

INTERNATIONAL STANDARD



**Low-voltage switchgear and controlgear –
Part 5-8: Control circuit devices and switching elements – Three-position
enabling switches**

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Part 5-8: Control circuit devices and switching elements – Three-position
enabling switches**

INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 5-8: Control circuit devices and switching elements –
Three-position enabling switches**

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60947-5-8 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.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

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

- a) due to the increasing range of useful applications of three-position enabling switches, note of scope, operational characteristics and tests are reviewed;
- b) figures for example of devices incorporating enabling switch are added in Annex A;
- c) new Annex B for procedure to determine reliability data for the switch used in functional safety applications is added.

The text of this document is based on the following documents:

FDIS	Report on voting
121A/358/FDIS	121A/369/RVD

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

This document should be used in conjunction with IEC 60947-1:2020 and IEC 60947-5-1:2016.

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.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-8: Control circuit devices and switching elements – Three-position enabling switches

1 ~~General~~

1 **Scope**

This part of IEC 60947 series specifies requirements for three-position enabling switches.

These switches are used as components of enabling devices ~~described in 10.9 of IEC 60204-1~~ to provide signals that,

- a) when activated, allow machine operation to be initiated by a separate start control, and
- b) when de-activated,
 - initiate a stop function, and
 - prevent initiation of machine operation.

NOTE 1 The enabling control function is described in ~~9.2.6.3~~ 9.2.3.9 of IEC 60204-1:2016 but the application of three-position enabling switches is not limited to a component of the enabling device described in IEC 60204-1.

NOTE 2 This document does not deal with enabling devices.

These switches are intended to be connected to circuits which rated voltage does not exceed 250 V AC 50 Hz/60 Hz or 300 V DC.

EXAMPLE Devices incorporating three-position enabling switches are:

- push-button enabling devices;
- grip actuated enabling devices;
- foot actuated enabling devices.

See Annex A for more typical examples.

This document does not apply to:

- three-position enabling switches for non-electrical control circuits, for example hydraulic, pneumatic;
- enabling switches without three-position mechanism;
- emergency stop devices (see IEC 60947-5-5).

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 60068-2-1:1990/2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*
~~Amendment 1 (1993)~~
~~Amendment 2 (1994)~~

IEC 60068-2-2:19742007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*
~~Amendment 1 (1993)~~
~~Amendment 2 (1994)~~

IEC 60068-2-6:19952007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:19872008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

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

IEC 60947-1:20042020, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-5-1:20032016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

3 Terms and definitions

For the purposes of this document, ~~the relevant definitions given in Clause 2 of IEC 60947-1 and Clause 2 of IEC 60947-5-1 apply, with the following additional definitions~~ the terms and definitions given in Clause 3 of IEC 60947-1:2020 and Clause 2 of IEC 60947-5-1:2016, and the following apply.

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

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

Alphabetical index of definitions

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	A
Actuating system (of a three position enabling switch)	3.3
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3.1 enabling device

manually operated control device used in conjunction with a start control and which, when continuously actuated, allows a machine operation

3.2

three-position enabling switch

~~switch having three sequential actuator positions, in which the contacts are closed when the actuator is in the mid position (partly depressed) and are open when the actuator is in the rest (not pressed) position and in the fully depressed position~~
three-position switch having enabling contact(s)

3.3

actuating system

<three-position enabling switch> all the mechanical parts which transmit the actuating force to the contact elements

[SOURCE: IEC 60050-441:2000, 441-15-21, modified – "all the operating means of a control switch" replaced by "all the mechanical parts", note to entry deleted.]

3.4

actuator

<three-position enabling switch> part of the actuating system which is actuated by a part of the human body

EXAMPLE A button.

3.5

auxiliary contact

contact of a three-position enabling switch that provides an auxiliary function

Note 1 to entry: Auxiliary contacts ~~may~~ can be normally open and/or normally closed.

3.6

enabling contact

contact of a three-position enabling switch, which is closed when the actuator is in the mid position (partly depressed, position 2 in Figure 1) and is open when the actuator is in the rest position (not pressed, position 1 in Figure 1) and in the fully depressed position (position 3 in Figure 1)

4 Classification

4.1 Contact elements

Subclause 3.1 of IEC 60947-5-1:2016 applies.

4.2 Three-position enabling switch

Three-position enabling switches may be classified according to the contact element and the nature of the actuating system, e.g. three-position enabling switches, form B.

5 Characteristics

5.1 Summary of characteristics

5.1.1 General

Subclause 4.1.1 of IEC 60947-5-1:2016 applies except for following type of equipment (see 5.2).

5.1.2 Operation of ~~a control~~ an enabling switch

Subclause ~~4.1.1~~ 4.1.2 of IEC 60947-5-1:2016 applies.

~~4.1.1.1 Normal conditions of use~~

~~Subclause 4.1.1.1 of IEC 60947-5-1 applies.~~

~~4.1.1.2 Abnormal conditions of use~~

~~Subclause 4.1.1.2 of IEC 60947-5-1 applies.~~

5.2 Type of three-position enabling switch

~~4.2.1 Examples of devices incorporating three-position enabling switches~~

- ~~— push-button enabling devices;~~
- ~~— grip-actuated enabling devices;~~
- ~~— foot-actuated enabling devices; etc.~~

5.2.1 Number of poles

The number of poles shall be stated by the manufacturer.

5.2.2 Kind of current

Alternating current or direct current.

5.3 Rated and limiting values for switching elements

Subclause 4.3 of IEC 60947-5-1:2016 applies.

5.4 Utilization categories for switching elements

Subclause 4.4 of IEC 60947-5-1:2016 applies.

5.5 Vacant

5.6 Vacant

5.7 Vacant

5.8 Vacant

5.9 ~~Switching overvoltages~~ Vacant

~~Subclause 4.9 of IEC 60947-1 applies.~~

5.10 Electrically separated contact elements

Subclause 4.10 of IEC 60947-5-1:2016 applies.

6 Product information

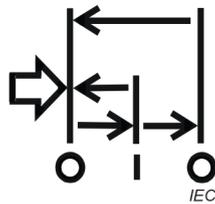
6.1 Nature of information

The following information shall be given by the manufacturer:

Identification

- a) The manufacturer's name or trade mark.
- b) A type designation or serial number that makes it possible to get the relevant information concerning the switching element (or the entire control switch) from the manufacturer.

- c) “IEC 60947-5-8” if the manufacturer claims compliance with this document.
- d) Three-position enabling switches shall be indelibly and legibly marked by the following symbol:



NOTE If it is not possible to affix the marking to the switch due to size constraints, then the symbol may can be put in the instructions for installation, operation and maintenance.

Basic rated values and utilization

- e) Actuating forces and ~~operational stroke~~ travel of the actuator.
- f) Rated operational voltage(s) (see ~~4.3.1.1~~ 4.3.2.2 of IEC 60947-5-1:2016).
- g) Utilization category and rated operational currents at the rated operational voltages of the switching element.
- h) Rated insulation voltage (see ~~4.3.1.2~~ 4.3.2.3 of IEC 60947-5-1:2016).
- i) Rated impulse withstand voltage U_{imp} in accordance with ~~4.3.1.3~~ 5.3.1.3 of IEC 60947-1:2020.
- j) IP code (see ~~5.1 and~~ Annex C of IEC 60947-1:2020).
- k) Pollution degree (see 6.1.3.2 of IEC 60947-5-1:2016).
- l) Type and maximum ratings of short-circuit protective device (see 8.3.4.3 of IEC 60947-5-1:2016).
- m) Conditional short-circuit current if less than 1 000 A.
- n) Indication of contact elements of same polarity.
- o) Mechanical and/or electrical durability.

6.2 Marking

6.2.1 General

Marking of data specified in items a), b), c) and d) of ~~5.1~~ 6.1 is mandatory on the nameplate of the three-position enabling switch in order to permit the complete information to be obtained from the manufacturer.

Marking shall be indelible and easily legible, and shall not be placed on screws and easily removable parts.

Whenever space permits, data under items e) to o) of ~~5.1~~ 6.1 shall be included on the nameplate, or on the three-position enabling switch or otherwise in the manufacturer's published literature.

6.2.2 Terminal identification and marking

Subclause ~~7.1.7.4~~ 5.2.2 of IEC 60947-5-1:2016 applies.

6.2.3 Functional markings

To avoid confusion with emergency stop devices, the actuator of an enabling switch shall not be coloured red (see ~~also~~ IEC 60204-1).

6.3 Instructions for installation, operation and maintenance

Subclause ~~5.3~~ 6.3 of IEC 60947-1:2020 applies with the following additions.

Manufacturers are encouraged to use graphical symbols as set out in international standards. Examples include ISO 7000 and IEC 60417.

EXAMPLE Following symbols can be used for “skilled person”.



IEC 60417-6182 (2013-09)
Installation, electrotechnical expertise



IEC 60417-6183 (2013-09)
Installation, mechanical expertise

6.4 Additional information

Subclause 5.4 of IEC 60947-5-1:2016 applies.

7 Normal service, mounting and transport conditions

7.1 General

Clause ~~6~~ 7 of IEC 60947-1:2020 applies with the following additions.

7.1.3.2 Pollution degree

~~Unless otherwise stated by the manufacturer, a three-position enabling switch is intended for installation under environmental conditions of pollution degree 3. However, other pollution degrees may apply, depending upon the micro-environment.~~

An enabling switch is intended for installation under environmental conditions of pollution degree 3. If it can be demonstrated that the micro-environment of a device to which the enabling switch (or part of) is exposed is different to pollution degree 3, then the pollution degree of the enabling switch can be adapted.

7.3 Mounting

Means shall be provided to allow the three-position enabling switch to be securely installed in its intended mounting position.

7.4 Special application

Environmental conditions (e.g. moisture, corrosive atmosphere, UV radiation) may cause additional requirements.

8 Constructional and performance requirements

8.1 Constructional requirements

8.1.1 General

Subclause ~~7.1~~ 8.1.1 of IEC 60947-1:2020 applies ~~except for 7.1.1, 7.1.2, 7.1.6, 7.1.8 and 7.1.12, and with the following additions.~~

~~7.1.1 Materials~~

~~Subclause 7.1.1 of IEC 60947-5-1 applies.~~

~~7.1.2 Current-carrying parts and their connections~~

~~Subclause 7.1.2 of IEC 60947-5-1 applies.~~

~~7.1.3 Clearances and creepage distances~~

~~Subclause 7.1.3 of IEC 60947-5-1 applies.~~

8.1.2 Materials

8.1.2.1 General material requirements

Subclause 7.1.2.1 of IEC 60947-5-1:2016 applies.

