



**International
Standard**

ISO 23063

**Foundry machinery — Safety
requirements for high pressure die
casting machines**

*Machines de fonderie — Exigences de sécurité pour les machines
à couler sous haute pression*

**First edition
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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 306, *Foundry machinery*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 202, *Foundry machinery*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

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

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (e.g. regulators, accident prevention organisations, market surveillance).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, for example, for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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

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

Where, for clarity, an example of a preventive measure is given in this document, this should not be considered as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved.

It is assumed that the machinery according to the scope is operated and maintained by trained personnel.

Foundry machinery — Safety requirements for high pressure die casting machines

1 Scope

This document applies to high pressure die casting machines:

- a) hot-chamber die casting machines (horizontal die closing system);
- b) horizontal cold-chamber die casting machines (horizontal die closing system).

This document applies to high pressure die casting units, i.e. high pressure die casting machines (HPDCM), and their interfaces with the following ancillary equipment:

- a) die;
- b) melting, holding and dosing furnaces (see ISO 13577-1:2016);
- c) metal feeding equipment;
- d) inserting and removal devices;
- e) spraying appliances;
- f) heating and cooling devices for the die.

This ancillary equipment itself is not covered.

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

This document does not apply to either low pressure die casting machines or gravity die casting machines, or both.

This document deals with all significant hazards, hazardous situations and events relevant to pressure die casting machines when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see [Clause 4](#)).

This includes hazards coming from intentional interactions as well as unintentional but foreseeable interactions between movable parts of the machine and persons.

This document 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.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

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

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ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*

ISO 7731:2003, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 7745:2024, *Hydraulic fluid power — Fire-resistant fluids — Requirements and guidelines for use*

ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections*

ISO 11204:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections*

ISO 11429:1996, *Ergonomics — System of auditory and visual danger and information signals*

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

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

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

ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13851:2019, *Safety of machinery — Two-hand control devices — Principles for design and selection*

ISO 13854:2017, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14119:2024, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-1:2016, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access*

ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*

ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 61310-1:2007, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61310-2:2007, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1

casting

component or product that has obtained its shape through the process of *die casting* (3.2)

3.2

die casting

process in which molten *metal* (3.7) is injected into a die and held under pressure until complete solidification

3.3

die casting machine

machine with the purpose to inject molten *metal* (3.7) under pressure into a parted die which is connected to the platens of the machine

3.4

die casting cell

die casting machine (3.3), together with auxiliary and ancillary equipment (3.6), which form a complete production unit

3.5

auxiliary equipment

set of all the devices which carry out additional process functions within a *die casting cell* (3.4)

3.6

ancillary equipment

devices which automatically carry out process functions additional to those of the *die casting machine* (3.3) itself, e.g. feeding the *metal* (3.7), removing the castings, spraying the die

3.7

metal

material, which is suitable for being cast in the *die casting* (3.2) process

3.8

hot-chamber die casting machine

die casting machine (3.3) with an inclined or horizontal *die closing system* (3.10) having the *shot sleeve* (3.19) and *plunger* (3.20) which are submerged in the molten *metal* (3.7) of the furnace

Note 1 to entry: See [Figure A.1](#).

3.9

cold-chamber die casting machine

die casting machine (3.3) with a horizontal *die closing system* (3.10), where molten *metal* (3.7) is delivered to the *shot sleeve* (3.19) in measured amounts from a separate furnace

Note 1 to entry: There are cold-chamber die casting machines with toggle (see [Figure A.2](#)) and toggle-free (see [Figure A.3](#)) closing systems.

3.10

die closing system

assembly which opens and closes the die, and holds the die against the force exerted on the molten *metal* (3.7) during injection and solidification

3.11

injection system

assembly which forces molten *metal* (3.7) from the *shot sleeve* (3.19) into the die cavity and applies pressure to the molten metal during solidification

3.12

ejector

system of assembled machine components (e.g. ejector plate and ejector rod) connected to the ejector device of the die, which allows the ejection of castings from the die cavity

3.13

core puller

assembly which controls movements of cores

3.14

tie bar pulling device

device for pulling *tie bars* (3.17) in order to facilitate die set-up procedure

3.15

die clamping device

device for clamping the die to the platens of the machine (automatically or manually)

3.16

moving platen

movable platen

platen to which the moving die-half is connected

3.17

tie bar

bar which carries the locking load and guide the *moving platen* (3.16)

3.18

injection drive

system (e.g. hydraulic) which moves the *plunger* (3.20) and applies force to it

3.19

shot sleeve

cylindrical container of a *cold-chamber die casting machine* (3.9) in which pressure is applied to molten *metal* (3.7)

3.20

plunger

plunger tip

piston which forces molten *metal* (3.7) from the *shot sleeve* (3.19) into the die and applies pressure to the molten metal during solidification

3.21

gooseneck

part of an *injection system* (3.11) [containing the *shot sleeve* (3.19) and *metal* (3.7) flow channel] which is submerged in molten metal

Note 1 to entry: Only applies to *hot-chamber die casting machines* (3.8).

3.22

nozzle

connection between the *gooseneck* (3.21) and the fixed die-half

3.23

biscuit

slug

metal (3.7) surplus which solidifies in the cold-chamber *shot sleeve* (3.19) and is ejected with the casting

3.24

fixed platen

platen to which the fixed die-half and the *metal* (3.7) *injection system* (3.11) are connected

3.25

die area

area between the *fixed platen* (3.24) and the *moving platen* (3.16)

3.26

cylinder platen

platen to which the die closing mechanism and the closing cylinder are connected

Note 1 to entry: Also known as thrust platen, reaction platen, link housing or rear platen.

3.27

die closing mechanism area

area between the *moving platen* (3.16) and the *cylinder platen* (3.26)

3.28

injection drive area

area between the *fixed platen* (3.24) and the shot cylinder

3.29

closing safety device

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

3.30

setting mode

operating mode where any step in the process can be selected and hand operated in any sequence with restricted operation of the safety functions

EXAMPLE To perform individual steps of the process (not necessarily in operating cycle sequence), like changing a die.

3.31

manual mode

operating mode where the individual steps in the machine cycle are hand initiated

EXAMPLE To perform the individual steps of the process (only in the sequence which is fixed by the program), such as to finish the casting cycle or to run the casting cycle in order to examine or to look for faults.

3.32

semi-automatic mode

operating mode where each cycle is hand initiated but thereafter automatically proceeds to completion

EXAMPLE 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* (3.35).

3.33

automatic mode

operating mode where the completion of a casting cycle initiates the next casting cycle

EXAMPLE To continuously produce castings with any external process steps being automatically carried out by ancillary device.

3.34

machine-setter

designated person, trained and skilled to carry out adjusting, die changing, setting and starting-up the *die casting* (3.2) process

3.35

operator

designated person trained and skilled to run the *die casting machine* (3.3)

3.36

access door

door of the distance guards of a *die casting cell* (3.4)

3.37

inspection

measure to observe and assess the current condition as well as fault finding

Note 1 to entry: Measures (e.g. measuring, testing, diagnostics) including the determination of the causes of wear or damage and the derivation of the necessary consequences for the continued use.

Note 2 to entry: This definition does not cover “material inspection”.

3.38

maintenance

combination of service, *inspection* (3.37), reconditioning and functional test of the equipment

Note 1 to entry: The purpose is to preserve the working condition or returning to this condition so that the required function can be performed (including safety requirements).

Note 2 to entry: Service is a measure to maintain the nominal condition. The nominal condition can be maintained in general without dismantling/disassembling major parts of the equipment (e.g. cleaning, lubrication of the work equipment as well as addition or replacement of agents) or by replacing tools or operational changing parts.

Note 3 to entry: Reconditioning is a measure to return to the nominal condition. Foreseeable measures to replace worn parts or parts having expired the foreseen lifetime (can require dismantling/disassembling). These parts should meet manufacturers' specification.

Note 4 to entry: A functional test is checking the functionality of the exchanged or repaired parts. Adjustment work can be required (e.g. test runs, verifying safety functions).

