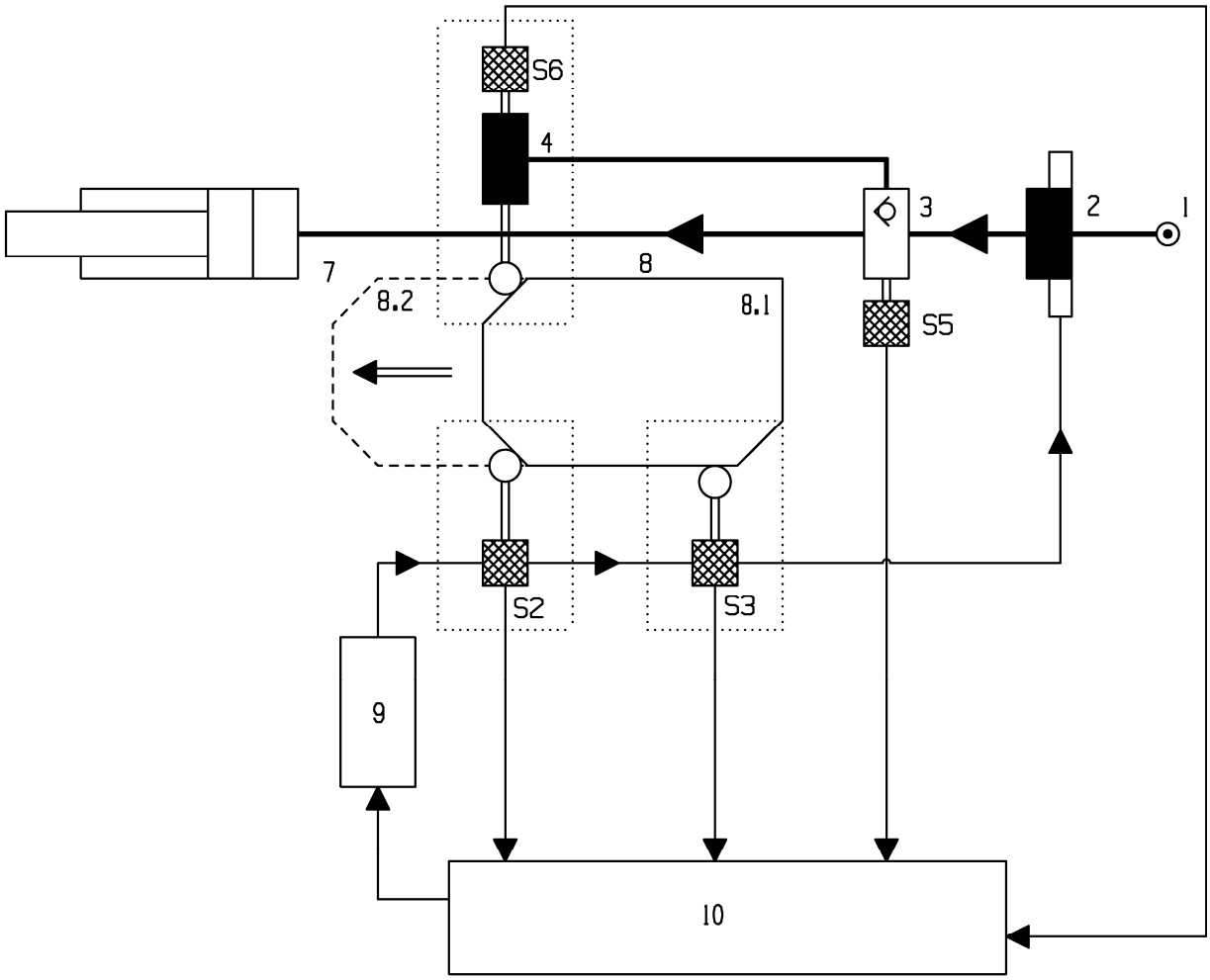


Key

1 source of power
2 directional valve
6 shut-off valve
7 closing cylinder
8 movable guard
8.1 movable guard (closed position)
8.2 movable guard (open position)
9 control circuit
10 monitoring circuit

