
Safety of machinery — Emergency stop function — Principles for design

*Sécurité des machines — Fonction d'arrêt d'urgence — Principes
de conception*

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 199, *Safety of machinery*.

This third edition cancels and replaces the ~~second edition~~ (ISO 13850:2006), which has been technically revised.

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Introduction

The structure of safety standards in the field of machinery is as follows.

- a) Type-A standards (basic safety standards) give basic concepts, principles for design, and general aspects that can be applied to machinery.
- b) Type-B standards (generic safety standards) deal with one or more safety aspect(s) or one or more type(s) of safeguard that can be used across a wide range of machinery:
 - type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);
 - type-B2 standards on safeguards (e.g. two-hands controls, interlocking devices, pressure sensitive devices, guards).
- c) Type-C standards (machinery safety standards) deal with detailed safety requirements for a particular machine or group of machines.

This International Standard is a type-B2 standard as stated in ISO 12100.

When provisions of a type-C standard are different from those which are stated in type-A or type-B standards, the provisions of the type-C standard take precedence.

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Safety of machinery — Emergency stop function — Principles for design

1 Scope

This International Standard specifies functional requirements and design principles for the emergency stop function on machinery, independent of the type of energy used.

It does not deal with functions such as reversal or limitation of motion, deflection of emissions (e.g. radiation, fluids), shielding, braking or disconnecting, which can be part of the emergency stop function.

The requirements for this International Standard apply to all machines, with exception to:

- machines where an emergency stop would not reduce the risk;
- hand-held or hand-operated machines.

NOTE The requirements for the realization of the emergency stop function based on electrical/electronic technology are described in IEC 60204-1.

2 Normative references

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

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

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

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 60204-1:2005, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60947-5-5:2005, *Low-voltage switchgear and controlgear — Part 5-5: Control circuit devices and switching elements — Electrical emergency stop device with mechanical latching function*

IEC 62061, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic 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.

3.1

emergency stop (E-stop)

emergency stop function

function which is intended to

- avert arising or reduce existing hazards to persons, damage to machinery or to work in progress, and
- be initiated by a single human action

[SOURCE: ISO 12100:2010, 3.40]

3.2

emergency stop equipment

safety related parts of a control system which perform the emergency stop function

Note 1 to entry: Typically emergency stop equipment is divided into input, processing and output elements.

3.3

emergency stop device

manually actuated control device used to initiate an emergency stop function

[SOURCE: IEC 60947-5-5:2005, 3.2]

3.4

machine actuator

power mechanism of the machine used to effect motion

Note 1 to entry: Example of machine actuators are motor, solenoid, pneumatic or hydraulic cylinder.

3.5

safety function

function of a machine whose failure can result in an immediate increase of risk(s)

[SOURCE: ISO 12100:2010, 3.30]

3.6

span of control of emergency stop device(s)

predetermined section of the machinery under control of specific emergency stop device(s)

3.7

protective shroud

mechanical measure provided to reduce the possibility of unintended actuation of an emergency stop device

3.8

emergency situation

hazardous situation needing to be urgently ended or averted

Note 1 to entry: An emergency situation can arise during normal operation of the machine (for example due to human interaction or as a result of external influences) or as a consequence of a malfunction or failure of any part of the machine.

[SOURCE: ISO 12100:2010, 3.38, modified]

3.9

operator control station

assembly of one or more control actuators fixed on the same panel or located in the same enclosure

Note 1 to entry: Actuator is a part of a device to which an external manual action is to be applied (see IEC 60204-1:2005, 3.1).

[SOURCE: IEC 60204-1:2005, 3.13, modified.]

4 Safety requirements

4.1 General requirements

4.1.1 Emergency stop function

4.1.1.1 The purpose of the emergency stop function is to avert actual or impending emergency situations arising from the behaviour of persons or from an unexpected hazardous event.

The emergency stop function is to be initiated by a single human action.

4.1.1.2 The emergency stop function shall be available and operational at all times. It shall override all other functions and operations in all operating modes of the machine without impairing other protective functions (e.g. release of trapped persons, fire suppression).

When the emergency stop function is activated:

- it shall be maintained until it is manually reset;
- it shall not be possible for any start command to be effective on those operations stopped by the initiation of the emergency stop function.

The emergency stop function shall be reset by intentional human action. Resetting of the emergency stop function shall be operated by disengagement of an emergency stop device (see [4.1.4](#)). The reset shall not initiate machine start up.

NOTE The emergency stop function cannot be considered as measure of prevention of unexpected start up as described in ISO 12100.

4.1.1.3 The emergency stop function is a complementary protective measure and shall not be applied as a substitute for safeguarding measures and other functions or safety functions.

4.1.1.4 The emergency stop function shall not impair the effectiveness of other safety functions.

NOTE For this purpose, it can be necessary to ensure the continuing operation of auxiliary equipment such as magnetic chucks or braking devices.

4.1.1.5 The emergency stop function shall be so designed, that after actuation of the emergency stop device, hazardous movements and operations of the machine are stopped in an appropriate manner, without creating additional hazards and without any further intervention.

NOTE An “appropriate manner” can include:

- choice of an optimal deceleration rate taking into account the necessary design restraints of the machine;
- selection of the stop category (see [4.1.3](#));
- necessity for a predetermined shutdown sequence.

Depending on the machine and the specific risks, the emergency stop function can initiate other functions other than stopping to minimize the risk of harm (e.g. reversal or limitation of motion, rate of braking) which can be part of the emergency stop function but not dealt with in this International Standard.

4.1.1.6 The emergency stop function shall be so designed that a decision to activate the emergency stop device does not require the consideration of the resultant effects.