

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Appareillage à basse tension -
Partie 5-5: Appareils et éléments de commutation pour circuits de commande -
Appareils d'arrêt d'urgence électriques à accrochage mécanique**



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

FOREWORD

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IEC 60947-5-5 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage. It is an International Standard.

This second edition cancels and replaces the first edition published in 1997. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) re-shaping the document with the clause numbers and names to be in line with other documents of the 60947 series;
- b) review of the test method to reasonably determine that the latch mechanism meets the requirements of the document;

- c) new Annex B for special requirements for illuminated push-button type emergency stop devices, including the reference to a function to distinguish between "active and inactive" by changing the colour of the push-button depending on the illumination.

The text of this International Standard is based on the following documents:

Draft	Report on voting
121A/699/FDIS	121A/703/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This International Standard is to be used in conjunction with IEC 60947-1:2020 and with IEC 60947-5-1:2024.

The provisions of the general rules, IEC 60947-1, are applicable to this standard, where specifically called for. General rules clauses and subclauses thus applicable, as well as tables, figures and annexes are identified by a reference to IEC 60947-1, for example 1.2.3 or Annex A of IEC 60947-1:2020.

A list of all parts in the IEC 60947 series, under the general title *Low-voltage switchgear and controlgear*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

This document deals specifically with electrical emergency stop devices with mechanical latching function and gives additional electrical and mechanical requirements to those given in the following International Standards:

- ISO 13850, giving requirements for the emergency stop function of a machine, whatever be the energy used;
- IEC 60204-1, giving additional requirements for an emergency stop function realized by the electrical equipment of a machine;
- IEC 60947-5-1, specifying electrical characteristics of electromechanical control circuit devices.

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1 Scope

This part of IEC 60947-5 provides detailed specifications relating to the electrical and mechanical construction of emergency stop devices with mechanical latching function and to their testing.

This document is applicable to electrical control circuit devices and switching elements which are used to initiate an emergency stop signal. Such devices can be provided with their own enclosure and will be installed according to the product documentation.

This document does not apply to:

- emergency stop devices for non-electrical control applications, for example hydraulic or pneumatic;
- emergency stop devices without mechanical latching function.

An emergency stop device conforming to this document can also be used as part of an emergency switching off means in compliance with IEC 60364-5-53.

NOTE See also IEC 60204-1:2016 and IEC 60204-1:2016/AMD1:2021, 9.2.3.4.

This document does not address specific requirements on acoustic noise as the noise emission of electrical emergency stop devices with mechanical latching function is not considered to be a relevant hazard.

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.

IEC 60068-2-1, *Environmental testing - Part 2-1: Tests - Test A: Cold*

IEC 60068-2-2, *Environmental testing - Part 2-2: Tests - Test B: Dry heat*

IEC 60068-2-6, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)*

IEC 60068-2-11, *Environmental testing - Part 2-11: Tests - Test Ka: Salt mist*

IEC 60068-2-27, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-75, *Environmental testing - Part 2-75: Tests - Test Eh: Hammer tests*

IEC 60417, *Graphical symbols for use on equipment*, available at <https://www.graphical-symbols.info/equipment>

IEC 60947-1:2020, *Low-voltage switchgear and controlgear - Part 1: General rules*

IEC 60947-5-1:2024, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60947-1, IEC 60947-5-1 and the following apply.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

emergency stop function

function which is intended to:

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

[SOURCE: ISO 12100:2010, 3.40, modified – the first preferred term "emergency stop" has been removed.]

3.2

emergency stop device

manually operated control circuit device used to initiate an emergency stop function

Note 1 to entry: An emergency stop device can also provide auxiliary functions, for example for redundancy or for signalling through additional contact element(s), or both. Such additional contact(s) can be normally open or normally closed, or both.

3.3

emergency stop signal

signal, which is generated by an emergency stop device contact, used to initiate an emergency stop function

3.4

actuating system

<of an emergency stop device> mechanical parts which transmit the actuating force to the contact elements

[SOURCE: IEC 60050-441:1984, 441-15-21, modified – restricted to electromechanical emergency stop devices; the note is not relevant anymore.]

3.5

actuator

<of an emergency stop device> part of the actuating system which is operated by a part of the human body

Note 1 to entry: Examples of an actuator include: a push-button, a wire, or a rope.

[SOURCE: IEC 60050-441:1984, 441-15-22, modified – actuation is intended to be achieved by human only, the domain has been added and the note has been revised.]

3.6

rest position

position of an emergency stop device, or of a part of it, which has not been actuated

Note 1 to entry: In rest position, the normally closed contacts are closed and the machine (or equipment) can work.

3.7

actuated position

position of an emergency stop device, or of a part of it, after it has been operated

Note 1 to entry: In the actuated position of the emergency stop device, the normally closed contacts remain open.