S1 limit switch valve 6
S2 limit switch movable guard
S3 limit switch movable guard

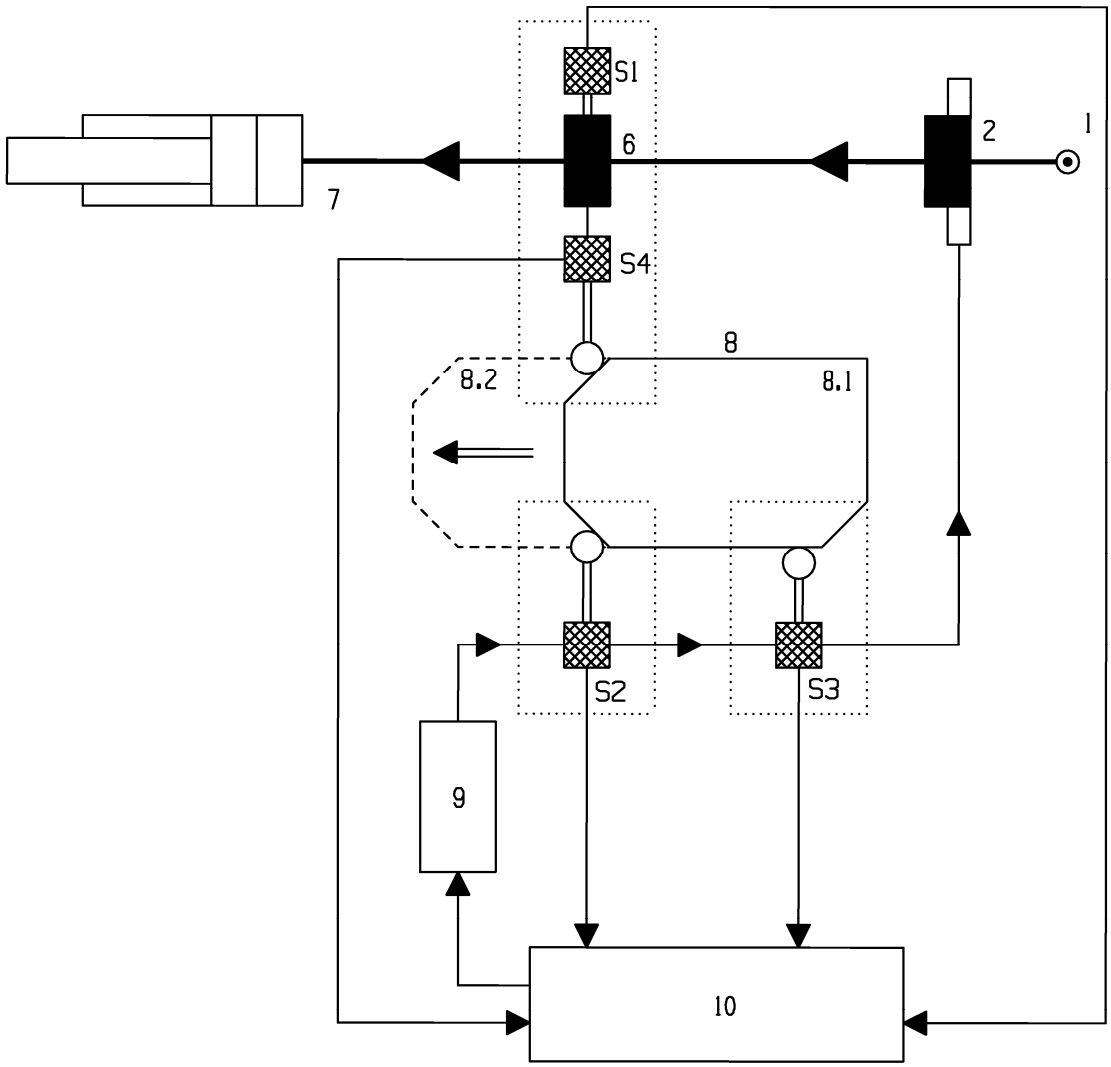
Figure A.10 — Example for a closing safety device with positively actuated hydraulic valve, see 5.3.5.1 a)