3.39

dry cycle

operation mode of the *die casting machine* (3.3), with all movements of the die casting machine, which are typical for a production cycle [e.g. with injection cylinder movements but without molten *metal* (3.7) and with die opening, die closing and interlocking using a die or a *test block* (3.40) mounted in the *die area* (3.25)]

3.40

test block

object for simulating the presence of a die in the *die area* (3.25) of the machine

3.41

performance level

PL

discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

Note 1 to entry: The symbols “a”, “b”, “c”, “d”, and “e” in this document indicate the performance level of safety-related components with respect to their average probability of dangerous failure. More information on these symbols is given in ISO 13849-1.

[SOURCE: ISO 13849-1:2023, 3.1.5, modified — Note 1 to entry has been replaced.]

4 List of significant hazards

4.1 General

[Clause 4](#) 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 either a die casting machine or its ancillary equipment, or both, additional hazards can exist, then an additional risk assessment shall be made.

4.2 Mechanical hazards

Mechanical hazards at die casting machines and at their ancillary equipment can occur because of the design and construction 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 following:

- a) die;
- b) core pullers;
- c) ejectors;
- d) ancillary equipment;
- e) injection system;
- f) power operated guards;
- g) die closing system;
- h) die clamping device;
- i) 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 pressurized fluids can cause hazards, e.g. whipping of hoses.

4.3 Electrical and control system hazards

4.3.1 Electrical hazards

Electrical hazards at die casting machines can occur, for example, by:

- electrical contact, direct or indirect;
- external influences on electrical equipment;
- damage of electrical components by thermal radiation or other phenomena (e.g. projection or leaking of molten metal particles).

4.3.2 Control system hazards

Failures which cause unexpected machine movements can occur in either the electric/electronic, hydraulic or pneumatic control system, or both.

4.4 Thermal hazards

Thermal hazards which can occur at die casting machines by:

- a) flashing, splashing or flowing out of molten metal, for example:
 - out of the parting-line of the die (see [Figures A.5](#) and [A.6](#));
 - between shot sleeve and plunger (see [Figures A.5](#));
 - between nozzle and die (see [Figure A.6](#));
- b) bursting of biscuits;
- c) contact with structural components of the machine which are being heated during the process;
- d) contact with ancillary equipment which are used to heat the working substances or dies;
- e) release of hot operating fluids;
- f) heat from furnaces.

4.5 Fire hazards

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

4.6 Noise hazards

Noise hazards can be caused by the operation of the high pressure die casting machine and/or the intended die casting process.

Sources of noise at high pressure die casting 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.

4.7 Hazards caused by gases, vapours, fumes and dusts

Hazards caused by dangerous gases, vapours, fumes and dust can occur at die casting machines, for example:

- by use of lubricants;
- by use of release agents;
- by fumes, vapours and dust given off when melting and holding molten metal (e.g. lead alloys);
- during cleaning.

Risk of explosion is not present as they are all diffused emissions and generation of explosive gaseous emissions is technological not possible.

4.8 Hazards generated by neglecting ergonomic principles in machinery design

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

- a) incorrect lifting of heavy loads due to the design of the machine, for example during:
 - setting up the die casting machine;

- maintenance of the die casting machine;
 - manual removing of the castings.
- b) work with repetitive motion, for example:
- manual feeding of molten metal;
 - manual removing of the castings.
- c) poor working postures, for example due to:
- wrong height of operating panel;
 - wrong position of operating panel;
 - poor access for maintenance and setting-up.

4.9 Hazards during the setting mode

Hazards can occur during setting mode when partial or full access of a person to hazardous areas of the machine is necessary.

4.10 Falls from heights

This hazard can occur with die casting machines when people work above ground level or over pits either during normal operation, set-up or maintenance work.

4.11 Hazards related to cold-chamber die casting machines

4.11.1 Bursting of biscuits

Biscuits 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 die casting 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 [Figure A.5](#).

4.12 Hazards related to hot-chamber die casting machines

4.12.1 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.6](#).

4.12.2 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.

4.13 Hazards due to 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 either the safety requirements or protective measures of [Clause 5](#), or both. If exceptions to general safety requirements are explicitly described for specific operation modes of the machine (these are: setting mode, manual mode, semi-automatic mode or automatic mode, see [Clause 3](#)), these exceptions can be preferentially applied.

In addition, the machine shall be designed in accordance with the principles of ISO 12100:2010 for relevant hazards which are not specifically listed within this document.

For the application of type B standards such as ISO 13857:2019, ISO 13854:2017, ISO 13850:2015, ISO 13851:2019 and IEC 60204-1:2016, the manufacturer shall carry out an adequate risk assessment to establish the requirements of the standard which are to be applied (as far as the choice of protective measures is not made in the requirements of [Clause 5](#)).

NOTE The requirements of this document and the described solutions are considered to offer an acceptable safety level. However, other solutions are acceptable if they offer an equivalent or higher level of safety.

The manufacturer of the high pressure die casting machine shall give provisions (e.g. information and description of the interface, recommendation for use) necessary for the integration of the ancillary equipment required for the intended use of the high pressure die casting unit.

5.2 Mechanical

5.2.1 General

Guards and protective devices shall be designed in accordance with ISO 12100:2010 and ISO 14120:2015. The safety distances shall be in accordance with ISO 13857:2019, Tables 2 and 4, ISO 13854:2017 and ISO 13855:2010. Guards and protective devices shall be designed so that they do not themselves cause hazards.

If a guard is power operated, it shall not create a danger by movement itself. Either the power provided shall be insufficient to cause injury in the event of collision, or the guards shall be provided in accordance with ISO 13856-2:2013 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. The part of the control system related to the trip device shall comply with at least PL = b as defined in ISO 13849-1:2023.

5.2.2 Guards and protective devices for the die area

5.2.2.1 Access from front and back of the machine

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, for example, of the die, the core pullers and die sprayers. Persons shall be prevented from staying between the guard and the machine frame when the guards are closed.

To ensure this, suitable measures are (see [Figure A.7](#)):

- a) the reduction of the distance between movable guards and the machine frame to a maximum of 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 left hand side of [Figure A.7](#)) 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 right-hand side of [Figure A.7](#)).

The supplementary protective device, which protects persons getting behind the guard, can, for example, be a type 4 electro-sensitive protective device according to IEC 61496-1:2020^[3], or an electromechanical or hydraulic-mechanical trip device with self-monitoring. In this case, the related part of the control system shall comply with PL = e in accordance with ISO 13849-1:2023.

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

- are operational as long as the die casting machine is operational;
- do not act as control devices with a start function;
- are not easily adjustable either in the vertical or in the horizontal direction by the operator;
- are interlocked with dangerous movements of the die casting machine and its interfaces with ancillary equipment; or

- c) a supplementary protective device used to detect the pass through of a person going to the die area (e.g. safety light curtain). Additional measures shall be taken to ensure that the person has left the area between the guards and the machine frame when the machine is started (see also [Figure A.8](#)).

For example, this can be achieved by the installation of push buttons inside and outside of the guard which have to be pressed in a predetermined order. First, press the inside button, then observe the passage of the person through the safety light curtain, then press the outside button.

If more than one person is working, there is a residual risk that a person can be trapped. Then, additional measures shall be taken, such as those given in the instructions in the operation manual.

The supplementary protective device can, for example, be a type 4 electro-sensitive protective device (e.g. safety light curtain) according to IEC 61496-1:2020^[3]. In this case, the related part of the control system shall comply with performance level PL = e in accordance with ISO 13849-1:2023.

Electro-sensitive protective devices shall be designed and arranged so that the devices:

- are operational as long as the movable guards are not closed;
- do not act as control devices with a start function;
- are not adjustable either in the vertical or in the horizontal direction by the operator;
- are interlocked with dangerous movements of the die casting machine and its interfaces to ancillary/auxiliary equipment.

Suitable measures other than a), b) or c) can be applied if they have at least an equivalent safety level according to the risk assessment.

5.2.2.2 Whole-body access to the die area

Die casting 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 for preventing the closing of the die when a person is in the die area.

Suitable measures are:

- a) a lockable control device (e.g. key switch, padlock selector) 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, according to IEC 60204-1:2016, 5.4; 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 automatically or manually operated, preventing the closing of the die; this device shall be interlocked with the closing movement; or
- d) a device for switching-off the hydraulic pump according to IEC 60204-1:2016, 5.4; the device for switching-off shall be located close to the access door.

Related parts of the control system shall comply with performance level PL = e in accordance with ISO 13849-1:2023.

