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Safety of machinery — Emergency stop — Principles for design

Sécurité des machines — 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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International Standard ISO 13850, based on the European standard EN 418:1992, was prepared jointly by Technical Committees ISO/TC 199, *Safety of machinery* and IEC/TC 44, *Safety of machinery — Electrotechnical aspects*, and adopted in parallel by the member bodies of ISO and the national committees of IEC.

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Introduction

This International Standard has the status of a horizontal standard and may be used, e.g. as a reference standard by technical committees in ISO and IEC preparing product family and/or dedicated product standards for machines. The requirements of this International Standard can also be applied by suppliers of machines for which no product family or dedicated product standard exists. Where a product family or a dedicated product standard exists, its requirements may take precedence.

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Safety of machinery — Emergency stop — Principles for design

1 Scope

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

The requirements of this International Standard apply to all machinery except

- machines in which the provision of emergency stop would not lessen the risk;
- hand-held portable machines and hand-guided machines.

This International Standard does not deal with functions such as reversal or limitation of motion, deflection, shielding, braking, or disconnecting, which may be part of the emergency stop function.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/TR 12100-1:1992, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology.*

ISO/TR 12100-2:1992, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications.*

IEC 204-1:1992, *Electrical equipment of industrial machines — Part 1: General requirements.*

IEC 947-5-1:1990, *Low-voltage switchgear and controlgear — Part 5: Control circuit devices and switching elements — Section 1: Electromechanical control circuit devices.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 emergency stop (function): Function which is intended

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

NOTE 1 Hazards, for the purposes of this International Standard, are those which may arise from

- functional irregularities (e.g. malfunctioning of the machinery, unacceptable properties of the processed material, human errors);
- normal operation.

See figure 1.

3.2 emergency stop device: Manually actuated control device used to initiate an emergency stop function.

NOTE 2 A standard dealing with electrical emergency stop devices with mechanical latching function is being prepared by subcommittee IEC/SC 17B.

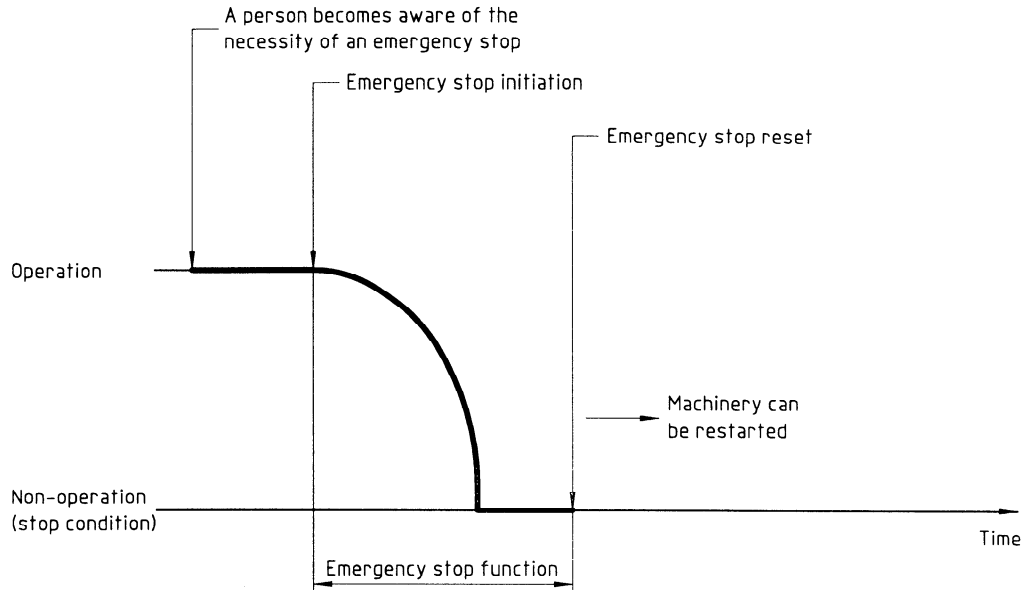


Figure 1 — Graphical representation of emergency stop function

3.3 machine actuator: Power mechanism used to effect motion of a machine.

4.1.4 The emergency stop function shall be designed so that, after actuation of the emergency stop device, the operation of the machine is stopped in an appropriate manner, without creating additional hazards, according to the risk assessment.

4 Safety requirements

NOTE 5 The statement "stopped in an appropriate manner" may include

4.1 General requirements

4.1.1 The emergency stop function shall override all other functions in all operating modes of the machine without impairing any facilities designed to release trapped persons. It shall not be possible for any start command (intended, unintended or unexpected) to be effective until the emergency stop function is reset.