8.1.2.2 Glow-wire testing

Subclause 7.1.2.2 of IEC 60947-5-1:2016 applies.

8.1.2.3 Test based on flammability category

Subclause 7.1.2.3 of IEC 60947-5-1:2016 applies.

8.1.2.4 Biological and chemical effects

Under agreement between manufacturer and user, the manufacturer may provide a list of relevant materials in order to let the user verify that the product is suitable for the application.

NOTE 1 Additional requirements can be relevant in conjunction with special applications/branches e.g. for food and beverage, chemical industry, marine.

NOTE 2 Three-position enabling switches can be utilized in applications where a human operator can be in contact with the device for substantial periods, with bare hands. Due consideration can be given to the biological and chemical effects of skin contact with materials that emit substances when touched, for example, polycyclic aromatic hydrocarbons (PAH).

8.1.3 Current-carrying parts and their connections

Subclause 7.1.3 of IEC 60947-5-1:2016 applies.

8.1.4 Clearances and creepage distances

Subclause 8.1.4 of IEC 60947-1:2020 applies.

8.1.5 Actuator

8.1.5.1 Insulation

Subclause 8.1.5.1 of IEC 60947-1:2020 applies.

8.1.5.2 Direction of movement

Subclause 8.1.5.2 of IEC 60947-1:2020 applies.

8.1.5.3 Actuating force (or ~~moment~~ torque)

The force (or ~~moment~~ torque) required to operate the actuator shall be compatible with the intended application, taking into account the size of the actuator, the type of enclosure or panel, the environment of the installation and the use for which it is intended.

See 8.1.17 for the actuating force on each operation.

8.1.6 Indication of the contact position

Subclause 8.1.6 of IEC 60947-1:2020 applies.

8.1.7 Vacant

8.1.8 Terminals

Subclause 8.1.8 of IEC 60947-1:2020 applies.

8.1.9 Vacant

8.1.10 Provisions for protective earthing

Subclause 8.1.10 of IEC 60947-1:2020 applies.

8.1.11 Enclosures for equipment

Subclause 8.1.11 of IEC 60947-1:2020 applies.

8.1.12 Degrees of protection of enclosed equipment

Subclause 8.1.12 of IEC 60947-1:2020 applies.

8.1.13 Vacant

8.1.14 Class II three-position enabling switches

Subclause ~~7.1.7~~ 7.1.14 of IEC 60947-5-1:2016 applies.

8.1.15 Requirements for three-position enabling switches with integrally connected cables

Subclause ~~7.1.8~~ 7.1.15 of IEC 60947-5-1:2016 applies.

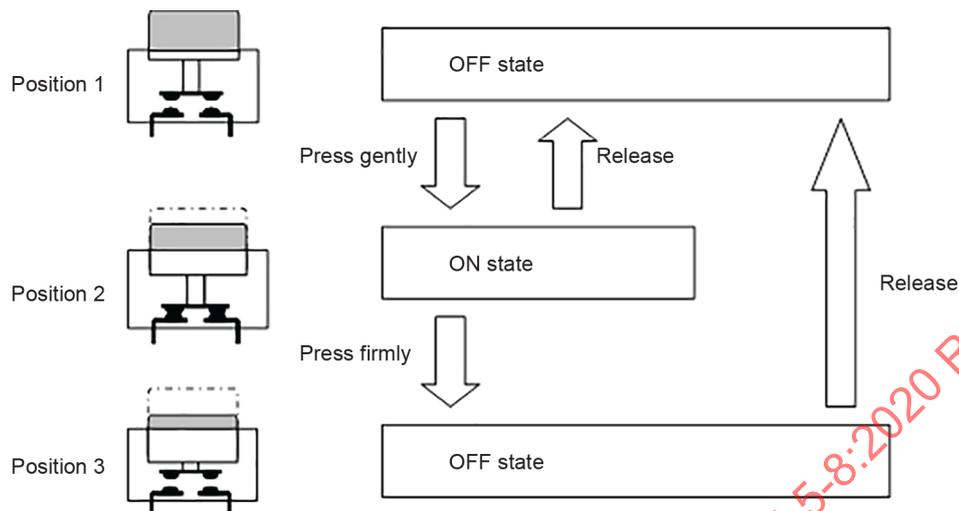
8.1.16 Three-position operation

The three positions are designated as follows (see Figure 2):

- position 1: OFF state of the contact (actuator is not pressed);
- position 2: ON state of the contact (actuator is pressed to the normal enabling position);
- position 3: OFF state of the contact (actuator is fully depressed).

The three-position enabling switch pressed to position 2 shall return to position 1 when released. The three-position enabling switch shall change from position 2 to position 3 when pressed further. When released from position 3 to position 1, the switching element shall not close when the actuator passes through position 2.

Figure 1 illustrates the three positions and the corresponding contact states.



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Figure 1 – Operation of three-position enabling switches

The operational stroke and force to actuate the three-position enabling switch from position 1 to position 2 and from position 2 to position 3 shall be stated by the manufacturer.

8.1.17 Operational characteristics

The three-position enabling switch shall be designed and manufactured to satisfy the following operational characteristics.

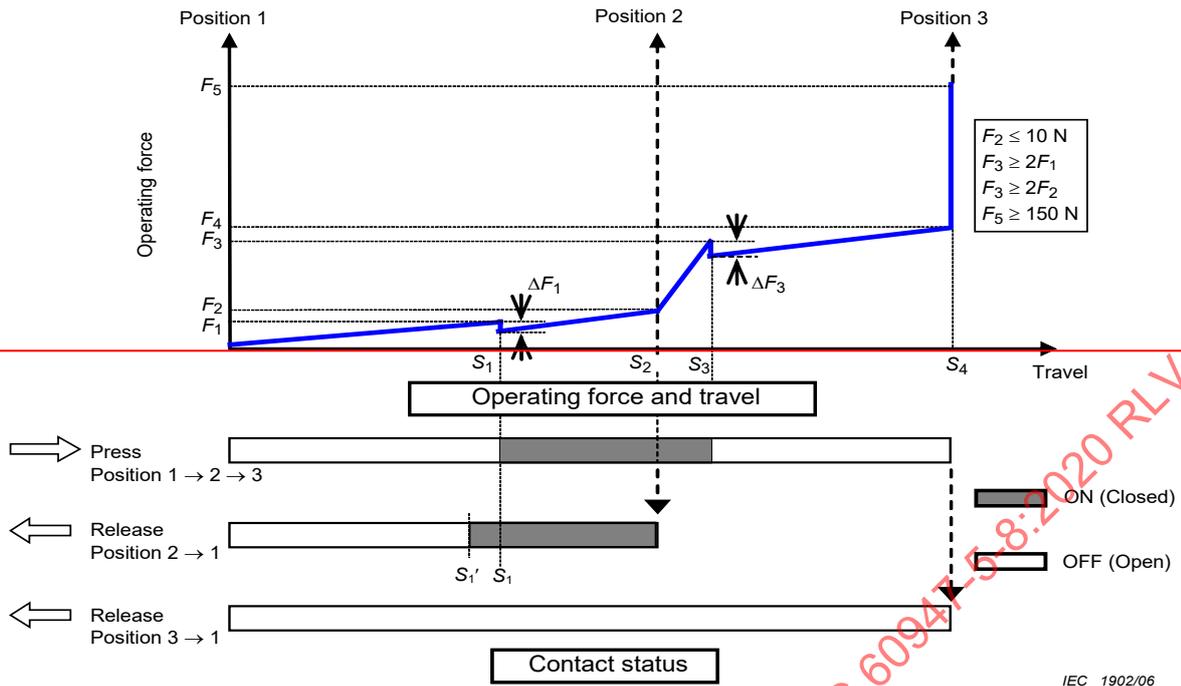
- To reduce physiological strain during actuation of three-position enabling switches, ~~F_2 shall be 10 N or smaller~~ the value of F_2 shall be as stated in Table 1 or lower. Manufacturer shall declare a maximum F_2 value.
- To reduce the possibility of inadvertent shifting of three-position enabling switches to position 3, ~~F_3 shall be $2 F_2$ or greater and F_3 shall be $2 F_1$ or greater~~ equal to or greater than 2 times the larger values of F_1 and F_2 .
- F_5 shall be 150 N or greater (see ~~8.2.6~~ 9.2.3).

NOTE 1 To prevent inadvertent shifting of the three-position enabling switch to position 1, ~~it is recommended to set S_4 to smaller than S_4~~ S_4' can be set smaller than S_4 .

NOTE 2 To provide operator with tactile sensation of contact shifting, ~~it is recommended to provide~~ operating force dips ΔF_1 and ΔF_3 can be provided.

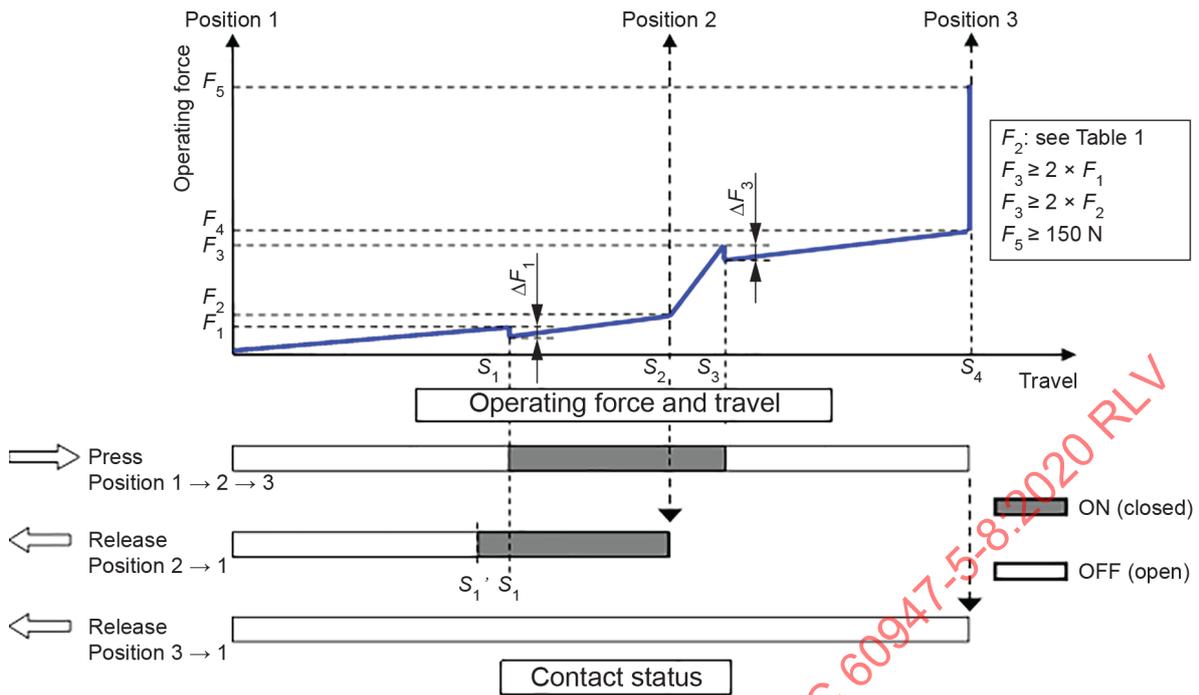
NOTE 3 The torque value is not specified in this document because there is no known enabling switch using torque for actuation.