Where ancillary equipment can cause hazards for persons present in the die area, measures shall be taken to prevent dangerous movements of these equipment and the control system of the die casting machine regarding the interfaces to the ancillary equipment shall be in accordance with at least PL = d.

5.2.2.3 Interlocked movable guards for the die area

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 ISO 14119:2024, 8.3.2; and
- b) an additional closing safety device in accordance with [5.3.4.3](#).

The mechanically actuated detectors can be replaced with non-mechanically operated detectors if the safety achieved is not less than obtained with mechanical detectors according to ISO 14119:2024.

5.2.3 Access to the die closing mechanism area

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

- a) the power supply for dangerous movements (e.g. switch off the hydraulic pump and release the pressure of the accumulators for die movement): The relevant part of the control system shall have at least a performance level PL = d in accordance with ISO 13849-1:2023. Restarting the machine shall only be possible if the guard for the closing mechanism area is closed; or
- b) 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 in accordance with ISO 13849-1:2023. Restarting the dangerous movement shall only be possible if the guard for the closing mechanism area is closed. Movements of the ejector with guard open are allowed, with a hold-to-run control (see [5.9.2](#)) and if the speed of the ejector is limited to 30 mm/s. The parts of the control system related to the speed reduction shall be at least performance level PL = b in accordance with ISO 13849-1:2023.

Suitable measures other than movable guards can be applied if they have at least an equivalent safety level according to the risk assessment.

5.2.4 Additional requirements for movable guards and access doors

Movable guards and access doors (see [5.2.5](#)) shall be interlocked with the control system so that:

- a) 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.
- b) Ejector and core pullers movement shall only be possible with the guards for the die area closed.

- c) Deviations from the requirements of [5.2.4 a\)](#) and [5.2.4 b\)](#) are allowed and the ejectors and core pullers may be operated with guards for the die area open in semi-automatic mode (e.g. for manual part extraction, manual spraying) provided that the ejectors and core pullers have no shearing or crushing areas; or, if there are shearing or crushing areas, a lockable mode selector switch (or equivalent access code in case of numerical control) is provided for the use by a well-trained operator.
- d) Any opening of the movable guard protecting the die area shall immediately stop the die closing movement.
- e) The casting process shall only take place when the movable guards of the die area, or the access doors are closed and the die closing system is closed and locked.
- f) Starting the next cycle after guards have been opened (e.g. when parts are extracted manually):
 - 1) starting the next cycle shall be initiated by a sequence of intentional start commands given by the operator:
 - the first command is to close the movable guards; and
 - when the movable guards are closed, the second command initiates the cycle; or
 - 2) for machines where the tie-bar distance does not exceed 1 200 mm it is allowed that the movable guard is closed automatically on a time base; the next cycle shall be initiated by an intentional start command within a time limit of 10 s; if this time limit is exceeded without an intentional start command, the movable guard shall open; or
 - 3) if the tie-bar distance does not exceed 650 mm, the next cycle can be started automatically after closing of the movable guard for the die area.

Whenever the guards close automatically [according to 2) and 3)] on a time base because of technological requirements (e.g. physical 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).

It shall be considered that:

- measures of [5.2.2.1](#) have to be carried out so that a person cannot be trapped between the guards and the machine frame;
 - measures of [5.2.1](#) have to be applied for the design of the power-driven movable guards;
 - automatically driven movable guards [according to 2) and 3)] should have warning signs according to [7.2](#).
- g) 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 movable guard.

5.2.5 Die casting units

The interaction between the die casting machine and the ancillary equipment (e.g. a robot take-off-unit) do not need a movable guard as defined in [5.2.2.1](#) if this area is protected by measures of at least the same level of safety. This includes all listed hazards, especially hazards according to [4.4](#). This incorporates measures for safety interlocking ensuring safety for this area (see [Figure A.9](#)).

NOTE 1 This requirement does not define the safety requirements of ancillary equipment, nor the requirements for the interlocking of enclosures for these devices. Higher levels can be required in some circumstances.

NOTE 2 If the power operated guard is inside of the distance guard, a trip device is not necessarily required, as long as the principles of ISO 12100:2010 are fulfilled.

The combination of the following measures is an example for the safety of this area.

Within the distance guards, emergency stop devices (according to ISO 13850:2015) shall be installed at suitable places. The emergency stop devices shall be adapted to the local conditions, for example, permanently connected to 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 die casting 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 ISO 14119:2024).

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 die casting 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 die casting machine shall comply with IEC 60204-1:2016.

5.3.2 Safety related parts of the control system: General

Unless otherwise stated in this document, the required performance level PL of a specific hazard shall be determined by the manufacturer on the basis of the risk assessment in accordance with ISO 13849-1:2023. In this case, safety related parts of the control system shall fulfil at least this performance level.

5.3.3 Emergency stop functions

The emergency stop function shall conform with stop category 0 or 1 in accordance with ISO 13850:2015 and IEC 60204-1:2016, 9.2.5.4.

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

5.3.4.1 General

The clamp safety device shall be designed in accordance with at least either the hydraulic circuit described in [5.3.4.3.1](#) or the mechanical restraint device described in [5.3.4.3.2](#).

5.3.4.2 Required level of safety

The parts of the control system of die casting machines related to dangerous movements of the die, shall be designed to comply with the performance level PL = e in accordance with ISO 13849-1:2023, or [5.3.4.3.1](#) or [5.3.4.3.2](#).

5.3.4.3 Closing safety device

5.3.4.3.1 Closing safety device designed with hydraulic safety measures

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 stops 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 opens, this hydraulic valve shall go to the safety position, for example:

- a) directly activated by the guard (see [Figure A.10](#)); or
- b) through a pilot valve, which is directly activated by the guard (see [Figure A.11](#)); or

c) through a dedicated electrical position detector, which is directly activated by the guard and is 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:

- have an independent wiring from the electric/electronic control system;
- be hardwired directly to the hydraulic supplementary valves;
- act with positively guided contacts; or

NOTE Positively guided contacts are two linked contacts, where one contact opens while the other contact closes.

d) by signal of the normal interlocking that complies to the performance level $PL = e$ in accordance with ISO 13849-1:2023 (see [Figures A.14](#) and [A.15](#)).

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 in accordance with 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 in accordance with [5.2.2.1](#) and [5.3.4.3.1](#) 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 applies to the monitoring circuit:

- the correct logic correlation of the signals of the limit switches shall be monitored;
- the enabling signal for the control circuit shall be created;
- 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](#).

5.3.4.3.2 Closing safety device designed with mechanical safety measures

A closing safety device shall prevent the closing of the die by a mechanical restraint device even in case of a failure in the normal interlocking system when the guard (or the access door in the distance guard) is open.

The mechanical restraint devices shall be designed to:

- a) reach automatically the restraining position if a guard is opened;
- b) withstand foreseeable die closing force of the machine;
- c) have a control system in accordance with $PL = e$;
- d) be interlocked not to start closing die, if the devices are in the holding position;
- e) be clearly identifiable if these devices are in the locked state.

5.3.5 Control of ancillary equipment

The interface of the die casting machine with ancillary equipment shall be designed in such a manner that there is no influence on the safety of the die casting machine. If a failure in the interface regarding safety occurs, the die casting machine is put in a safe state.

The movements of ancillary equipment are allowed with the guard open if their dangerous movements are interlocked with other protective devices, for example, electro-sensitive protective devices. If ancillary

equipment for either removing products or spraying devices, or both are used, for example, from the backside or the upper side of the machine, the movable guard on the operator side shall only open if:

- the ancillary equipment has left the area of the die and causes no additional danger; or
- other exceptions are made in this document for special machine modes, for example, setting mode (see [5.9](#)).

Otherwise, the machine shall stop any dangerous movements and put the interface in safe state.

5.4 Measures against thermal hazards

5.4.1 Spurting of molten metal

The required guards in accordance with [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](#) and [A.6](#)).

5.4.2 Contact with hot surfaces

The manufacturer shall apply measures in accordance with ISO 13732-1:2006 for reducing the hazards due to contact with high temperatures. Possible solutions are the use of protective covers at a safe thermal distance, insulation of hot surfaces or cooling of hot surfaces to ensure the appropriate allowable thermal limits.

Where these limits cannot be adhered, for example, in the case of service or during set up, protection against the residual risk is necessary by, for example, instruction about safe working procedures and use of personal protective equipment.