Key

1 source of power
2 directional valve
3 shut-off valve
4 pilot valve
7 closing cylinder
8 movable guard
8.1 movable guard (closed position)
8.2 movable guard (open position)
9 control circuit
10 monitoring circuit
S2 limit switch movable guard
S3 limit switch movable guard
S5 limit switch valve 3
S6 limit switch valve 4

Figure A.11 — Example for a closing safety device with positively actuated pilot valve, see 5.3.5.1 b)

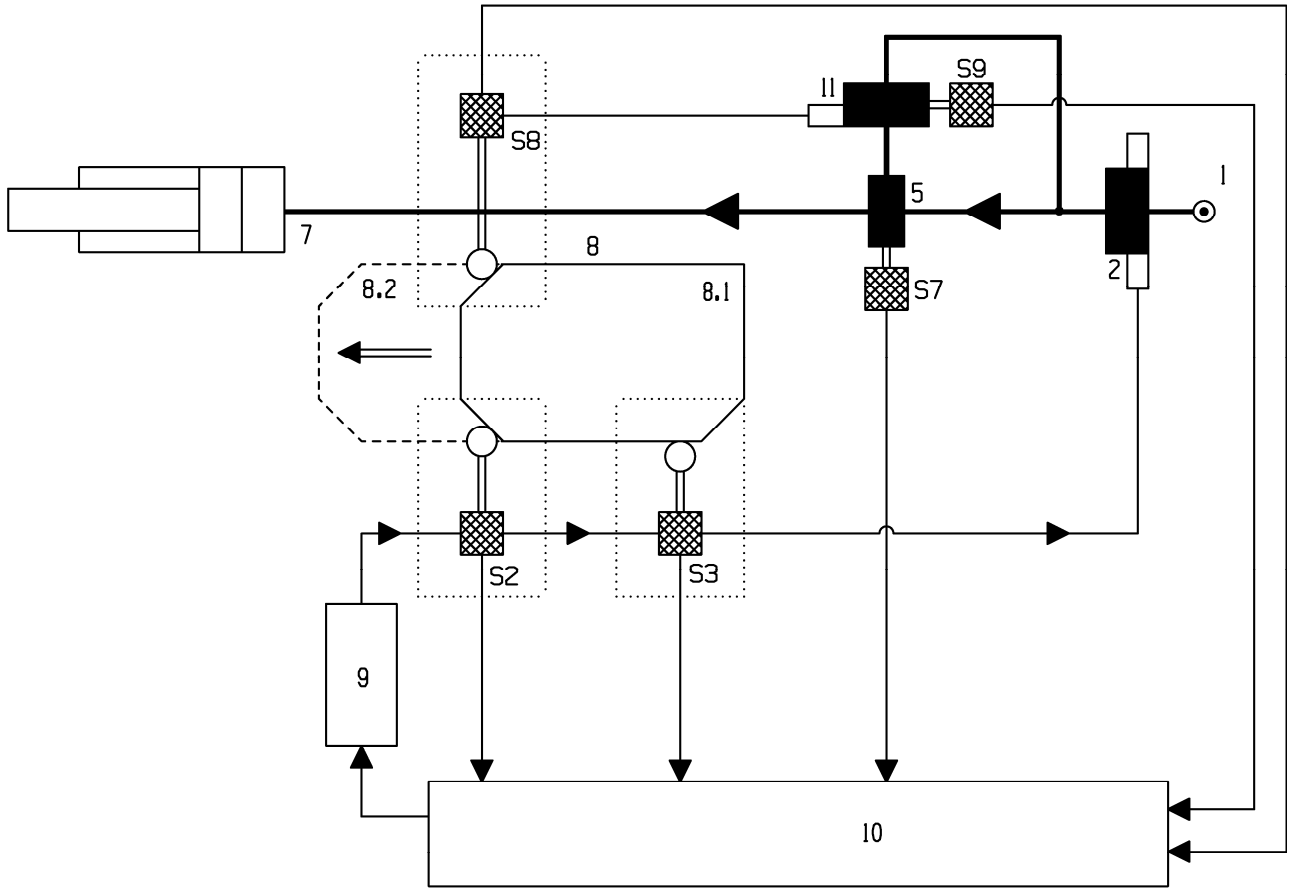


Key