3.8

latching

<of an emergency stop device> function or means which engage and maintain the actuating system in the actuated position until reset by a separate manual action

3.9

resetting

disengaging

<of an emergency stop device> manual action to return the actuating system of the emergency stop device from the actuated position to the rest position

Note 1 to entry: Examples of resetting include the rotation of a key or the actuator, pulling the actuator or pushing or rotating a dedicated reset button.

3.10

direct opening action

DEPRECATED: positive opening action

<of a contact element> achievement of contact separation as a direct result of a specified movement of the switch actuator through non-resilient members (e.g. non dependent upon springs)

[SOURCE: IEC 60947-5-1:2024, 3.1.15.2, modified – addition of a deprecated term.]

3.11

push-button type emergency stop device

emergency stop device with a button type as actuator

3.12

trigger mechanism

positive latching

safety lock mechanism

mechanical means ensuring that when operated, latching occurs at the point where the emergency stop signal is generated

3.13

trip wire switch

rope pull switch

emergency stop device in which the actuator is a rope, a wire or similar means

4 Classification

4.1 Contact elements

Subclause 4.1 of IEC 60947-5-1:2024 applies.

4.2 Means of actuation

Emergency stop devices can be classified according to the means of actuation, for example push-button, trip wire switch.

4.3 Additional functions

Emergency stop devices can be classified according to the additional function(s) of the device (e.g. illumination, trigger mechanism, resetting means or locking mechanism to maintain the emergency stop signal).

4.4 Emergency stop device mounting

Emergency stop devices can be classified according to the mounting of the device, for example hole size D16, D22, D30 for a push-button type.

5 Characteristics

5.1 Summary of characteristics

Subclause 5.1 of IEC 60947-5-1:2024 applies.

NOTE For information exchange in electronic format, see ACC515 and ACC522 classes of IEC 62683-1 Common Data Dictionary for trip wire switch, and emergency stop push-button respectively.

5.2 Type of emergency stop device

The kind of emergency stop device shall be stated:

- push-button;
- trip wire switch.

5.3 Rated and limiting values for switching elements

Subclause 5.3 of IEC 60947-5-1:2024 applies.

5.4 Utilization categories for switching elements

For emergency stop contact elements with direct opening action, the utilization categories shall be one or more categories specified in IEC 60947-5-1:2024, K.5.4.

For additional contact elements for auxiliary functions, the utilization categories shall be one or more categories selected from IEC 60947-5-1:2024, Table 1.

6 Product information

6.1 Nature of information

Subclause 6.1 and Clause K.6 of IEC 60947-5-1:2024 apply with the following addition.

For push-button switches, information provided in the product documentation shall include:

- resetting/unlatching method;
- trigger mechanism, if applicable;
- illumination function, if applicable.

For trip wire switches, information provided in the product documentation shall include:

- resetting/unlatching method;
- the maximum length of wire or rope;
- information to establish correct tension of wire or rope;
- the distances between supports;
- recommendation to use only straight runs of wire or rope;
- if applicable, guidance on maintenance for pulleys and eyelets, and the measures necessary to ensure that the wire or rope remains in proper position.

6.2 Marking

6.2.1 General

Subclause 6.2 of IEC 60947-5-1:2024, with the exception of 6.2.4, applies with the following additions.

6.2.2 Push-button type emergency stop devices

Where a symbol is necessary for clarification, the symbol IEC 60417-5638:2002-10 shall be used (see Figure 1).



Figure 1 – Symbol (IEC 60417-5638:2002-10) for emergency stop

The direction of unlatching shall be identified when resetting is achieved by rotation of the button. The identification of the direction of unlatching shall have the same or nearly the same colour as the actuator in order to avoid misinterpretation.

NOTE 1 Compliance with this requirement fulfils ISO 13850:2015, 4.3.7.

NOTE 2 See also IEC 60073 and ISO 3864 series for general information concerning identification and safety colours.

6.2.3 Trip wire switches

Marker flags may be attached to trip wires or ropes for improved visibility. See 8.1.3. Where a symbol is necessary for clarification on the marker flag, the symbol IEC 60417-5638:2002-10 shall be used (see Figure 1).

6.3 Instructions for installation, operation and maintenance, decommissioning and dismantling

Subclause 6.3 of IEC 60947-5-1:2024 applies.

6.4 Environmental information

Subclause 6.4 of IEC 60947-5-1:2024 applies.

6.5 Reliability data

According to IEC 62061:2021 and IEC 62061:2021/AMD1:2024, Annex C and ISO 13849-1:2023, Annex O, the main functional safety parameter characterizing an emergency stop device is B_{10D} .

B_{10D} for an emergency stop device is the number of cycles by which 10 % of the device population will have failed dangerously, which means the normally closed contact failed to open.