5.5 Hydraulics, pneumatics and combustible fluids

5.5.1 Hydraulics, pneumatics

Hydraulic equipment shall comply with ISO 4413:2010. Pneumatic equipment shall comply with ISO 4414:2010.

5.5.2 Pressure fluids

Hydraulic systems in die casting machines shall be built in such a manner that fire-resistant fluids as defined in ISO 7745:2024 can be used.

Pipelines 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 fire-resistant hydraulic fluids.

Countries of the European Union and associated countries shall follow the requirements in [Annex B](#).

5.5.3 Spray systems for release agents

If the die casting machine is intended to be used with spray systems (via direct control or interface) for pressurized combustible release agents, protective measures shall be taken within the die casting cell which automatically prevent spraying of fluid if a pipe break. Examples of suitable measures are pump shut-off devices and line break safety devices.

The person responsible for the die casting cell shall consider this hazard.

If spraying devices provide release agents almost pressure less (e.g. using venturi principle), no additional measures against uncontrolled discharge of spraying agents are necessary.

5.6 Noise

5.6.1 Noise reduction as a safety requirement

When designing a machine, technical measures for reducing noise at source at the design stage shall be considered in accordance with ISO/TR 11688-1:1995. 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 or partial acoustic enclosures to limit the radiation of noise into the environment.
- g) providing recommendations for placing the machine [see 7.3.1 b)].

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

NOTE ISO/TR 11688-2:1998 gives useful information on noise generation mechanisms in machinery.

5.6.2 Noise emission measurement and declaration on die casting machines

Noise emission measurement on die casting machines and declaration of noise emissions shall be carried out in accordance with the noise test code in 5.6.3. For deliveries into countries of the European Union and associated countries, the requirements in Annex B shall be followed. For deliveries to China, the requirements in Annex C shall be followed.

5.6.3 Noise test code

5.6.3.1 General

The measuring objects include power devices, such as motors and hydraulic units, built in the machine.

During the noise tests, the machine needs to run a complete dry cycle without any ancillary equipment such as conveyors.

5.6.3.2 Measurement of the emission sound pressure level of the die casting machine

A-weighted emission sound pressure levels shall be measured in accordance with one of the following basic noise emission standards: ISO 11201:2010 (Grade 2: Engineering), ISO 11202:2010 (Grade 3: Survey) or ISO 11204:2010 (Grade 2 or Grade 3, with environmental corrections). The use of Grade 2 (Engineering) is recommended. However, if it is impossible, the reason shall be stated in the report.

- a) Measurement positions: A-weighted emission sound pressure levels shall be measured at a distance of 1 m from the reference box of the machine and at a height of 1,6 m from the floor. The measurement positions shall be at least eight spots on the perimeter, one of which shall be close to the operator panel [see Figure A.16 with Key 5 (measurement position) and Key 6 (measurement position close to operator panel)].
- b) Determination and reporting of the A-weighted emission sound pressure levels: In accordance with ISO 11201:2010, an A-weighted emission sound pressure level shall be determined for each measurement position in Figure A.16 as a mean value of all measurements during operation of the HPDC in accordance

with [5.6.3.4](#). These values shall be averaged to determine the A-weighted emission sound pressure level of the HPDC.

- c) Measurement uncertainty: The results of noise measurement depend on the reproducibility of measurement, the installation conditions and the operating conditions. Therefore, the uncertainty shall be stated in the report. The measurement uncertainty shall be 2,5 dB for a measurement method of Grade 2 accuracy.

5.6.3.3 Installation conditions of the die casting machine

The noise tests shall be conducted in the manufacturer's factory. The machine shall be installed at a position as far as possible from any other objects or other reflecting surfaces, so that the tests shall not be affected by any nearby installations.

5.6.3.4 Operating conditions

The operating conditions are as follows.

- The measurements shall be conducted in automatic mode of a dry cycle (see [3.39](#)).
- The measurement shall be conducted for at least five cycles of operation and the total measurement period shall be at least 60 s. Machines with shorter cycle times than 12 s have to run more cycles to reach the minimum time 60s.

NOTE The measurement during the dry cycle does not include process related noise sources.

5.6.3.5 Measurement records

The manufacturer shall record the following information about measurement:

- noise emission standards adopted for measurement;
- acoustic environment;
- measurement positions;
- measuring instruments;
- operating conditions;
- other necessary information.

5.6.3.6 Information to be declared

The manufacturer shall declare the A-weighted sound pressure level determined in accordance with the measurement in [5.6.3.2](#).

[Table 1](#) gives an example of the manufacturer's noise measurement declaration. It contains the determined noise measurement values. In addition to that, [Table 1](#) contains also general data on the die casting machine (model, manufacturer, etc.) and information about the noise measurement itself (date, location, measuring equipment, installation and operating conditions during measurement, etc.).

Table 1 — Example of a manufacturer's declaration for noise measurement

Machine information/specifications		
Die casting machine model		
Manufacturer		
Die clamping force (kN)		
Distance between tie bars $W \times H$ (mm)		
Injection force (kN)		
Machine dimensions $L \times W \times H$ (mm)		
Information about noise measurement		
Date of manufacture		
Date of noise measurement		
Measuring instruments		
Location of noise measurement		
Installation condition		
Operating conditions	Die clamping force (kN)	
	Die closing speed (% or m/s)	
	Die opening speed (% or m/s)	
	Ejector forward speed (% or m/s)	
	Ejector backward speed (% or m/s)	
	Injection low speed (% or m/s)	
	Injection backward speed (% or m/s)	
	Cycle time (s)	
Measurement time (s)	Real time duration according to 5.6.3.4	
Noise measurement values		
A-weighted emission sound pressure level	Standards adopted for measurement	ISO**** Grade 2
	Measured value (dB)	
	Uncertainty (dB)	

5.7 Gases, vapours, fumes and dusts

High pressure die casting machines are universally applicable machines for processing non-ferrous metals. The high pressure die casting machine itself does not produce any hazardous gases, vapours, fumes or dust.

5.8 Ergonomic aspects

Ergonomic principles in accordance with ISO 12100:2010 shall be taken into account in designing die casting machines to reduce mental or physical stress and strain of the operator.

5.9 Protective measures when setting-up of die casting machines, inserting and removing appliances, tie bar pulling devices and other ancillary equipment

5.9.1 Setting-up without protective devices for the die area

When for technical reasons, for example, changing a die, the protective devices according to [5.2.2](#), [5.2.3](#) and [5.2.5](#) cannot be used and the setting mode is activated, then their interlocking 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 hands hold-to-run control according to type III B of ISO 13851:2019 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 shall 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 7.3.1 d)].

5.9.2 Movement of core pullers and ejectors

When the mode select switch is positioned to setting 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 bars

The tie bar movements shall be activated by a hold-to-run control. The speed of the tie bar movements in the last 300 mm before entering into the bore shall be limited to:

- a) a maximum of 30 mm/s with a hold-to-run control; or
- b) a maximum of 60 mm/s with a two hands hold-to-run control according to type III B of ISO 13851:2019.

The limits of a) and b) may be exceeded if the danger areas are outside the safety distances according to ISO 13857:2019.

If the safety distances are according to ISO 13857:2019 and the guards for the die area are closed and interlocked, the tie bar movements can be activated by a single initiating control without hold-to-run control and without any speed limits.

5.9.4 Movement of the plunger of cold-chamber machines

In die-setting mode with injection area or die area guards open, the movements of the injection piston can be possible only if:

- a) the speed is limited to 30 mm/s with a hold-to-run control; or
- b) the speed is limited to 60 mm/s with two hands hold-to run control according to type III B of ISO 13851:2019.

When all guards are closed (die and injection area), movements can be initiated without speed limit even in the die setting mode.

5.10 Elevated working places

If working platforms are installed on the machine for operation, setting-up and maintenance, they shall be designed in accordance with ISO 14122-1:2016, ISO 14122-2:2016 and ISO 14122-3:2016.

5.11 Additional protective measures for cold-chamber die casting machines

5.11.1 Bursting and removal of biscuit

For cold-chamber die casting 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.

For cold-chamber die casting machines with horizontal shot sleeves, the movable guards for the die area shall be interlocked with the control system in such a way that:

- a) movable guard opening is only possible after the die has reached at least one third of its opening stroke;
- b) stop die opening and injection motion when the movable guard is opened manually before the die has reached one third of its opening stroke.