1 source of power
2 directional valve
6 shut-off valve
7 closing cylinder
8 movable guard
8.1 movable guard (closed position)
8.2 movable guard (open position)
9 control circuit
10 monitoring circuit

S1 limit switch valve 6
S2 limit switch movable guard
S3 limit switch movable guard
S4 limit switch movable guard

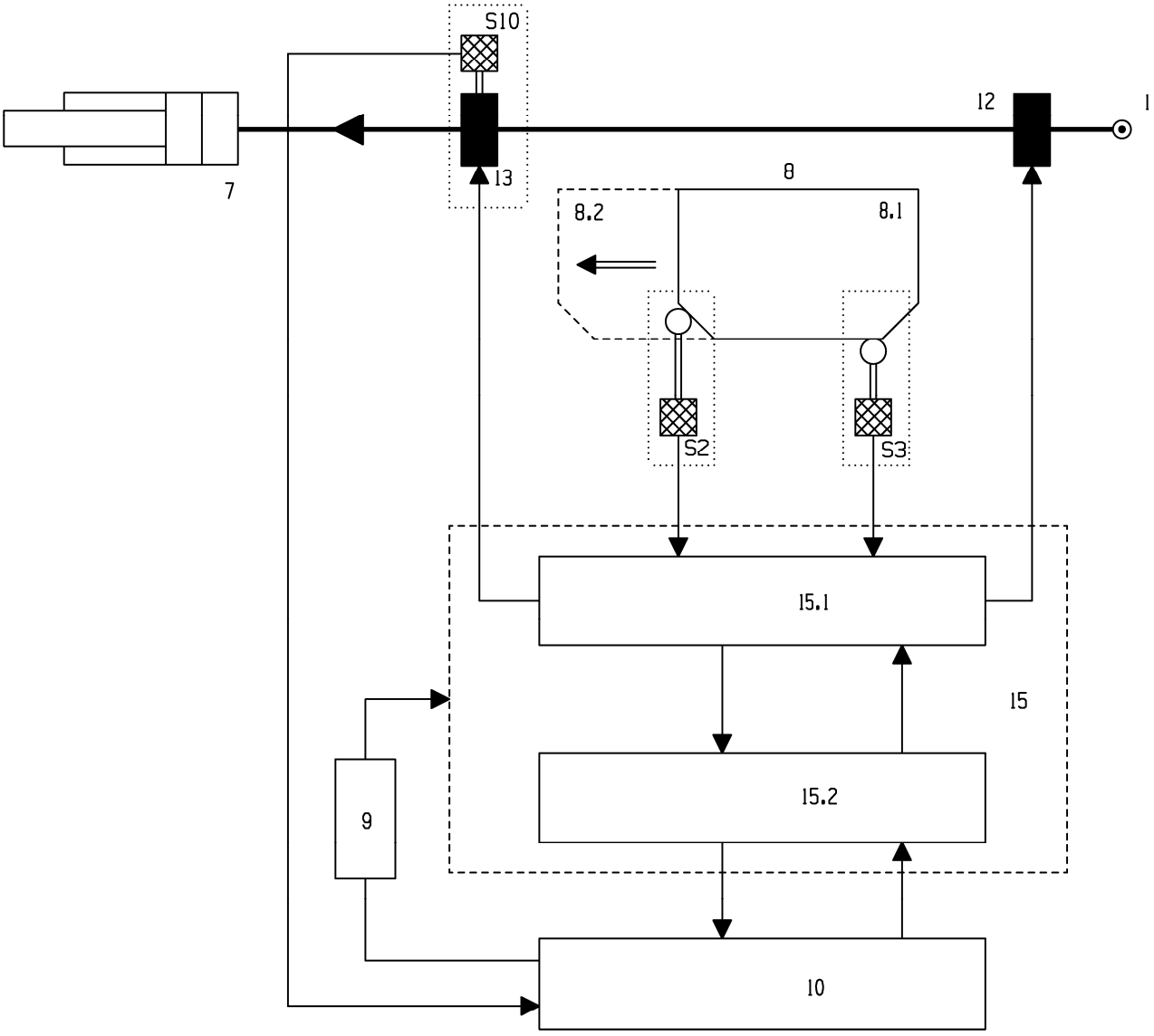
Figure A.12 — Example for a closing safety device with positively actuated limit switch which drives the shut-off valve, see 5.3.5.1 c)