Figure 2 shows the operational characteristics of the three-position enabling switch when the switch is pressed.



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Key

- F_1 Force to turn on the enabling contacts from position 1 to position 2
- F_2 Force to maintain the switch in position 2
- F_3 Force to turn off the enabling contacts from position 2 to position 3
- F_4 Full stroke force (position 3)
- F_5 Maximum rated operating force
- ΔF_1 Operating force dip across point S_1
- ΔF_3 Operating force dip across point S_3
- S_1 Point where the switch shifts from position 1 to position 2. Enabling contacts turn ON
- S_1' Point where the switch returns from position 2 to position 1. Enabling contacts turn OFF
- S_2 Point where the switch is maintained in position 2
- S_3 Point where the switch shifts from position 2 to position 3. Enabling contacts turn OFF
- S_4 Full stroke point

Figure 2 – Operating force, travel and enabling contact status

When released from position 3 to position 1, the enabling contacts shall not close.

Table 1 – Force values for F_2

Designated use of the three-position enabling switch	Maximum value of F_2 N
Actuation of the enabling device by finger	10
Actuation of the enabling device by hand	20
Actuation of the enabling device by foot	25

Manufacturer of foot-actuated enabling devices shall design their device to avoid mechanical stress to the switch greater than F_5 .

8.2 Performance requirements

8.2.1 General

~~Subclauses 7.2.1.1 and 7.2.2 of IEC 60947-1 apply with the following additions.~~

Subclause 8.2.1.1 of IEC 60947-1:2020 applies.

8.2.2 Temperature-rise

Subclause 8.2.2 of IEC 60947-1:2020 applies.

8.2.3 Dielectric properties

Subclause 7.2.3 of IEC 60947-5-1:2016 applies.

8.2.4 Ability to make and break under normal and abnormal conditions

8.2.4.1 General

Subclause 7.2.4 of IEC 60947-5-1:2016 applies with the following addition.

8.2.4.2 Durability

Three-position enabling switches shall be tested according to ~~8.3.3.6~~ 9.3.3.6.

8.2.5 Conditional short-circuit current

Subclause 7.2.5 of IEC 60947-5-1:2016 applies.

~~7.2.6 Switching overvoltage~~

~~Subclause 7.2.6 of IEC 60947-1 applies.~~

8.2.6 Additional requirements for control switches suitable for isolation

Subclause 7.2.7 of IEC 60947-5-1:2016 applies.

8.2.7 Shock and vibration

Shock or vibration shall not cause opening of closed contacts or closing of open contacts. The tests shall be conducted according to ~~8.3.5.2 and 8.3.5.3~~ 9.3.5.2 and 9.3.5.3.

9 Tests

9.1 Kinds of test

9.1.1 General

Subclause ~~8.1.4~~ 9.1.1 of IEC 60947-1:2020 applies.

9.1.2 Type tests

Type tests are intended to verify compliance of the design of the three-position enabling switches with this document.

They comprise the verification of:

- a) temperature-rise (~~8.3.3.3~~ 9.3.3.3);
- b) dielectric properties (~~8.3.3.4~~ 9.3.3.4);
- c) making and breaking capacities of switching elements under normal conditions (~~8.3.3.5~~ 9.3.3.5);
- d) making and breaking capacities of switching elements under abnormal conditions (~~8.3.3.5~~ 9.3.3.5);
- e) performance under conditional short-circuit current (~~8.3.4~~ 9.3.4);
- f) constructional requirements (~~8.2~~ 9.2);
- g) degree of protection of three-position enabling switches, if applicable (~~8.3.1~~ 9.3.1);
- h) durability (~~8.3.3.6~~ 9.3.3.6);
- i) shock and vibration (~~8.3.5~~ 9.3.5).

9.1.3 Routine tests

Routine tests are the responsibility of the manufacturer and are usually limited to a mechanical inspection and a verification of the electromechanical operation.

The inspection shall be supplemented by a dielectric test which is carried out according to ~~8.3.3.4~~ 9.3.3.4 with the following amendments: the required minimum duration of voltage application is reduced to 1 s and the metal foil and external terminal connections are unnecessary.

Additional routine tests for the three-position enabling switch may be specified as appropriate. A sampling plan may be accepted.

9.1.4 Sampling tests

Subclause ~~8.1.4~~ 9.1.4 of IEC 60947-1:2020 applies.

9.1.5 Special tests

These tests are subject to agreement between manufacturer and user.

The manufacturer of the three-position-enabling device (user of the enabling switch) shall verify all necessary requirements of the application with the three-position-enabling device.

In cases where it is necessary to verify environmental conditions of damp heat, salt mist, vibration and shock, the tests shall be conducted according to Annex Q of IEC 60947-1:2020.

During the damp heat test and salt mist test, the enabling switch is assembled to an enabling device, or to a representative enclosure.

Reliability data for three-position enabling switches intended for use in functional safety applications shall be made available in accordance with Annex B.

9.2 Compliance with constructional requirements

~~Subclause 8.2 of IEC 60947-1 applies except for 8.2.5 and 8.2.6.~~

9.2.1 General

Subclause 9.2 of IEC 60947-1:2020 applies except 9.2.6 and 9.2.7 and with the following additions.

9.2.2 Verification of operation of three-position enabling switches

The requirements of ~~7.1.9~~ 8.1.16 are verified by operating the actuator while monitoring the state of the enabling contacts. The monitoring means shall be capable of detecting a contact closure longer than 0,2 ms.

Three-position operation shall be verified during test sequence VII of ~~8.3.1~~ 9.3.1.

9.2.3 Verification of operation of actuator

The actuator shall withstand the maximum rated operating force specified by the manufacturer (see F_5 as defined in Figure 2) in the direction of normal operation.

This shall be verified during test sequence VII of 9.3.1.

9.3 Performance

9.3.1 Test sequences

The type and sequence of tests to be performed on representative samples are as follows.

- **Test sequence I** (sample No. 1)
 - Test No. 1 – Temperature rise (~~8.3.3.3~~ 9.3.3.3)
 - Test No. 2 – Dielectric properties (~~8.3.3.4~~ 9.3.3.4)
 - Test No. 3 – Mechanical properties of terminals (~~8.2.4~~ 9.2.5 of IEC 60947-1:2020)
- **Test sequence II** (sample No. 2)
 - Test No. 1 – Making and breaking capacities of switching elements under normal conditions (~~8.3.3.5.2~~ 8.3.3.5.3 of IEC 60947-5-1:2016)
 - Test No. 2 – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence III** (sample No. 3)
 - Test No. 1 – Making and breaking capacities of switching elements under abnormal conditions (~~8.3.3.5.3~~ 8.3.3.5.4 of IEC 60947-5-1:2016)
 - Test No. 2 – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence IV** (sample No. 4)
 - Test No. 1 – Performance under conditional short-circuit current (~~8.3.4~~ 9.3.4)
 - Test No. 2 – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence V** (sample No. 5)
 - Test No. 1 – Degree of protection of three-position enabling switches (Annex C of IEC 60947-1:2020)
 - Test No. 2 – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence VI** (sample No. 6)
 - Test No. 1 – Verification of clearances and creepage distances, if applicable (~~7.1.3~~ 8.1.4)
 - Test No. 2 – Measurement of actuation force ~~or moment~~ (~~7.1.10~~) (~~8.2.5~~) (or torque) (8.1.17, 9.2.2)
 - Test No. 3 – Verification of robustness of actuator (~~8.3.3.7~~ 9.3.3.7)
- **Test sequence VII** (sample No. 7)
 - Test No. 1 – Verification of operation of three-position enabling switches (9.2.2)
 - Test No. ~~42~~ – Mechanical durability (~~8.3.3.6.1~~ 9.3.3.6.2, 9.2.3)
 - Test No. ~~23~~ – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)

- Test No. 4 – Verification of operation of three-position enabling switches (9.2.2)
- **Test sequence VIII** (sample No. 8)
 - Test No. 1 – Electrical durability (~~8.3.3.6.2~~ 9.3.3.6.3)
 - Test No. 2 – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence IX** (sample No. 9)
 - Test No. 1 – Shock and vibration (~~8.3.5~~ 9.3.5)
 - Test No. 2 – Dielectric verification (~~8.3.3.5.5~~ 8.3.3.5.6 item b) of IEC 60947-5-1:2016)

There shall be no failure in any of the above tests.

More than one test sequence or all test sequences may be conducted on one sample at the request of the manufacturer. However, the tests shall be conducted in the sequence given for each sample above.

NOTE 1 For class II three-position enabling switches insulated by encapsulation, additional samples are ~~required~~ used (see Annex F of IEC 60947-5-1:2016).

NOTE 2 For three-position enabling switches with integrally connected cables, see Annex G of IEC 60947-5-1:2016.

For shock and vibration tests, the test shall be conducted on three samples, see ~~8.3.5~~ 9.3.5.

9.3.2 General test conditions

9.3.2.1 General requirements

Subclause ~~8.3.2.1~~ 9.3.2.1 of IEC 60947-1:2020 applies with the following addition.

The tests shall be performed with the actuator operated by a machine complying with the following:

- the operating machine shall apply the actuating force to the actuator in the direction of its motion;
- the maximum force exerted on the actuator shall not exceed F_4 (see Figure 2);
- at the moment when the switching operation occurs, the velocity of the part of the operating machine that contacts the actuator shall be between 0,05 m/s and 0,15 m/s;
- the mechanical connection between the operating machine and the actuator shall not impede the free motion of the actuator away from it.