In case the biscuit 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 and protective devices for the injection area

The operator shall be protected against hazards described in [4.2](#), [4.4](#) and [4.5](#).

The side of the injection unit where the pouring of molten metal is done shall be protected as follows:

- a) In case of automatic pouring, there shall be a fixed guard or an interface for a distance guard to prevent persons from accessing the hazardous area. In case of the interface, it shall be interlocked with movement of the injection plunger.
- b) In case of manual pouring, if, for technological reasons, it is not possible to install distance guards, the residual risk shall be indicated by warning signs and in the operation manual. The button for initiating the casting process after manual pouring shall be positioned in a way that the operator can be out of the hazardous area.

The opposite side (where no pouring of metal is done) of the injection unit shall be protected with movable guards which are interlocked with the movements of the injection plunger or with a fixed guard. In addition, in case of automatic pouring, a movable guard shall be interlocked with the control system of the die casting machine regarding the interface to the ancillary equipment.

5.12 Additional protective measures for hot-chamber die casting machines

5.12.1 Metal splashing

At hot-chamber die casting machines, the operator shall be protected by at least a fixed guard against the injuries due to splashing of metal between nozzle and die as well as between gooseneck and nozzle (see [Figure A.6](#)).

5.12.2 Movement of the injection piston

There shall be at least two control devices or an equivalent measure, independent from the point of view of safety (e.g. hydraulic and/or mechanical devices) 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 devices shall be interlocked with the movable guard of the die area.

The movement of the injection piston itself should not create a hazard. If the injection piston is in a reachable distance for the operator, there should be a guard to cover these areas of the piston.

6 Verification of the safety requirements and/or protective measures

Verification of the safety requirements and/or measures detailed in [Clause 5](#) and [Clause 7](#) shall be carried out as shown in [Table 2](#).

Table 2 — Methods of verification

Subclause	Heading	V	T	M	D
5.2.1	General	X	X	X	X
5.2.2.1	Access from front and back of the machine	X	X	X	X
5.2.2.2	Whole body access of the die area	X	X		X
5.2.2.3	Interlocked movable guards of the die area	X	X		X
5.2.3	Guards for the die closing mechanism area	X	X	X	X
5.2.4	Additional requirement for movable guards and access doors	X	X	X	X
5.2.5	Die casting units	X	X		X
5.3.1	Electric equipment		X		X
5.3.2	Safety related parts of the control system: General	X			X
5.3.3	Emergency stop functions	X	X		X
5.3.4	Safety related control system of the dangerous movements of the die		X		X
5.3.5	Control of ancillary equipment		X		X
5.4.1	Spurting of molten metal	X			X
5.4.2	Contact with hot surfaces	X		X	X
5.5.1	Hydraulics, pneumatics	X	X		X
5.5.2	Pressure fluids	X			X
5.5.3	Spray systems	X			X
5.6	Noise reduction			X	X
5.7	Gases, vapours, fumes and dust				X
5.8	Ergonomic aspects	X		X	X
5.9.1	Setting-up without protective devices for the die area		X	X	X
5.9.2	Movement of core pullers and ejectors		X		X
5.9.3	Movement of tie bar pulling devices		X	X	X
5.9.4	Movement of plunger of cold chamber		X	X	X
5.10	Elevated working places	X			X
5.11.1	Bursting and removal of biscuit		X	X	X
5.11.2	Guards for the plunger area with horizontal shot sleeve	X	X		X
5.12.1	Metal spraying between nozzle and die	X			X
5.12.2	Movement of the injection piston	X	X		X
7.2	Warning devices and safety signs	X			X
7.3	Accompanying documents	X			X
7.4	Marking	X			

Key

V visual inspection

T functional test/check/validation to verify that the features provided perform their function in such a way that the requirement is met

M measurements needed to verify that the requirements are met to the specified limits

D check of the contents of, for example, drawings, calculations, instructions

7 Information for use

7.1 General

Information for use shall be provided in accordance with ISO 12100:2010 and [7.2](#) to [7.4](#).

7.2 Warning devices and safety signs

Where hazards cannot be sufficiently reduced by design or safeguarding, the manufacturer shall provide either warning devices or safety signs warning for the residual hazards of the machine, or both.

Warning devices and safety signs in accordance with IEC 61310-1:2007 and IEC 61310-2:2007 shall be used.

Graphical symbols shall be in accordance with either ISO 3864-1:2011 or ISO 7000:2019, or both.

Danger signals shall be in accordance with either ISO 7731:2003, ISO 11428:1996 or ISO 11429:1996, or all.

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

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

7.3 Accompanying documents

7.3.1 Instruction handbook

The information for use supplied with the machine shall include an instruction handbook in accordance with ISO 12100:2010 and the following elements. These elements describe examples of the structure and content of an instruction handbook and shall 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 (e.g. circuit diagrams, parts list, data sheets, information/reference for spare parts);
 - 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 of their control (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) transportation safety devices and their removal before commissioning;
 - 4) machine 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);

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- 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 can generate gas, fumes or dust hazardous to human health; a cautionary note for the user that ventilation systems can be required in that case and information on how ventilation systems can 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 to the operation of the machine, and
 - iii) introduction of the machine-setter to the operation and setting of 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 die area and in the area of melting furnaces and feeding of material, and
 - iv) flying off of material parts;
 - 12) references to particular hazards in case of access on special occasions (e.g. maintenance, troubleshooting) shall be pointed out in the instruction handbook and on the machine by markings/symbols (according to IEC 61310-1:2007) 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 (e.g. pressurized gas in the accumulator),
 - ii) malfunction of programmable electronic systems,

- iii) temperature, and
 - iv) fire;
 - 14) references to manual handling in accordance with [5.8](#);
 - 15) the intended materials to be cast.
- e) Maintenance manual:
- 1) The maintenance manual shall contain instructions for the testing to be carried out and instructions for maintenance 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 to a periodical inspection programme. The frequency of these thorough inspections shall be defined at the design stage in accordance with the reliability and the nature and importance of the device.
 - 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 (e.g. replacement of wearing parts, lubrication);
 - 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 maintenance;
 - vii) where necessary, instructions about existing residual energy (e.g. hydraulic reservoir) and reduction of those.
 - viii) maintenance of hydraulic fluid.
- f) Information dealing with noise:
- 1) a noise emission declaration, see [5.6.2](#);
 - 2) a reference to use personal hearing protection.

7.4 Marking

The following information shall be attached clearly and durably to die casting machines:

- a) name of manufacturer; the European Union and associated countries shall follow the requirements in [Annex B](#).
- b) designation of series or type, if any;
- c) mandatory marking; the European Union and associated countries shall follow the requirements in [Annex B](#).
- d) serial number/machine number, if any;
- e) year of construction, that is the year in which the manufacturing process is completed;

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- f) nominal locking force;
- g) electrical power supply in accordance with IEC 60204-1:2016, 16.4.

The auxiliary electrical equipment shall be fitted with durable plates containing data in accordance with IEC 60204-1:2016, 16.4, including casing protection grade.