Key

1 source of power
2 directional valve
5 shut-off valve
7 closing cylinder
8 movable guard
8.1 movable guard (closed position)
8.2 movable guard (open position)
9 control circuit
10 monitoring circuit
11 pilot valve
S2 limit switch movable guard
S3 limit switch movable guard
S7 limit switch valve 5
S8 limit switch movable guard
S9 limit switch valve 11

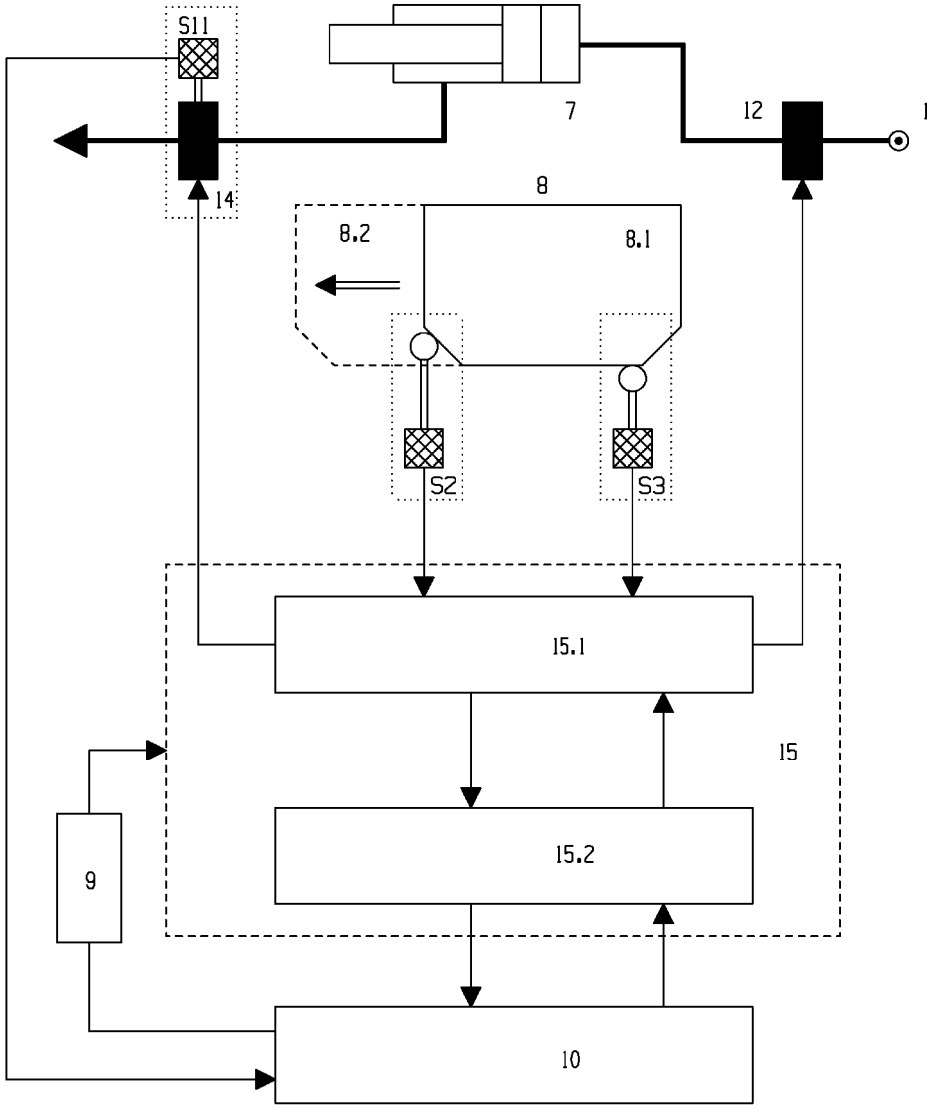
Figure A.13 — Example for a closing safety device with positively actuated limit switch which drives a pilot valve, see 5.3.5.1 c)



