
**Plastics and rubber machines —
Clamping systems —**

**Part 1:
Safety requirements for magnetic
clamping systems**

*Machines pour les matières plastiques et le caoutchouc — Systèmes
de bridage —
Partie 1: Prescriptions de sécurité pour les systèmes de bridage
magnétique*

[ISO 23582-1:2023](https://standards.iso.org/iso-23582-1-2023)

<https://standards.iteh.ai/catalog/standards/sist/1b6b4ad5-e3e9-49af-bdb4-a5c292c51bb2/iso-23582-1-2023>



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ISO 23582-1:2023

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Published in Switzerland

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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 270, *Plastics and rubber machines*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 145, *Plastics and rubber machines*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 23582 series can be found on the ISO website.

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 has been created in recognition of the particular hazards that are presented by magnetic clamping systems when integrated and installed in a plastics or rubber machine.

Hazards are frequently unique to a particular magnetic clamping system integrated in a plastics or rubber machine. The number and types of hazards are directly related to the nature of the application, the automation process and the complexity of the installation.

The risks associated with these hazards vary with the type of application and production process.

For the purpose of understanding requirements in this document, a word syntax is used to distinguish absolute requirements from recommended practices or suggested actions. The word “shall” is used to identify requirements necessary for conformance with this document. Such requirements are to be accomplished unless an alternative instruction is provided, or a suitable alternative is determined by a risk assessment. The word “should” is used to identify suggestions, recommended actions or possible solutions for requirements, but alternatives are possible and the suggested actions are not absolute.

In recognition of the variable nature of hazards with the application of magnetic clamping system integrated in a plastics or rubber machine, this document provides guidance for the assurance of safety in the design of magnetic clamping systems. Since safety in the use of magnetic clamping systems is influenced by the integration in the machine and by the design and use of the different moulds, a supplementary, though equally important, purpose is to provide guidelines for the integration, the installation and the use of magnetic clamping systems.

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 (regulators, accident prevention organizations, market surveillance etc.)

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, e. g. 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.

Plastics and rubber machines — Clamping systems —

Part 1: Safety requirements for magnetic clamping systems

1 Scope

This document specifies the essential safety requirements for the design, the construction and the integration of magnetic clamping systems (MCS) for plastics and rubber machines (e.g. injection moulding machines, compression moulding machines) and provides operational limits and information for their safe use.

This document deals with the basic hazards, hazardous situations or hazardous events that are listed in [Annex A](#), when an MCS is used utilizing magnetic force to affix a mould to the platen of a machine in which it is integrated, and provides requirements to eliminate or adequately reduce the risks associated with these hazards taking into consideration conditions of misuse that are reasonably foreseeable by the manufacturer.

This document also specifies requirements for the MCS when integrated into a machine. This document does not deal specifically with hazards associated with production processes or other processes (e.g. horizontal or vertical injection moulding processes). Other standards can be applicable to these process hazards.

This document does not cover hydraulic, pneumatic or mechanical clamping systems.

This document is not applicable to MCS manufactured before the date of its publication.

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

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

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

IEC 62061, *Safety of machinery — Functional safety of safety-related control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010 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
magnetic clamping system
MCS**

combination of one or more *magnetic plates* (3.3) and a *magnetic clamping control system* (3.2)

**3.2
magnetic clamping control system**

system to control and monitor the status of the *magnetic plate(s)* (3.3)

**3.3
magnetic plate**

plate composed of ferromagnetic material including coils, magnets and sensors

**3.4
magnetic clamping system force**

force retaining the mould installed on the *magnetic plate* (3.3)

**3.5
ejector force**

maximum ejector(s) force applied to the installed mould

**3.6
nozzle force**

force of the nozzle against the fixed side of the installed mould

Note 1 to entry: This force is relevant only when the mould is open or while opening or closing.

**3.7
magnetic saturation**

state reached when an increase in external magnetic field does not increase the magnetization of the plate further

**3.8
machine**

plastics and rubber machine where the *magnetic clamping system* (3.1) is integrated

**3.9
mould change mode**

selectable mode of operation of the *machine* (3.8) that allows individual motions at a low speed, low pressure and low force, used for changing the mould

**3.10
MCS special mode**

mode where the *magnetic clamping system* (3.1) enables machine movements to recover from an MCS alarm, this mode is only available when the *machine* (3.8) is in *mould change mode* (3.9) and the MCS in alarm

**3.11
fully automatic machine**

machine (3.8) that completes its working cycle without the intervention of an operator between the machine platens

**3.12
integration**

act of combining a *magnetic clamping system* (3.1) with plastics and rubber *machines* (3.8) to form a machine system capable of performing useful work such as production of parts

Note 1 to entry: This act of machine building can include the requirements for the installation of the system.