9.3.2.2 Test quantities

Subclause ~~8.3.2.2~~ 9.3.2.2 of IEC 60947-1:2020 applies except for ~~8.3.2.2.3~~ 9.3.2.2.3.

9.3.2.3 Evaluation of test results

The condition of the three-position enabling switch after each test shall be checked by the verifications applicable to each test.

A three-position enabling switch is deemed to have met the requirements of this document if it meets the requirements of each test and/or test sequence as applicable.

9.3.2.4 Test report

Subclause ~~8.3.2.4~~ 9.3.2.4 of IEC 60947-1:2020 applies.

9.3.3 Performance under no-load, normal load and abnormal load conditions

9.3.3.1 Operation

Subclause ~~8.3.3.1~~ 9.3.3.1 of IEC 60947-1:2020 applies.

9.3.3.2 Vacant

9.3.3.3 Temperature rise

Subclause 8.3.3.3 of IEC 60947-5-1:2016 applies.

9.3.3.4 Dielectric properties

Subclause 8.3.3.4 of IEC 60947-5-1:2016 applies.

9.3.3.5 Making and breaking capacities

Subclause 8.3.3.5 of IEC 60947-5-1:2016 applies.

9.3.3.6 Durability

9.3.3.6.1 General

The three-position enabling switch shall successfully pass the mechanical and electrical durability tests described in ~~8.3.3.6.1 and 8.3.3.6.2~~ 9.3.3.6.2 and 9.3.3.6.3.

Minimum test operations: 100 000 cycles

Recommended test operations: 0,1 – 0,3 – 1 – 3 – 10 – 30 – 100 million operations

9.3.3.6.2 Mechanical durability

The three samples (see ~~8.1~~ 9.1) shall be subjected to the following test.

The test shall be performed for minimum 50 000 cycles of position 1 → 2 → 1 operation and minimum 50 000 cycles of position 1 → 2 → 3 → 1 operation. The actuator of a three-position enabling switch shall be subjected to the forces necessary to achieve the required positions.

The maximum rated operating force specified by the manufacturer (see F_5 as defined in Figure 2) is applied at position 3.

The movement and actuating forces of the three-position enabling switch shall be consistent throughout the test. This shall be verified by measurement before and after the tests.

The mechanical durability of the three-position enabling switch is defined as the number of no-load operating cycles which will be attained by all samples tested without repair or replacement of any part.

Tests shall be carried out according to C.1.2 of IEC 60947-5-1:2016.

During the test, the enabling contacts shall be checked at each change of state by the manufacturer at the conditions described below, and there shall be no failure.

Test voltage and current: 24 V DC, 10 mA maximum.

Test method: The agreement of switch position and enabling contact status shall be checked at every position before shifting to the next position.

The enabling contact status shall be checked at each position. The three-position enabling switch shall be shifted to the next position only when the agreement of switch position and contact status has been confirmed. When any disagreement of position and contact status is found, tests shall be stopped.

Position 1: enabling contacts open

↓

Position 2: enabling contacts closed

↓

Position 3: enabling contacts open

↓

Position 3 – Position 1: enabling contacts open

Failure criteria:

During the tests, there shall be no electrical and/or mechanical failures. Following the tests, the switching element shall pass the dielectric test of 8.3.3.4 of IEC 60947-5-1:2016 with a test voltage equal to $2 U_e$ with a minimum of 1 000 V.

9.3.3.6.3 Electrical durability

The test conditions are those of ~~8.3.3.6.1~~ 9.3.3.6.2 except that the circuit of the switch is energized according to the manufacturer's specified ratings in accordance with ~~5.4~~ 6.1, item g).

9.3.3.7 Robustness

The actuator shall withstand a force of 150 % of the maximum rated operating force specified by the manufacturer (see F_5 as defined in Figure 2), applied three times in the direction of normal operation in a manner simulating human action.

9.3.4 Performance under conditional short-circuit current

Subclause 8.3.4 of IEC 60947-5-1:2016 applies.

9.3.5 Shock and vibration tests

9.3.5.1 Conditioning procedures

The purpose of the following procedures is to expose the three-position enabling switches to various environmental conditions in order to verify their functioning after such exposure.

The three three-position enabling switches shall be subjected to the following exposures:

- 96 h at +40 °C in dry atmosphere according to test ~~Ba~~ Bb of IEC 60068-2-2;
- 96 h at +5 °C according to test ~~Aa~~ Ab of IEC 60068-2-1.

Following the environmental exposures and after the samples have been restored to room temperature, the sequence of tests in ~~8.3.5.2 and 8.3.5.3~~ 9.3.5.2 and 9.3.5.3 shall be conducted.

9.3.5.2 Shock

The three three-position enabling switches that have been conditioned in accordance with ~~8.3.5.1~~ 9.3.5.1 shall be tested in each of the three mutually perpendicular axes.

Each three-position enabling switch is tested in position 1 and shall withstand 15 g shock in both directions of each axis according to IEC 60068-2-27: 11 ms – 15 g.

During the test, no closed contacts shall open and no open contacts shall close.

The monitoring means shall be able to detect any opening or closing of contacts longer than 0,2 ms.

9.3.5.3 Vibration

The three samples used for ~~8.3.5.2~~ 9.3.5.2 shall be tested, in accordance with IEC 60068-2-6, with the following conditions, in each of the three mutually perpendicular axes:

- frequency range: 10 Hz to 55 Hz;
- amplitude: 0,5 mm;
- sweep cycle duration: 5 min;
- duration at resonant frequency or at 55 Hz: 30 min in each of the three axes (90 min in total).

During the test, no closed contacts shall open and no open contacts shall close.

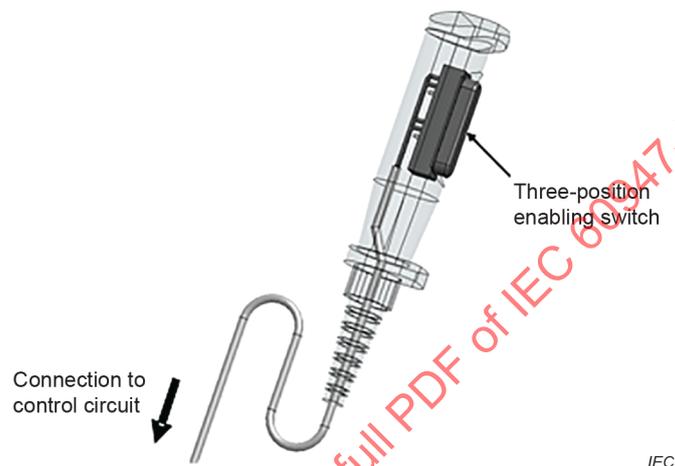
The monitoring means shall be able to detect any opening or closing of contacts longer than 0,2 ms.

Annex A (informative)

Example of ~~an~~ enabling devices incorporating a three-position enabling switch

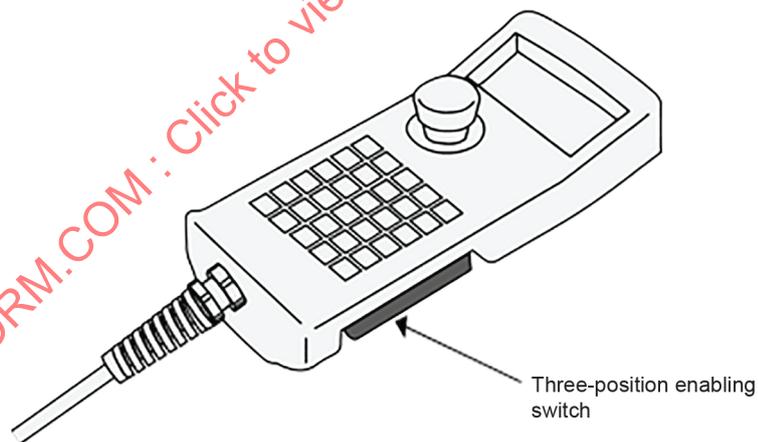
~~Figure A.1 shows an enabling device incorporating a three-position enabling switch. The enabling device is used as a control circuit device to initiate the enabling function described in IEC 60204-1.~~

Figure A.1 to Figure A.8 show enabling devices incorporating three-position enabling switches.