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Annex A
(informative)

Examples

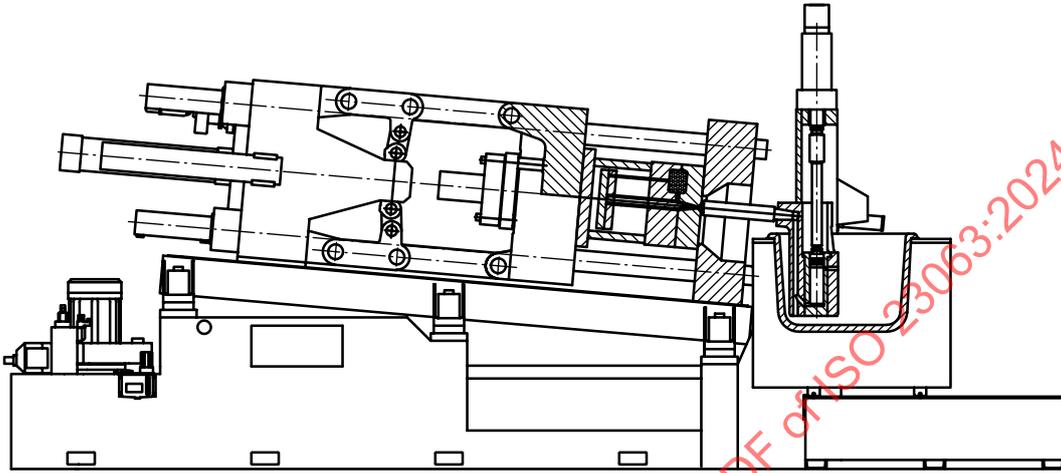


Figure A.1 — Example of a hot-chamber die casting machine

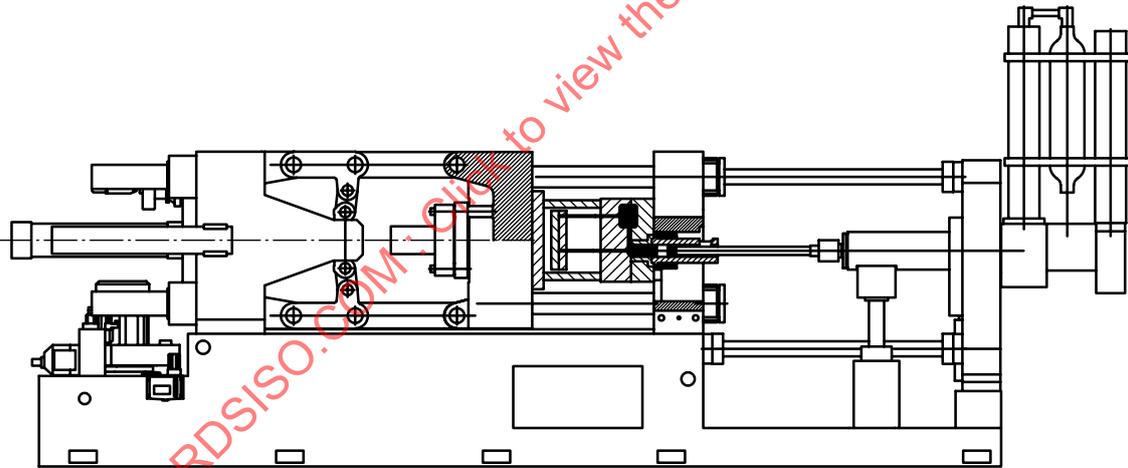


Figure A.2 — Example of a horizontal cold-chamber die casting machine with a toggle die closing system

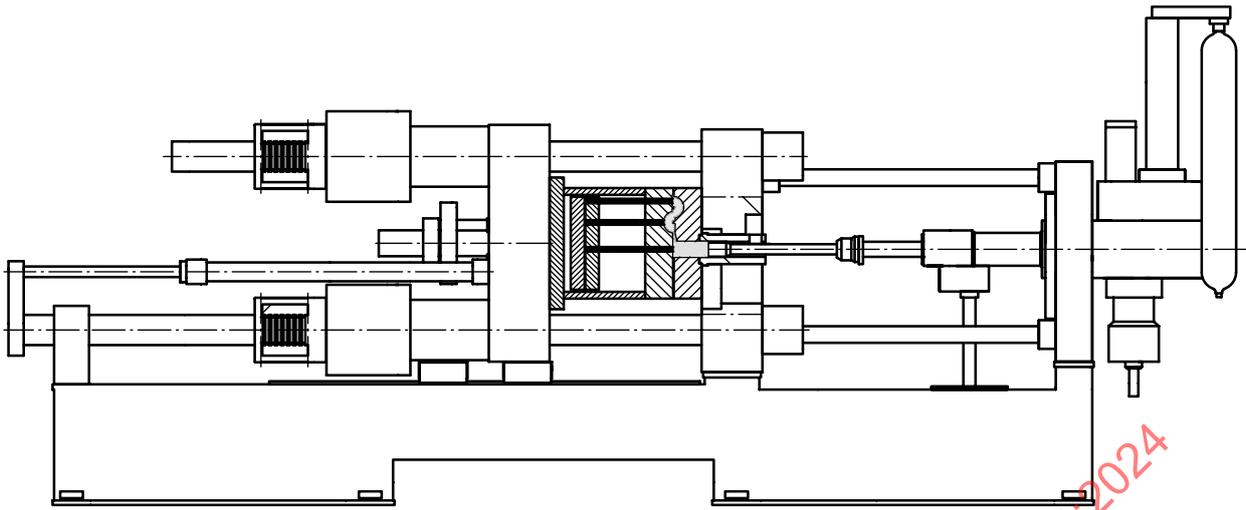
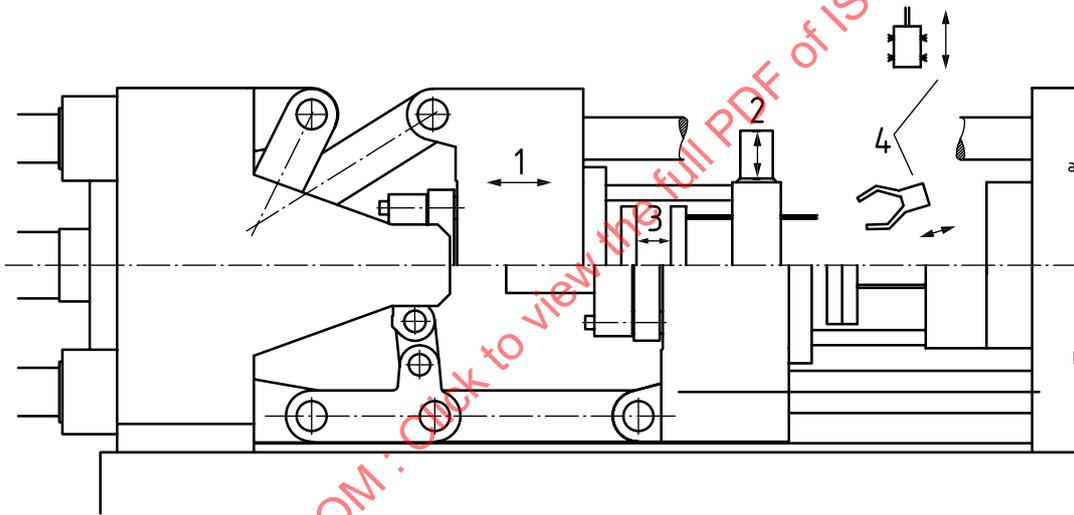


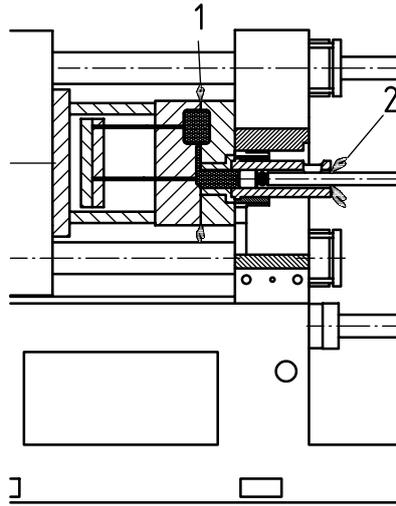
Figure A.3 — Example of a horizontal cold-chamber die casting machine with a toggle free die closing system



Key

- 1 movement of the die
- 2 movement of core pullers
- 3 movement of the ejector
- 4 movement of ancillary equipment
- a Die open.
- b Die closed.