Key

1	source of power	13	second shut-off device
7	closing cylinder	[A1] 15	control and monitoring unit according to category 4 of EN ISO 13849-1:2008 [A1]
8	movable guard	15.1	control circuit of shut-off devices
8.1	movable guard (closed position)	15.2	monitoring circuit of position detectors
8.2	movable guard (open position)		
9	control circuit	S2	limit switch movable guard
10	monitoring circuit	S3	limit switch movable guard
12	first shut-off device	S10	limit switch valve 13

Figure A.14 — Example of safety related control system with closing safety device for closing units, see 5.3.5.1 d)

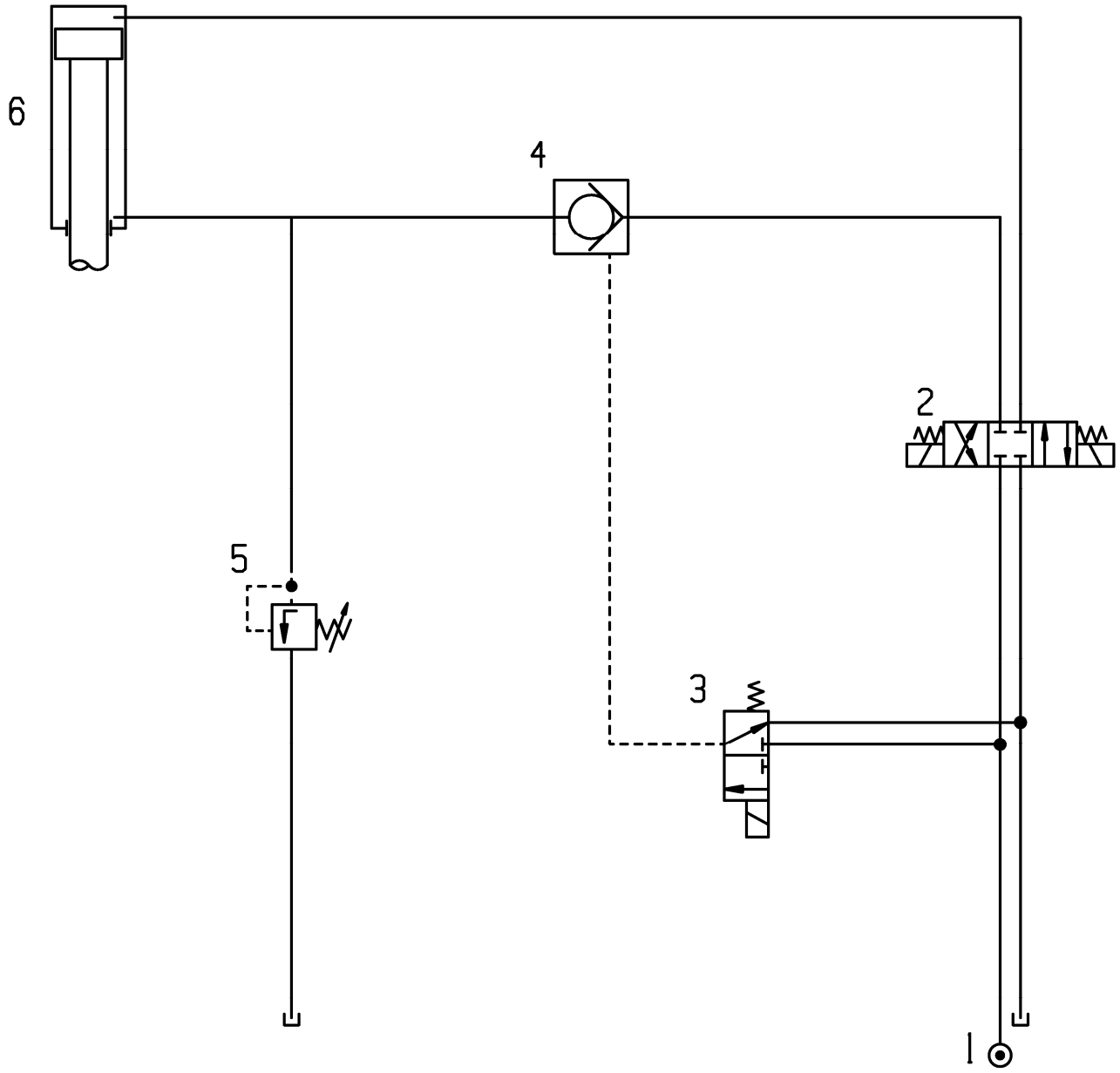


NOTE Overpressure due to the pressure ratio of the different cylinder areas should be considered with appropriate measures (e. g., mechanical dimensioning, safety valve) to avoid the destroying of the cylinder.

Key

1 source of power
7 closing cylinder
8 movable guard
8.1 movable guard (closed position)
8.2 movable guard (open position)
9 control circuit
10 monitoring circuit
12 first shut-off device
14 second shut-off device
[A1] 15 control and monitoring unit according to category 4 of EN ISO 13849-1:2008 [A1]
15.1 control circuit of shut-off devices
15.2 monitoring circuit of position detectors
S2 limit switch movable guard
S3 limit switch movable guard
S11 limit switch valve 14

Figure A.15 — Example of safety related control system with closing safety device for closing units, see 5.3.5.1 d)



NOTE The pressure relief valve no. 5 acts exclusively as a safeguard against pressure peaks and should not respond under normal operating conditions. The pressure relief valve should be adjusted at a response pressure which is 10% less than maximum pressure for which the hydraulic circuit has to be designed. The pressure relief valve should be type-tested and sealed after adjustment by the manufacturer of the valve.

Key

1 source of power
2 directional valve
3 pilot valve
4 shut-off valve
5 pressure relief valve
6 closing cylinder

Figure A.16 — Example of additional requirements on the hydraulic control of machines with vertical closing movement against pressure peaks and gravity (for electrical interlocking and monitoring, see Figures A.10 to A.15

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by 98/79/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

[A1] Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard. [A1]

Bibliography

〈A1〉 *deleted text* 〈A1〉

[1] 〈A1〉 EN 746-1 〈A1〉, *Industrial thermoprocessing equipment — Part 1: Common safety requirements for industrial thermoprocessing equipment*

[2] EN 1005-1:2001, *Safety of machinery — Human physical performance — Part 1: Terms and definitions*

[3] EN 1005-2:2003, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

[4] EN 1005-3:2002, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

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

[6] 〈A1〉 EN ISO 11688-2 〈A1〉, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998)*

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