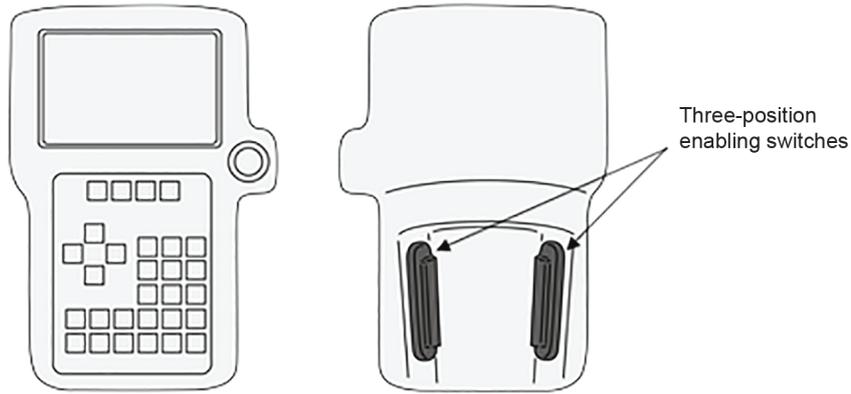
IEC

Figure A.1 – Grip type enabling device



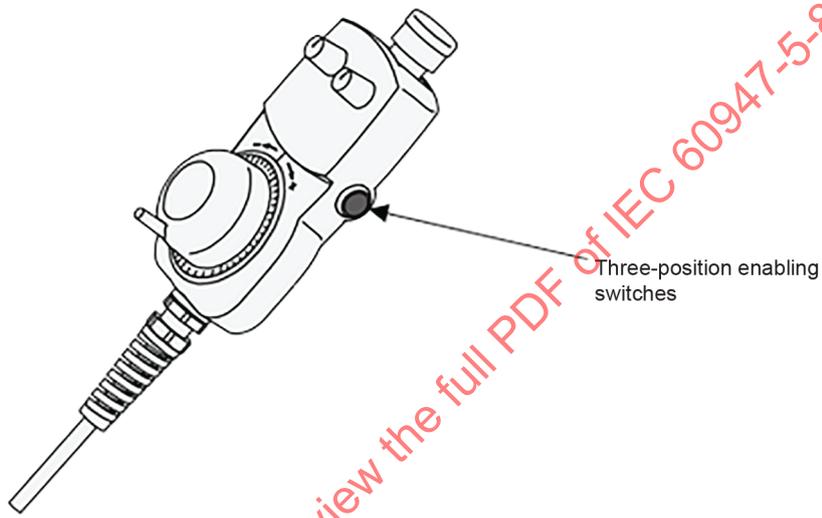
IEC

Figure A.2 – One hand teaching pendant type enabling device



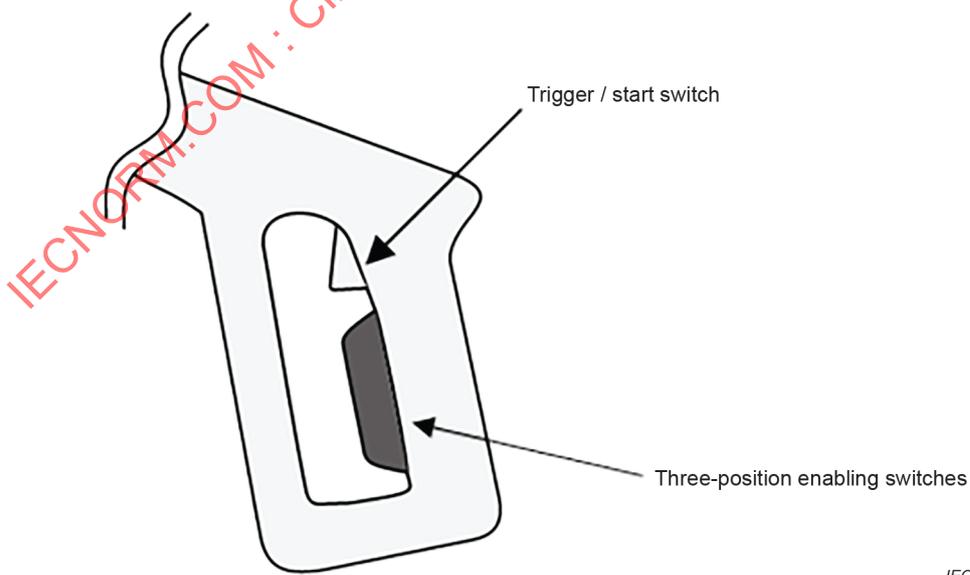
IEC

Figure A.3 – Two hand teaching pendant type enabling device



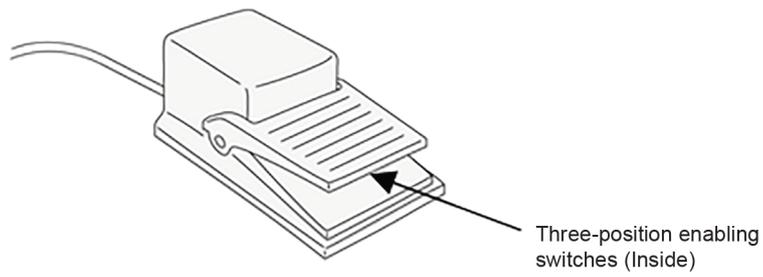
IEC

Figure A.4 – Manual pulse generator



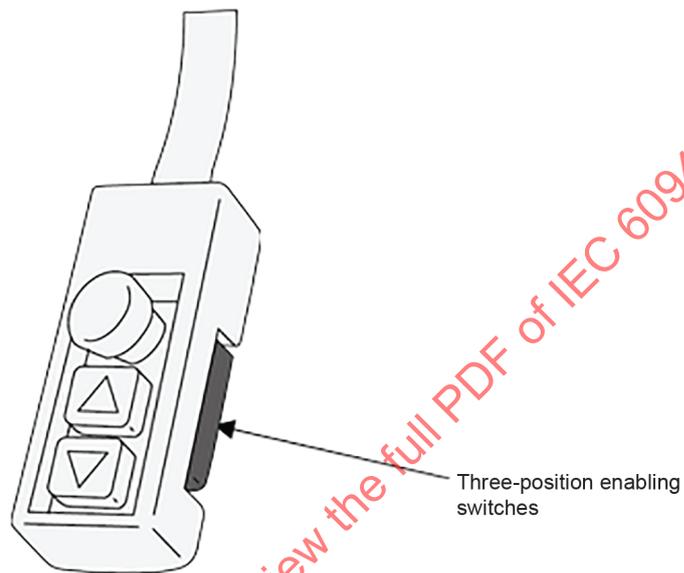
IEC

Figure A.5 – Grip type enabling device for hand-held machine



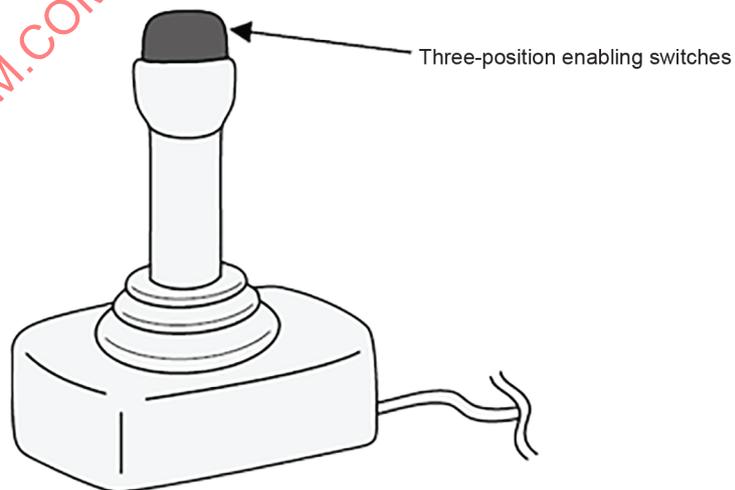
IEC

Figure A.6 – Foot actuated enabling device



IEC

Figure A.7 – Hoist controller



IEC

Figure A.8 – Joystick type enabling device

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Annex B (normative)

Procedure to determine reliability data for three-position enabling switches used in functional safety applications

B.1 General

B.1.1 Object

Subclause K.1.2 of IEC 60947-1:2020 applies with the following addition:

This annex only addresses the electromechanical contacts in three-position enabling switches intended for use in functional safety applications.

EXAMPLE The intended use for enabling contacts is to open the circuit.

B.1.2 General requirements

Subclause K.1.3 of IEC 60947-1:2020 applies.

B.2 Terms, definitions and symbols

Clause K.2 of IEC 60947-1:2020 applies.

B.3 Method based on durability test results

Clause N.3 of IEC 60947-5-1:2016 applies.

B.4 Data information

Clause K.4 of IEC 60947-1:2020 applies.

B.5 Examples

Clause K.5 of IEC 60947-1:2020 applies.

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Bibliography

IEC 60050-441:1984, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses*
IEC 60050-441:1984/AMD1:2000

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

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

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*
IEC 60695-2-12:2010/AMD1:2014

IEC 60947-5-5:1997, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function*

IEC 60947-5-5:1997/AMD1:2005

IEC 60947-5-5:1997/AMD2:2016

ISO 7000, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

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INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Low-voltage switchgear and controlgear –
Part 5-8: Control circuit devices and switching elements – Three-position
enabling switches**

**Appareillage à basse tension –
Partie 5-8: Appareils et éléments de commutation pour circuits de commande –
Interrupteurs de commande de validation à trois positions**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –**Part 5-8: Control circuit devices and switching elements –
Three-position enabling switches**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60947-5-8 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.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

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

- a) due to the increasing range of useful applications of three-position enabling switches, note of scope, operational characteristics and tests are reviewed;
- b) figures for example of devices incorporating enabling switch are added in Annex A;
- c) new Annex B for procedure to determine reliability data for the switch used in functional safety applications is added.

The text of this document is based on the following documents:

FDIS	Report on voting
121A/358/FDIS	121A/369/RVD

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

This document should be used in conjunction with IEC 60947-1:2020 and IEC 60947-5-1:2016.

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.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-8: Control circuit devices and switching elements – Three-position enabling switches

1 Scope

This part of IEC 60947 series specifies requirements for three-position enabling switches.

These switches are used as components of enabling devices to provide signals that

- a) when activated, allow machine operation to be initiated by a separate start control, and
- b) when de-activated,
 - initiate a stop function, and
 - prevent initiation of machine operation.

NOTE 1 The enabling control function is described in 9.2.3.9 of IEC 60204-1:2016 but the application of three-position enabling switches is not limited to a component of the enabling device described in IEC 60204-1.

NOTE 2 This document does not deal with enabling devices.

These switches are intended to be connected to circuits which rated voltage does not exceed 250 V AC 50 Hz/60 Hz or 300 V DC.

EXAMPLE Devices incorporating three-position enabling switches are:

- push-button enabling devices;
- grip actuated enabling devices;
- foot actuated enabling devices.

See Annex A for more typical examples.

This document does not apply to:

- three-position enabling switches for non-electrical control circuits, for example hydraulic, pneumatic;
- enabling switches without three-position mechanism;
- emergency stop devices (see IEC 60947-5-5).

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 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

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

IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60947-1:2020 and Clause 2 of IEC 60947-5-1:2016, and the following apply.

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

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

Alphabetical index of definitions

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Three-position enabling switch	3.2

3.1

enabling device

manually operated control device used in conjunction with a start control and which, when continuously actuated, allows a machine operation

3.2

three-position enabling switch

three-position switch having enabling contact(s)

3.3

actuating system

<three-position enabling switch> all the mechanical parts which transmit the actuating force to the contact elements

[SOURCE: IEC 60050-441:2000, 441-15-21, modified – "all the operating means of a control switch" replaced by "all the mechanical parts", note to entry deleted.]

3.4

actuator

<three-position enabling switch> part of the actuating system which is actuated by a part of the human body

EXAMPLE A button.

3.5

auxiliary contact

contact of a three-position enabling switch that provides an auxiliary function

Note 1 to entry: Auxiliary contacts can be normally open and/or normally closed.

3.6

enabling contact

contact of a three-position enabling switch, which is closed when the actuator is in the mid position (partly depressed, position 2 in Figure 1) and is open when the actuator is in the rest position (not pressed, position 1 in Figure 1) and in the fully depressed position (position 3 in Figure 1)

4 Classification

4.1 Contact elements

Subclause 3.1 of IEC 60947-5-1:2016 applies.

4.2 Three-position enabling switch

Three-position enabling switches may be classified according to the contact element and the nature of the actuating system, e.g. three-position enabling switches, form B.