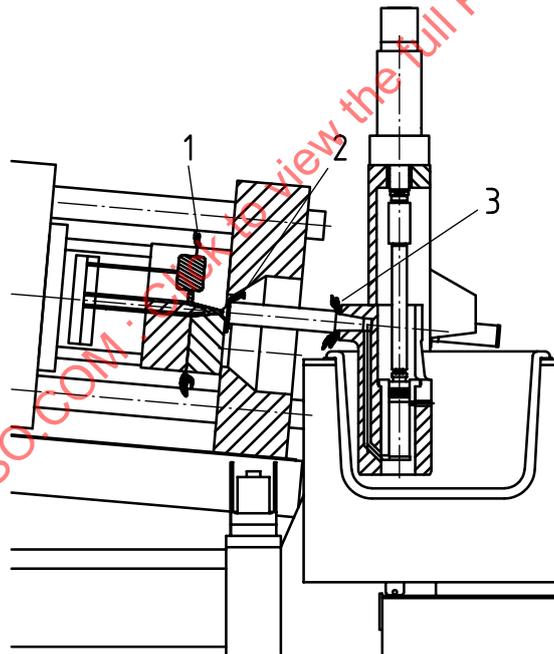
Figure A.4 — Examples of mechanical hazards and danger zones



Key

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

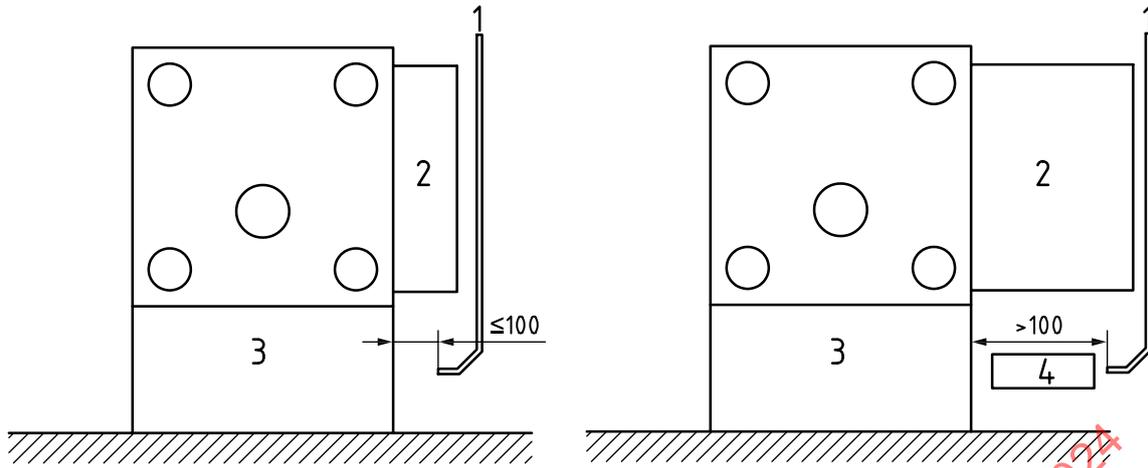
Figure A.5 — Examples of danger zones for metal spraying at horizontal cold-chamber die casting machines



Key

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

Figure A.6 — Examples of danger zones for metal spraying at hot-chamber die casting machines

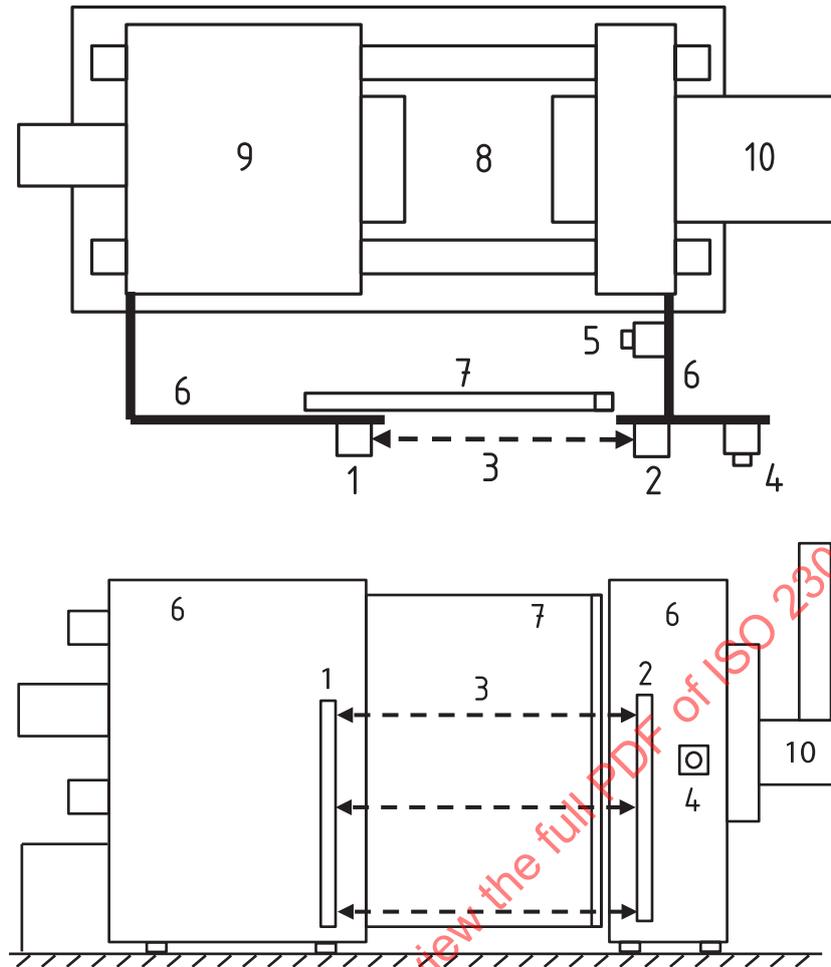


Key

- 1 movable guard
- 2 additional fixed guard
- 3 machine frame
- 4 additional protective device

Figure A.7 — Example of the distance between the movable guard and the die casting machine according to [5.2.2.1](#)

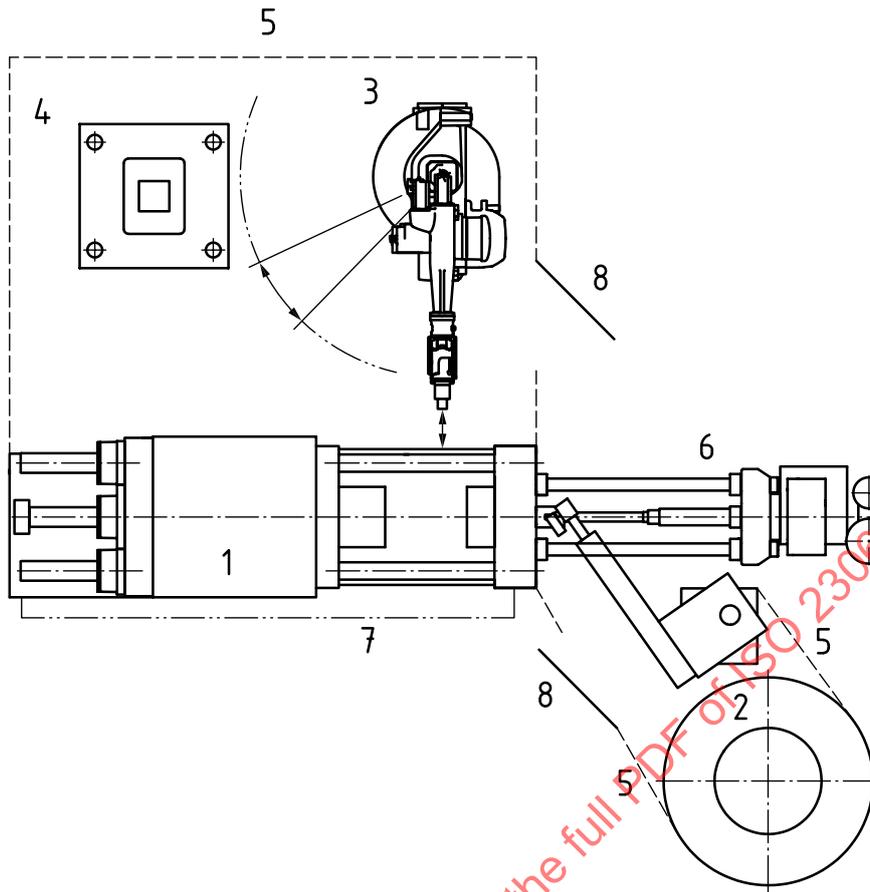
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Key

- 1 safety light curtain, part 1
- 2 safety light curtain, part 2
- 3 light beam
- 4 push button outside
- 5 push button inside
- 6 fixed guard
- 7 movable guard (door)
- 8 die area
- 9 die closing system
- 10 casting unit