3.13**MCS enable signal**

interlock signal from the machine to the *magnetic clamping system* (3.1) to allow magnetizing and demagnetizing

4 Safety requirements and/or protective/risk reduction measures**4.1 General**

The MCS shall conform with the safety requirements and/or protective/risk reduction measures of this clause. In addition, it shall be designed in accordance with the principles of ISO 12100:2010 for relevant but not significant hazards, which are not dealt with by this document.

The safety related parts of the control systems shall be in accordance with the required performance levels PL_r in accordance with ISO 13849-1 or SIL in accordance with IEC 62061, as specified in the relevant subclauses.

4.2 Magnets

Only magnets that ensure the mould is held without power after magnetization shall be used.

4.3 Magnetic plate(s)

Magnetic plate(s) shall be marked to identify which machine platen they affect. At least two separate actions shall be required for magnetization/demagnetization; the actuators used to effect magnetization/demagnetization shall clearly identify which magnetic plates they affect. A visual indicator shall display the magnetic status of the magnetic plate when the MCS is under power.

4.4 Magnetizing/demagnetizing current

The MCS control for switch off the current of magnetization and demagnetization shall be designed to achieve $PL_r=e$ with MCS enable signals coming from the machine control system.

4.5 Magnetic clamping control system**4.5.1 Magnetic clamping control system detection requirements**

The control circuit of the MCS shall detect each of the following conditions:

- the contact of the mould base on the magnetic plate in accordance with $PL_r = b$ or SIL=1;
- the magnetic state of the magnetic plate in accordance with $PL_r = d$ or SIL=2;
- the overtemperature of the magnetic plate in accordance with $PL_r = b$ or SIL=1.

Sensors to detect the presence of the mould shall be monitored during every mould change. If a change of state of sensors is not detected during mould change, magnetization shall be prevented.

The PL_r or SIL for each signal provided to the machine control circuit shall be the same as the detection circuit or a single signal can be provided in accordance with $PL_r=d$ or SIL=2. See 6.1.4.

4.5.2 Magnetic clamping control system magnetizing/demagnetizing

The control circuit of the MCS shall allow magnetization or demagnetization only when the MCS receives MCS enable signals and mould change mode signal from the machine.

The MCS enable signal coming from the protective devices to detect the presence of a human body part or whole body in the mould area shall comply with $PL_r=d$ or $SIL=2$ for fully automatic machines or, for all other machines, $PL_r=e$ or $SIL=3$.

The mould change mode signal coming from the machine control system shall comply with $PL_r=b$ or $SIL=1$.

The control circuit of the MCS shall allow magnetization in accordance with $PL_r=b$ or $SIL=1$ when the contact of the mould base on the plate is detected.

4.5.3 Magnetic clamping control system enabling machine movements

The control circuit of the MCS shall provide signals to enable machine movements when:

- no overtemperature of the magnetic plate is detected and each plate verifies one of the following conditions:
 - plate is magnetized and have reached magnetic saturation, and a mould is detected,
 - plate is demagnetized and, either a mould is not detected, or machine is in mould change mode;
or
- the machine is in mould change mode and the MCS is in MCS special mode after an alarm detection. The MCS shall provide an information to the user that the MCS special mode is active, for example an indicator on the MCS control panel. The control circuit of MCS special mode shall be in accordance to $PL_r=d$ and a maintained action on a specific actuator shall be necessary to activate this MCS special mode.

See [6.1.3](#).

When the MCS is switched off no enabling signals shall be given to the machine.

4.6 Magnetic clamping system force

4.6.1 General

The magnetic clamping system force may vary depending on the mould that is installed.

The magnetic clamping system force shall be sufficient to hold the mould half on each platen, considering all forces, accelerations due to movements and their moments applied to the mould half. See [6.1.2](#) and [6.2](#).

4.6.2 Magnetic clamping system force when the MCS is integrated in horizontal machines

For the movable and fixed platen with a magnetic plate, the magnetic clamping system force of each magnetic plate shall be at least the highest of the following values:

- 1) 6,5 times of the weight of each mould half;
- 2) 3,5 times of the weight of the complete mould;
- 3) 3,0 times of the mould half weight multiplied for the ratio between the horizontal and vertical extension of the mould half (see [Annex B](#)).

4.6.3 Magnetic clamping system force when the MCS is integrated in vertical machines

For the upper platen with a magnetic plate, the magnetic clamping system force shall be at least the highest of the following values:

- 1) 6,5 times of the weight of the upper mould half; or