5 Characteristics

5.1 Summary of characteristics

5.1.1 General

Subclause 4.1.1 of IEC 60947-5-1:2016 applies except for following type of equipment (see 5.2).

5.1.2 Operation of an enabling switch

Subclause 4.1.2 of IEC 60947-5-1:2016 applies.

5.2 Type of three-position enabling switch

5.2.1 Number of poles

The number of poles shall be stated by the manufacturer.

5.2.2 Kind of current

Alternating current or direct current.

5.3 Rated and limiting values for switching elements

Subclause 4.3 of IEC 60947-5-1:2016 applies.

5.4 Utilization categories for switching elements

Subclause 4.4 of IEC 60947-5-1:2016 applies.

5.5 Vacant

5.6 Vacant

5.7 Vacant

5.8 Vacant

5.9 Vacant

5.10 Electrically separated contact elements

Subclause 4.10 of IEC 60947-5-1:2016 applies.

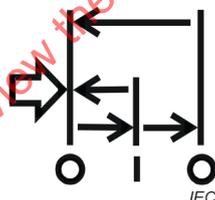
6 Product information

6.1 Nature of information

The following information shall be given by the manufacturer:

Identification

- a) The manufacturer's name or trade mark.
- b) A type designation or serial number that makes it possible to get the relevant information concerning the switching element (or the entire control switch) from the manufacturer.
- c) "IEC 60947-5-8" if the manufacturer claims compliance with this document.
- d) Three-position enabling switches shall be indelibly and legibly marked by the following symbol:



NOTE If it is not possible to affix the marking to the switch due to size constraints, then the symbol can be put in the instructions for installation, operation and maintenance.

Basic rated values and utilization

- e) Actuating forces and travel of the actuator.
- f) Rated operational voltage(s) (see 4.3.2.2 of IEC 60947-5-1:2016).
- g) Utilization category and rated operational currents at the rated operational voltages of the switching element.
- h) Rated insulation voltage (see 4.3.2.3 of IEC 60947-5-1:2016).
- i) Rated impulse withstand voltage U_{imp} in accordance with 5.3.1.3 of IEC 60947-1:2020.
- j) IP code (see Annex C of IEC 60947-1:2020).
- k) Pollution degree (see 6.1.3.2 of IEC 60947-5-1:2016).
- l) Type and maximum ratings of short-circuit protective device (see 8.3.4.3 of IEC 60947-5-1:2016).
- m) Conditional short-circuit current if less than 1 000 A.
- n) Indication of contact elements of same polarity.
- o) Mechanical and/or electrical durability.

6.2 Marking

6.2.1 General

Marking of data specified in items a), b), c) and d) of 6.1 is mandatory on the nameplate of the three-position enabling switch in order to permit the complete information to be obtained from the manufacturer.

Marking shall be indelible and easily legible, and shall not be placed on screws and easily removable parts.

Whenever space permits, data under items e) to o) of 6.1 shall be included on the nameplate, or on the three-position enabling switch or otherwise in the manufacturer's published literature.

6.2.2 Terminal identification and marking

Subclause 5.2.2 of IEC 60947-5-1:2016 applies.

6.2.3 Functional markings

To avoid confusion with emergency stop devices, the actuator of an enabling switch shall not be coloured red (see IEC 60204-1).

6.3 Instructions for installation, operation and maintenance

Subclause 6.3 of IEC 60947-1:2020 applies with the following additions.

Manufacturers are encouraged to use graphical symbols as set out in international standards. Examples include ISO 7000 and IEC 60417.

EXAMPLE Following symbols can be used for "skilled person".



IEC 60417-6182 (2013-09)

Installation, electrotechnical expertise



IEC 60417-6183 (2013-09)

Installation, mechanical expertise

6.4 Additional information

Subclause 5.4 of IEC 60947-5-1:2016 applies.

7 Normal service, mounting and transport conditions

7.1 General

Clause 7 of IEC 60947-1:2020 applies with the following additions.

7.1.3.2 Pollution degree

An enabling switch is intended for installation under environmental conditions of pollution degree 3. If it can be demonstrated that the micro-environment of a device to which the enabling switch (or part of) is exposed is different to pollution degree 3, then the pollution degree of the enabling switch can be adapted.

7.3 Mounting

Means shall be provided to allow the three-position enabling switch to be securely installed in its intended mounting position.

7.4 Special application

Environmental conditions (e.g. moisture, corrosive atmosphere, UV radiation) may cause additional requirements.

8 Constructional and performance requirements

8.1 Constructional requirements

8.1.1 General

Subclause 8.1.1 of IEC 60947-1:2020 applies.

8.1.2 Materials

8.1.2.1 General material requirements

Subclause 7.1.2.1 of IEC 60947-5-1:2016 applies.

8.1.2.2 Glow-wire testing

Subclause 7.1.2.2 of IEC 60947-5-1:2016 applies.

8.1.2.3 Test based on flammability category

Subclause 7.1.2.3 of IEC 60947-5-1:2016 applies.

8.1.2.4 Biological and chemical effects

Under agreement between manufacturer and user, the manufacturer may provide a list of relevant materials in order to let the user verify that the product is suitable for the application.

NOTE 1 Additional requirements can be relevant in conjunction with special applications/branches e.g. for food and beverage, chemical industry, marine.

NOTE 2 Three-position enabling switches can be utilized in applications where a human operator can be in contact with the device for substantial periods, with bare hands. Due consideration can be given to the biological and chemical effects of skin contact with materials that emit substances when touched, for example, polycyclic aromatic hydrocarbons (PAH).

8.1.3 Current-carrying parts and their connections

Subclause 7.1.3 of IEC 60947-5-1:2016 applies.

8.1.4 Clearances and creepage distances

Subclause 8.1.4 of IEC 60947-1:2020 applies.

8.1.5 Actuator

8.1.5.1 Insulation

Subclause 8.1.5.1 of IEC 60947-1:2020 applies.

8.1.5.2 Direction of movement

Subclause 8.1.5.2 of IEC 60947-1:2020 applies.

8.1.5.3 Actuating force (or torque)

The force (or torque) required to operate the actuator shall be compatible with the intended application, taking into account the size of the actuator, the type of enclosure or panel, the environment of the installation and the use for which it is intended.

See 8.1.17 for the actuating force on each operation.

8.1.6 Indication of the contact position

Subclause 8.1.6 of IEC 60947-1:2020 applies.

8.1.7 Vacant

8.1.8 Terminals

Subclause 8.1.8 of IEC 60947-1:2020 applies.

8.1.9 Vacant

8.1.10 Provisions for protective earthing

Subclause 8.1.10 of IEC 60947-1:2020 applies.

8.1.11 Enclosures for equipment

Subclause 8.1.11 of IEC 60947-1:2020 applies.

8.1.12 Degrees of protection of enclosed equipment

Subclause 8.1.12 of IEC 60947-1:2020 applies.

8.1.13 Vacant

8.1.14 Class II three-position enabling switches

Subclause 7.1.14 of IEC 60947-5-1:2016 applies.

8.1.15 Requirements for three-position enabling switches with integrally connected cables

Subclause 7.1.15 of IEC 60947-5-1:2016 applies.

8.1.16 Three-position operation

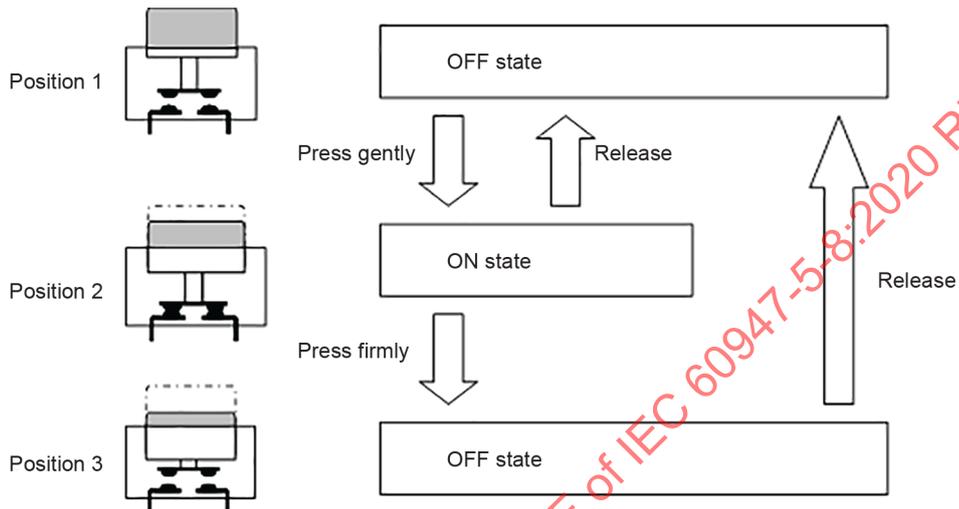
The three positions are designated as follows (see Figure 2):

- position 1: OFF state of the contact (actuator is not pressed);
- position 2: ON state of the contact (actuator is pressed to the normal enabling position);

- position 3: OFF state of the contact (actuator is fully depressed).

The three-position enabling switch pressed to position 2 shall return to position 1 when released. The three-position enabling switch shall change from position 2 to position 3 when pressed further. When released from position 3 to position 1, the switching element shall not close when the actuator passes through position 2.

Figure 1 illustrates the three positions and the corresponding contact states.



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Figure 1 – Operation of three-position enabling switches

The operational stroke and force to actuate the three-position enabling switch from position 1 to position 2 and from position 2 to position 3 shall be stated by the manufacturer.

8.1.17 Operational characteristics

The three-position enabling switch shall be designed and manufactured to satisfy the following operational characteristics.