B_{10D} for an emergency stop device shall be established in accordance with Annex A.

For information exchange in electronic format, the ACC007 class and ACE056 property (defined in the IEC 62683 domain of IEC CDD) should be used.

7 Normal service, mounting and transport conditions

Clause 7 of IEC 60947-5-1:2024 applies with the following addition.

Additional tests for shock and vibration are defined in 9.3.8 and 9.3.9.

8 Constructional and performance requirements

8.1 Constructional requirements

8.1.1 General

Subclause 8.1 of IEC 60947-5-1:2024 applies with the following additions.

Means shall be provided to enable the emergency stop device to be securely installed in its intended mounting position.

Verification of the applicable constructional requirements in 8.1.2 or 8.1.3 shall be conducted in accordance with 9.2.

8.1.2 Additional requirements for push-button type emergency stop devices

Push-buttons used as emergency stop device actuators shall be coloured red. When a background exists behind the actuator, it shall be coloured yellow.

Additional requirements for illuminated push-button type emergency stop devices are defined in Annex B.

8.1.3 Additional requirements for trip wire switches

Ropes or wires used for trip wire switches shall be coloured red. If marker flags are used to improve the visibility of wires or ropes, they shall be coloured yellow or "red and yellow" (alternating stripes or colours).

The integral resetting actuator shall be coloured blue.

When coloured indicators are provided to assist setting of a trip wire switch, green shall indicate the correct setting of the rest position and yellow shall indicate the correct setting of the actuated position.

8.2 Performance requirements

8.2.1 General

Subclause 8.2 of IEC 60947-5-1:2024 applies with the following additions.

8.2.2 Direct opening action

Emergency stop devices including all normally closed contact elements generating the emergency stop signal shall have a direct opening action in accordance with IEC 60947-5-1:2024, Annex K.

8.2.3 Operation

It shall be possible to operate and reset the emergency stop device under all normal service conditions.

For the normally closed contacts generating the emergency stop signal, vibrations or shocks, or both, shall not cause the opening of the contacts in the closed position or the closing of the contacts in the open position, nor actuation or release of the latching mechanism.

The tests shall be conducted in accordance with 9.3.

8.2.4 Opening and latching

When the emergency stop signal has been generated during actuation of the emergency stop device, the emergency stop signal shall be maintained by latching of the actuating system. The emergency stop signal shall be maintained until the emergency stop device is reset (disengaged). It shall not be possible for the emergency stop device to latch without generating the emergency stop signal.

The latching shall operate correctly when the emergency stop device is tested following the conditioning procedures specified in 9.3.7.

The opening test shall be conducted in accordance with 9.3.10.2.1. Additionally, the latching test can be conducted in accordance with 9.3.10.2.2 in case the trigger mechanism is stated in the product documentation.

8.2.5 Additional requirements for push-button type emergency stop device

A push-button type emergency stop device shall be designed such that:

- the emergency stop actuator can be operated in a direction perpendicular to its mounting surface;
- removal of the actuator is preferably from the inside of the enclosure, or from the outside of the enclosure by use of a tool intended for that purpose;
- it can be actuated by a one-handed continuous single motion; and
- the latching means can be reset by rotation in the designated direction or by a pulling motion, or by turning a key.

The tests shall be conducted in accordance with 9.3.

8.2.6 Additional requirements for trip wire switches

Trip wire switches shall be designed such that:

- if not provided with the trip wire switch, specification of the wire or rope shall be provided;
- the setting of the wire or rope, and subsequent adjustment, can be carried out without causing malfunction;
- the amount of force and deflection of the trip wire or rope required to initiate an emergency stop signal (opening of the contacts) shall be less than 200 N of force and less than 400 mm of deflection;
- the trip wire or rope can withstand a tension force not less than 10 times the designed tension (see 6.1) without breaking;
- the loss of tension or reduction of tension below the recommended range, such as due to breaking of the trip wire or rope or loosening of a fastening, shall result in actuation of the emergency stop signal;
- the latching means can be reset by pressing or pulling an integral resetting button or rotating the button in the designated direction.

The tests shall be conducted in accordance with 9.3.5, with consideration for changes in the length of wire or rope based on external factors (for example temperature, age, etc.).

8.3 Electromagnetic compatibility (EMC)

Subclause 8.3 of IEC 60947-5-1:2024 applies.

8.4 Special requirements

8.4.1 Requirements for functional safety applications

If functional safety data is necessary, tests shall be made in accordance with 9.1.5.3.

8.4.2 Requirements for emergency stop devices embedding additional functions

Emergency stop devices may incorporate additional functions for signalling, diagnostic, contact monitoring, remote control or other purpose.

In this case the additional function(s) shall not impede the emergency stop device from complying with all applicable performance and constructional requirements stated in 8.1, 8.2 and 8.3, and the related tests described in Clause 9.