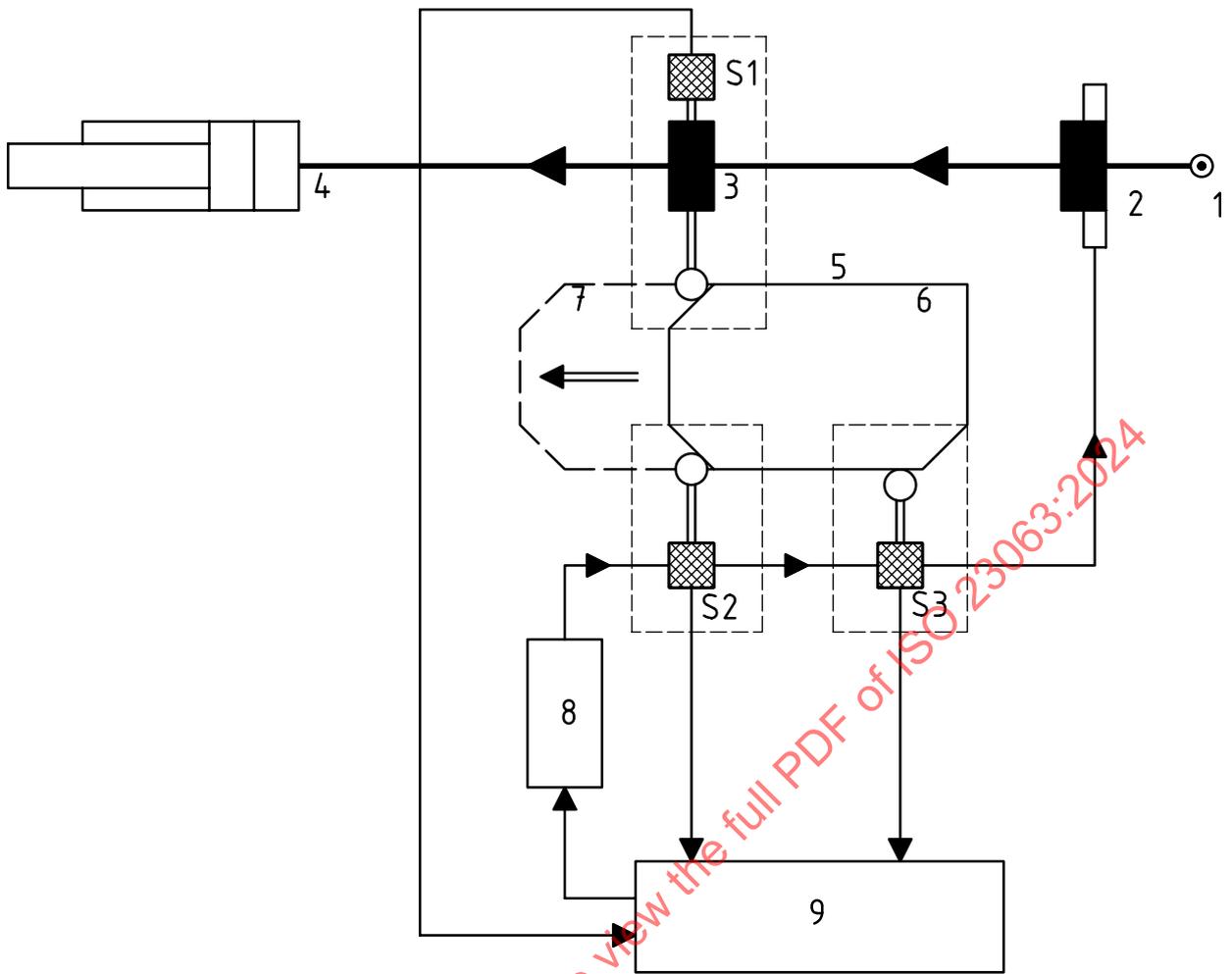
Figure A.8 – Example of a safety light curtain as a supplementary protective device according to [5.2.2.1 c\)](#)



Key

- 1 high pressure die casting machine
- 2 metal feeding equipment
- 3 handling equipment (e.g. robot)
- 4 trimming press
- 5 distance guard
- 6 guard for injection area
- 7 movable guard for die area
- 8 access door

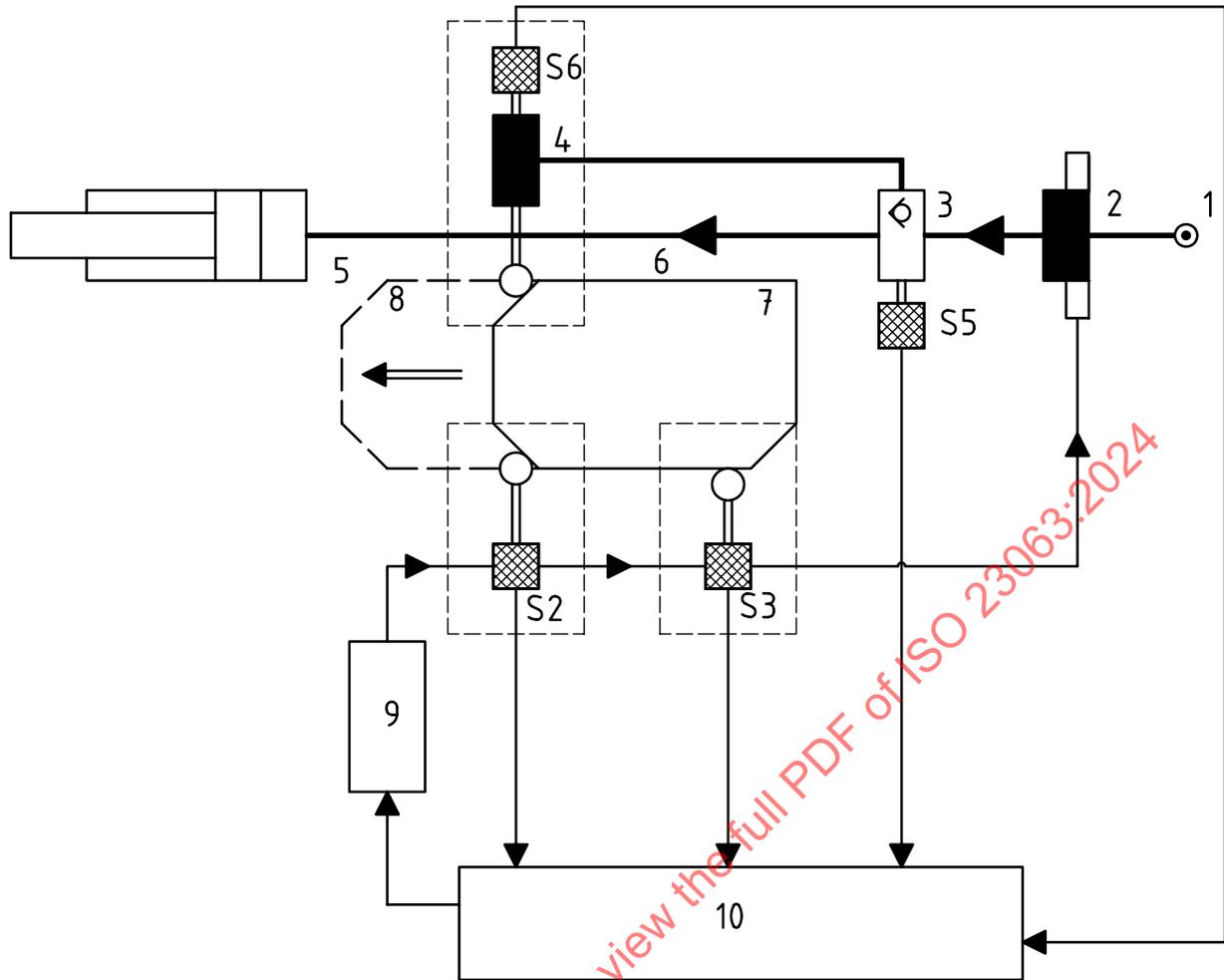
Figure A.9 — Example of guarding the hazardous area of a die casting cell



Key

- 1 source of power
- 2 directional valve
- 3 shut-off valve
- 4 closing cylinder
- 5 movable guard
- 6 movable guard (closed position)
- 7 movable guard (open position)
- 8 control circuit
- 9 monitoring circuit
- S1 limit switch valve 3
- S2 limit switch movable guard
- S3 limit switch movable guard

Figure A.10 — Example of a closing safety device with positively actuated hydraulic valve



Key

- 1 source of power
- 2 directional valve
- 3 shut-off valve
- 4 pilot valve
- 5 closing cylinder
- 6 movable guard
- 7 movable guard (closed position)
- 8 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 of a closing safety device with positively actuated pilot valve