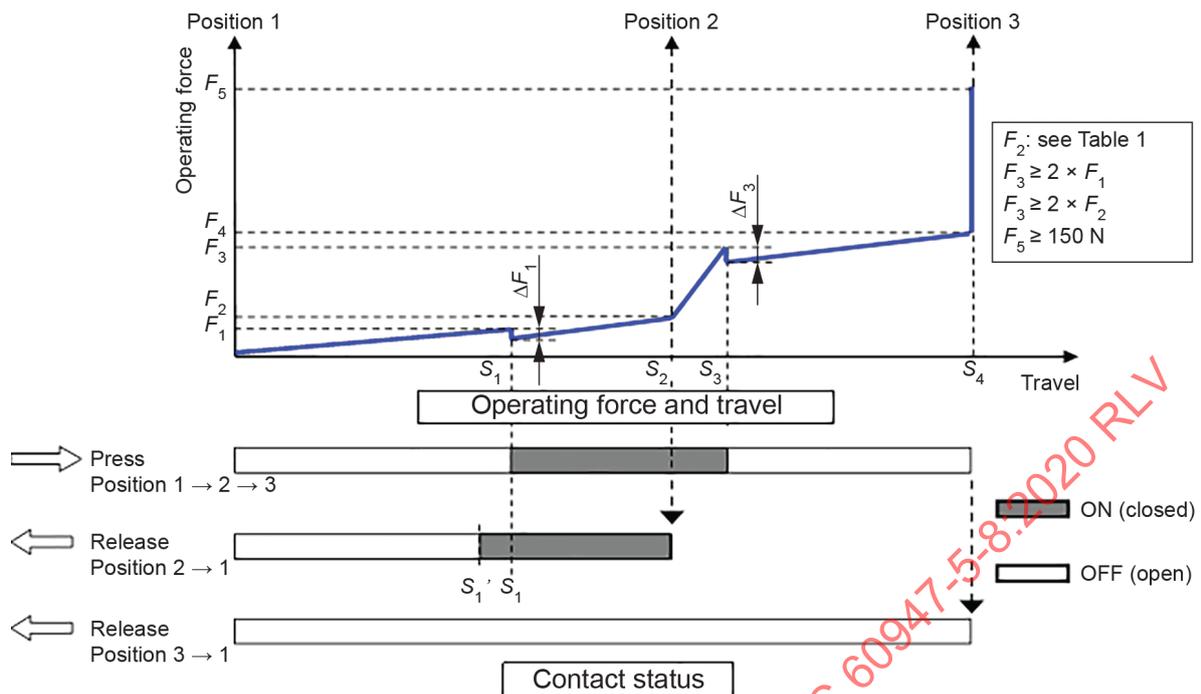
- To reduce physiological strain during actuation of three-position enabling switches, the value of F_2 shall be as stated in Table 1 or lower. Manufacturer shall declare a maximum F_2 value.
- To reduce the possibility of inadvertent shifting of three-position enabling switches to position 3, F_3 shall be equal to or greater than 2 times the larger values of F_1 and F_2 .
- F_5 shall be 150 N or greater (see 9.2.3).

NOTE 1 To prevent inadvertent shifting of the three-position enabling switch to position 1, S_1' can be set smaller than S_1 .

NOTE 2 To provide operator with tactile sensation of contact shifting, operating force dips ΔF_1 and ΔF_3 can be provided.

NOTE 3 The torque value is not specified in this document because there is no known enabling switch using torque for actuation.

Figure 2 shows the operational characteristics of the three-position enabling switch when the switch is pressed.



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Key

- F_1 Force to turn on the enabling contacts from position 1 to position 2
- F_2 Force to maintain the switch in position 2
- F_3 Force to turn off the enabling contacts from position 2 to position 3
- F_4 Full stroke force (position 3)
- F_5 Maximum rated operating force
- ΔF_1 Operating force dip across point S_1
- ΔF_3 Operating force dip across point S_3
- S_1 Point where the switch shifts from position 1 to position 2. Enabling contacts turn ON
- S_1' Point where the switch returns from position 2 to position 1. Enabling contacts turn OFF
- S_2 Point where the switch is maintained in position 2
- S_3 Point where the switch shifts from position 2 to position 3. Enabling contacts turn OFF
- S_4 Full stroke point

Figure 2 – Operating force, travel and enabling contact status

When released from position 3 to position 1, the enabling contacts shall not close.

Table 1 – Force values for F_2

Designated use of the three-position enabling switch	Maximum value of F_2 N
Actuation of the enabling device by finger	10
Actuation of the enabling device by hand	20
Actuation of the enabling device by foot	25

Manufacturer of foot-actuated enabling devices shall design their device to avoid mechanical stress to the switch greater than F_5 .

8.2 Performance requirements

8.2.1 General

Subclause 8.2.1.1 of IEC 60947-1:2020 applies.

8.2.2 Temperature-rise

Subclause 8.2.2 of IEC 60947-1:2020 applies.

8.2.3 Dielectric properties

Subclause 7.2.3 of IEC 60947-5-1:2016 applies.

8.2.4 Ability to make and break under normal and abnormal conditions

8.2.4.1 General

Subclause 7.2.4 of IEC 60947-5-1:2016 applies with the following addition.

8.2.4.2 Durability

Three-position enabling switches shall be tested according to 9.3.3.6.

8.2.5 Conditional short-circuit current

Subclause 7.2.5 of IEC 60947-5-1:2016 applies.

8.2.6 Additional requirements for control switches suitable for isolation

Subclause 7.2.7 of IEC 60947-5-1:2016 applies.

8.2.7 Shock and vibration

Shock or vibration shall not cause opening of closed contacts or closing of open contacts. The tests shall be conducted according to 9.3.5.2 and 9.3.5.3.

9 Tests

9.1 Kinds of test

9.1.1 General

Subclause 9.1.1 of IEC 60947-1:2020 applies.

9.1.2 Type tests

Type tests are intended to verify compliance of the design of the three-position enabling switches with this document.

They comprise the verification of:

- a) temperature-rise (9.3.3.3);
- b) dielectric properties (9.3.3.4);
- c) making and breaking capacities of switching elements under normal conditions (9.3.3.5);

- d) making and breaking capacities of switching elements under abnormal conditions (9.3.3.5);
- e) performance under conditional short-circuit current (9.3.4);
- f) constructional requirements (9.2);
- g) degree of protection of three-position enabling switches, if applicable (9.3.1);
- h) durability (9.3.3.6);
- i) shock and vibration (9.3.5).

9.1.3 Routine tests

Routine tests are the responsibility of the manufacturer and are usually limited to a mechanical inspection and a verification of the electromechanical operation.

The inspection shall be supplemented by a dielectric test which is carried out according to 9.3.3.4 with the following amendments: the required minimum duration of voltage application is reduced to 1 s and the metal foil and external terminal connections are unnecessary.

Additional routine tests for the three-position enabling switch may be specified as appropriate. A sampling plan may be accepted.

9.1.4 Sampling tests

Subclause 9.1.4 of IEC 60947-1:2020 applies.

9.1.5 Special tests

These tests are subject to agreement between manufacturer and user.

The manufacturer of the three-position-enabling device (user of the enabling switch) shall verify all necessary requirements of the application with the three-position-enabling device.

In cases where it is necessary to verify environmental conditions of damp heat, salt mist, vibration and shock, the tests shall be conducted according to Annex Q of IEC 60947-1:2020.

During the damp heat test and salt mist test, the enabling switch is assembled to an enabling device, or to a representative enclosure.

Reliability data for three-position enabling switches intended for use in functional safety applications shall be made available in accordance with Annex B.

9.2 Compliance with constructional requirements

9.2.1 General

Subclause 9.2 of IEC 60947-1:2020 applies except 9.2.6 and 9.2.7 and with the following additions.

9.2.2 Verification of operation of three-position enabling switches

The requirements of 8.1.16 are verified by operating the actuator while monitoring the state of the enabling contacts. The monitoring means shall be capable of detecting a contact closure longer than 0,2 ms.

Three-position operation shall be verified during test sequence VII of 9.3.1.

9.2.3 Verification of operation of actuator

The actuator shall withstand the maximum rated operating force specified by the manufacturer (see F_5 as defined in Figure 2) in the direction of normal operation.

This shall be verified during test sequence VII of 9.3.1.

9.3 Performance

9.3.1 Test sequences

The type and sequence of tests to be performed on representative samples are as follows.

- **Test sequence I** (sample No. 1)
 - Test No. 1 – Temperature rise (9.3.3.3)
 - Test No. 2 – Dielectric properties (9.3.3.4)
 - Test No. 3 – Mechanical properties of terminals (9.2.5 of IEC 60947-1:2020)
- **Test sequence II** (sample No. 2)
 - Test No. 1 – Making and breaking capacities of switching elements under normal conditions (8.3.3.5.3 of IEC 60947-5-1:2016)
 - Test No. 2 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence III** (sample No. 3)
 - Test No. 1 – Making and breaking capacities of switching elements under abnormal conditions (8.3.3.5.4 of IEC 60947-5-1:2016)
 - Test No. 2 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence IV** (sample No. 4)
 - Test No. 1 – Performance under conditional short-circuit current (9.3.4)
 - Test No. 2 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence V** (sample No. 5)
 - Test No. 1 – Degree of protection of three-position enabling switches (Annex C of IEC 60947-1:2020)
 - Test No. 2 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence VI** (sample No. 6)
 - Test No. 1 – Verification of clearances and creepage distances, if applicable (8.1.4)
 - Test No. 2 – Measurement of actuation force (or torque) (8.1.17, 9.2.2)
 - Test No. 3 – Verification of robustness of actuator (9.3.3.7)
- **Test sequence VII** (sample No. 7)
 - Test No. 1 – Verification of operation of three-position enabling switches (9.2.2)
 - Test No. 2 – Mechanical durability (9.3.3.6.2, 9.2.3)
 - Test No. 3 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)
 - Test No. 4 – Verification of operation of three-position enabling switches (9.2.2)
- **Test sequence VIII** (sample No. 8)
 - Test No. 1 – Electrical durability (9.3.3.6.3)
 - Test No. 2 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)
- **Test sequence IX** (sample No. 9)
 - Test No. 1 – Shock and vibration (9.3.5)
 - Test No. 2 – Dielectric verification (8.3.3.5.6 item b) of IEC 60947-5-1:2016)

There shall be no failure in any of the above tests.

More than one test sequence or all test sequences may be conducted on one sample at the request of the manufacturer. However, the tests shall be conducted in the sequence given for each sample above.

NOTE 1 For class II three-position enabling switches insulated by encapsulation, additional samples are used (see Annex F of IEC 60947-5-1:2016).

NOTE 2 For three-position enabling switches with integrally connected cables, see Annex G of IEC 60947-5-1:2016.

For shock and vibration tests, the test shall be conducted on three samples, see 9.3.5.

9.3.2 General test conditions

9.3.2.1 General requirements

Subclause 9.3.2.1 of IEC 60947-1:2020 applies with the following addition.