NOTE 3 When emergency stop devices can be disconnected (e.g. portable teaching pendants) or when machinery can be partially isolated, care should be taken to avoid confusion between active and inactive control devices.

4.1.2 The emergency stop function shall not be applied for use as a substitute for safeguarding measures and other safety-critical functions, but should be designed for use as a backup measure (e.g. in case of failure).

4.1.3 The emergency stop function shall not impair the effectiveness of protective devices or of devices with other safety-critical functions.

NOTE 4 For this purpose, it may be necessary to ensure the continuing operation of auxiliary equipment such as magnetic chucks or braking devices.

choice of optimal deceleration rate;

- selection of the stop category (see 4.1.5);
- employment of predetermined shutdown sequence.

4.1.5 The emergency stop shall function as either a category 0 or a category 1 stop (see 9.2.2 of IEC 204-1:1992), which includes the removal of the power source to the machine actuator(s).

NOTE 6 Examples of the removal of power include

- switching off the electrical power to the electric motor;
- declutching the movable elements from the source of mechanical energy;
- blocking the fluid power supply to a ram/slide.

The choice of category of emergency stop shall be determined by the risk assessment of the machine. (See also 9.2.5.4 of IEC 204-1:1992.)

4.2 Specific requirements for electrical equipment

The specific requirements for electrical equipment given in 9.2.2, 9.2.5.4 and 10.7 of IEC 204-1:1992 apply.

4.3 Operating conditions and environmental influences

The components and elements used to achieve the emergency stop function (see annex A) shall be selected, assembled, interconnected and protected so as to be capable of operating correctly under the expected operating conditions and environmental influences. This process includes consideration of

- frequency of operation and the need for periodic testing in the case of infrequent operation, and
- vibration, shock, temperature, dust, foreign bodies, moisture, corrosive materials, fluids, etc.

4.4 Requirements for emergency stop devices

4.4.1 The emergency stop device shall be designed for easy actuation by the operator and others who may need to operate it. Types of actuator that may be used include:

- mushroom-type push-buttons;
- wires, ropes, bars;
- handles;
- in specific applications, foot-pedals without protective cover.

4.4.2 Emergency stop devices shall be located at each operator control station and at other locations where emergency stop is required. They shall be positioned for easy access and for non-hazardous operation by the operator and others who may need to operate them.

NOTE 7 Measures against inadvertent operation should not impair accessibility.

4.4.3 The emergency stop device shall apply the principle of positive mechanical action (see 3.5 of ISO/TR 12100-2:1992).

NOTE 8 An example of the application of this principle is an emergency stop device employing electrical contacts having positive opening operation. According to IEC 947-5-1:1990 (clause 3, subclause 2.2), positive opening operation (of a contact element) is the achievement of contact separation as the direct result of a specified movement of the switch actuator through non-resilient members (e.g. not dependent upon springs).

4.4.4 Once the emergency stop command has been generated during actuation of the emergency stop device, the command shall be maintained by engagement (latching-in) of the actuating means. The emergency stop command shall be maintained until

the emergency stop device is reset (disengaged). It shall not be possible for the emergency stop device to engage without generating the stop command.

In case of a failure in the emergency stop device (engagement means included), generation of the stop command shall have priority over the engagement means.

4.4.5 Resetting (disengaging) of the emergency stop device shall only be possible as the result of a manual action on the emergency stop device itself.

Resetting the emergency stop device shall not by itself cause a restart command.

It shall not be possible to restart the machine until all emergency stop devices which have been actuated are reset.

4.4.6 The actuator of the emergency stop device shall be coloured red. As far as a background exists behind the actuator and as far as is practicable, it shall be coloured yellow. When using wires or ropes, it may be useful to improve their visibility by using marker flags attached to them.

In certain circumstances, it may be useful to provide labels in addition, such as that shown in figure 2.

NOTE 9 For electrical equipment, see also 10.2.1 of IEC 204-1:1992.



Figure 2 — Label for emergency stop devices
(IEC 417-5638)

4.5 Additional requirements for wires and ropes used as actuators

4.5.1 Consideration shall be given to:

- the amount of deflection necessary for generating the emergency stop command;
- the maximum deflection possible;
- the minimum clearance between the wire or the rope and the nearest object in the vicinity;
- the force to be applied to the wire or rope in order to operate the emergency stop device;
- making such wires or ropes visible for operators (e.g. by use of marker flags).

4.5.2 An emergency stop command shall be generated automatically in the event of breaking or disengagement of a wire or a rope. In exceptional applications (e.g. in open cast mines) this requirement may be difficult to follow. In such cases, alternative safety measures may be required.

4.5.3 Means to reset the emergency stop device should be placed so that the whole length of the wire

or rope is visible from the location of the resetting means.

If this is not practicable, the instructions for use should state that, after actuation and before resetting, the machinery should be inspected along the whole length of the wire or rope in order to detect the reason for activation.

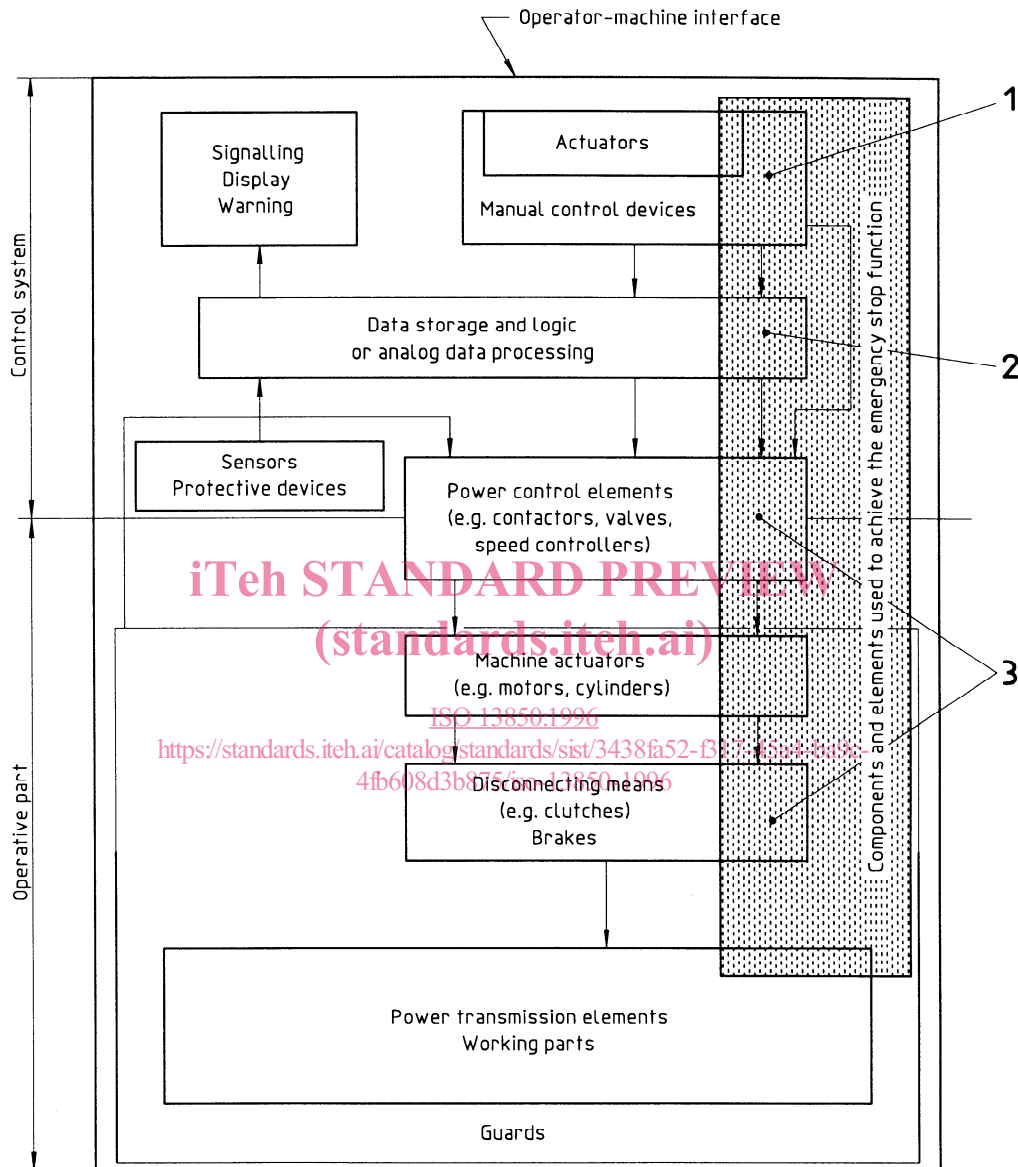
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Annex A (informative)

Components and elements used to achieve the emergency stop function



- 1 Emergency stop device(s)
- 2 Part of the control system intended for the emergency stop command processing
- 3 Power control elements (contactors, valves, speed controllers), disconnecting means (clutches, etc.), and brakes used for achieving emergency stop, even if they are also used for the normal operation of the machine

(from ISO/TR 12100-1, annex A)