The tests shall be performed with the actuator operated by a machine complying with the following:

- the operating machine shall apply the actuating force to the actuator in the direction of its motion;
- the maximum force exerted on the actuator shall not exceed F_4 (see Figure 2);
- at the moment when the switching operation occurs, the velocity of the part of the operating machine that contacts the actuator shall be between 0,05 m/s and 0,15 m/s;
- the mechanical connection between the operating machine and the actuator shall not impede the free motion of the actuator away from it.

9.3.2.2 Test quantities

Subclause 9.3.2.2 of IEC 60947-1:2020 applies except for 9.3.2.2.3.

9.3.2.3 Evaluation of test results

The condition of the three-position enabling switch after each test shall be checked by the verifications applicable to each test.

A three-position enabling switch is deemed to have met the requirements of this document if it meets the requirements of each test and/or test sequence as applicable.

9.3.2.4 Test report

Subclause 9.3.2.4 of IEC 60947-1:2020 applies.

9.3.3 Performance under no-load, normal load and abnormal load conditions

9.3.3.1 Operation

Subclause 9.3.3.1 of IEC 60947-1:2020 applies.

9.3.3.2 Vacant

9.3.3.3 Temperature rise

Subclause 8.3.3.3 of IEC 60947-5-1:2016 applies.

9.3.3.4 Dielectric properties

Subclause 8.3.3.4 of IEC 60947-5-1:2016 applies.

9.3.3.5 Making and breaking capacities

Subclause 8.3.3.5 of IEC 60947-5-1:2016 applies.

9.3.3.6 Durability

9.3.3.6.1 General

The three-position enabling switch shall successfully pass the mechanical and electrical durability tests described in 9.3.3.6.2 and 9.3.3.6.3.

Minimum test operations: 100 000 cycles

Recommended test operations: 0,1 – 0,3 – 1 – 3 – 10 – 30 – 100 million operations

9.3.3.6.2 Mechanical durability

The three samples (see 9.1) shall be subjected to the following test.

The test shall be performed for minimum 50 000 cycles of position 1 → 2 → 1 operation and minimum 50 000 cycles of position 1 → 2 → 3 → 1 operation. The actuator of a three-position enabling switch shall be subjected to the forces necessary to achieve the required positions.

The maximum rated operating force specified by the manufacturer (see F_5 as defined in Figure 2) is applied at position 3.

The movement and actuating forces of the three-position enabling switch shall be consistent throughout the test. This shall be verified by measurement before and after the tests.

The mechanical durability of the three-position enabling switch is defined as the number of no-load operating cycles which will be attained by all samples tested without repair or replacement of any part.

Tests shall be carried out according to C.1.2 of IEC 60947-5-1:2016.

During the test, the enabling contacts shall be checked at each change of state by the manufacturer at the conditions described below, and there shall be no failure.

Test voltage and current: 24 V DC, 10 mA maximum.

Test method: The agreement of switch position and enabling contact status shall be checked at every position before shifting to the next position.

The enabling contact status shall be checked at each position. The three-position enabling switch shall be shifted to the next position only when the agreement of switch position and contact status has been confirmed. When any disagreement of position and contact status is found, tests shall be stopped.

Position 1: enabling contacts open



Position 2: enabling contacts closed



Position 3: enabling contacts open



Position 3 – Position 1: enabling contacts open

Failure criteria:

During the tests, there shall be no electrical and/or mechanical failures. Following the tests, the switching element shall pass the dielectric test of 8.3.3.4 of IEC 60947-5-1:2016 with a test voltage equal to $2 U_e$ with a minimum of 1 000 V.

9.3.3.6.3 Electrical durability

The test conditions are those of 9.3.3.6.2 except that the circuit of the switch is energized according to the manufacturer's specified ratings in accordance with 6.1, item g).

9.3.3.7 Robustness

The actuator shall withstand a force of 150 % of the maximum rated operating force specified by the manufacturer (see F_5 as defined in Figure 2), applied three times in the direction of normal operation in a manner simulating human action.

9.3.4 Performance under conditional short-circuit current

Subclause 8.3.4 of IEC 60947-5-1:2016 applies.

9.3.5 Shock and vibration tests

9.3.5.1 Conditioning procedures

The purpose of the following procedures is to expose the three-position enabling switches to various environmental conditions in order to verify their functioning after such exposure.

The three three-position enabling switches shall be subjected to the following exposures:

- 96 h at +40 °C in dry atmosphere according to test Bb of IEC 60068-2-2;
- 96 h at +5 °C according to test Ab of IEC 60068-2-1.

Following the environmental exposures and after the samples have been restored to room temperature, the sequence of tests in 9.3.5.2 and 9.3.5.3 shall be conducted.

9.3.5.2 Shock

The three three-position enabling switches that have been conditioned in accordance with 9.3.5.1 shall be tested in each of the three mutually perpendicular axes.

Each three-position enabling switch is tested in position 1 and shall withstand 15 g shock in both directions of each axis according to IEC 60068-2-27: 11 ms – 15 g.

During the test, no closed contacts shall open and no open contacts shall close.

The monitoring means shall be able to detect any opening or closing of contacts longer than 0,2 ms.

9.3.5.3 Vibration

The three samples used for 9.3.5.2 shall be tested, in accordance with IEC 60068-2-6, with the following conditions, in each of the three mutually perpendicular axes:

- frequency range: 10 Hz to 55 Hz;
- amplitude: 0,5 mm;
- sweep cycle duration: 5 min;
- duration at resonant frequency or at 55 Hz: 30 min in each of the three axes (90 min in total).

During the test, no closed contacts shall open and no open contacts shall close.

The monitoring means shall be able to detect any opening or closing of contacts longer than 0,2 ms.

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Annex A (informative)

Example of enabling devices incorporating a three-position enabling switch

Figure A.1 to Figure A.8 show enabling devices incorporating three-position enabling switches.

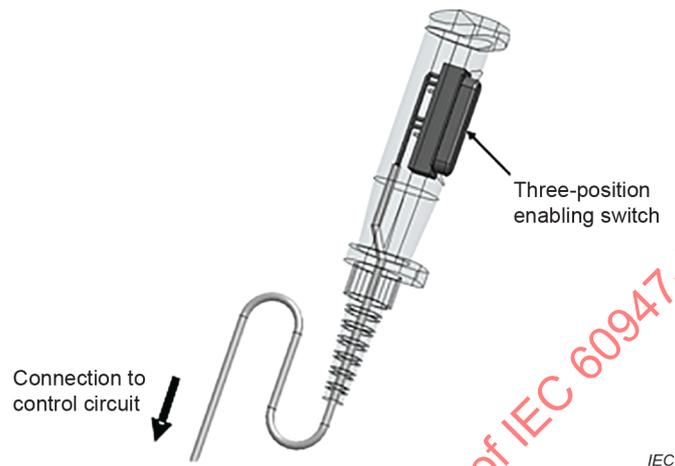


Figure A.1 – Grip type enabling device

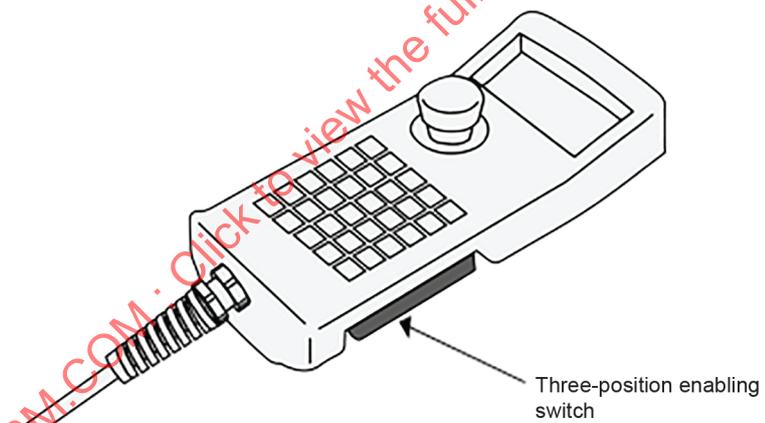
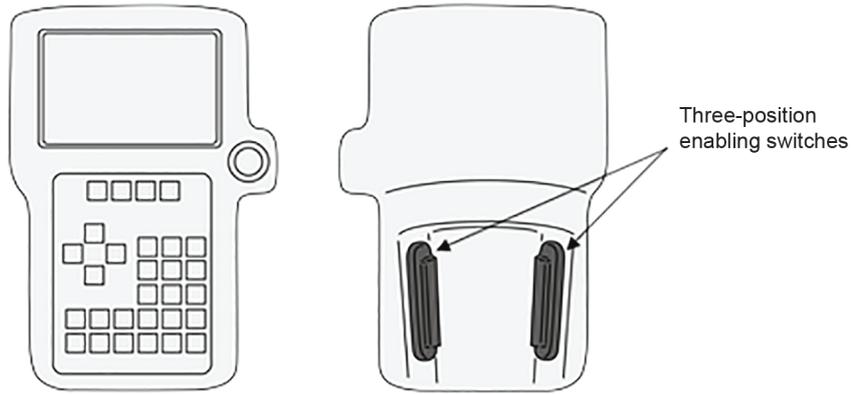
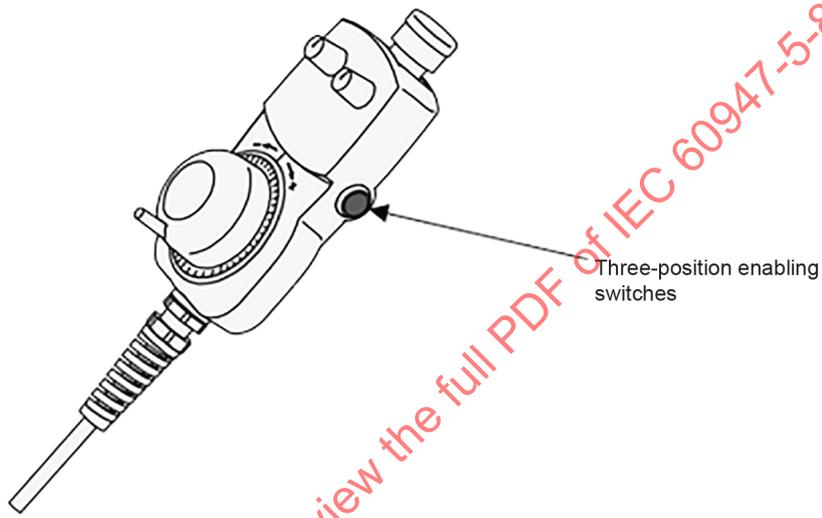


Figure A.2 – One hand teaching pendant type enabling device



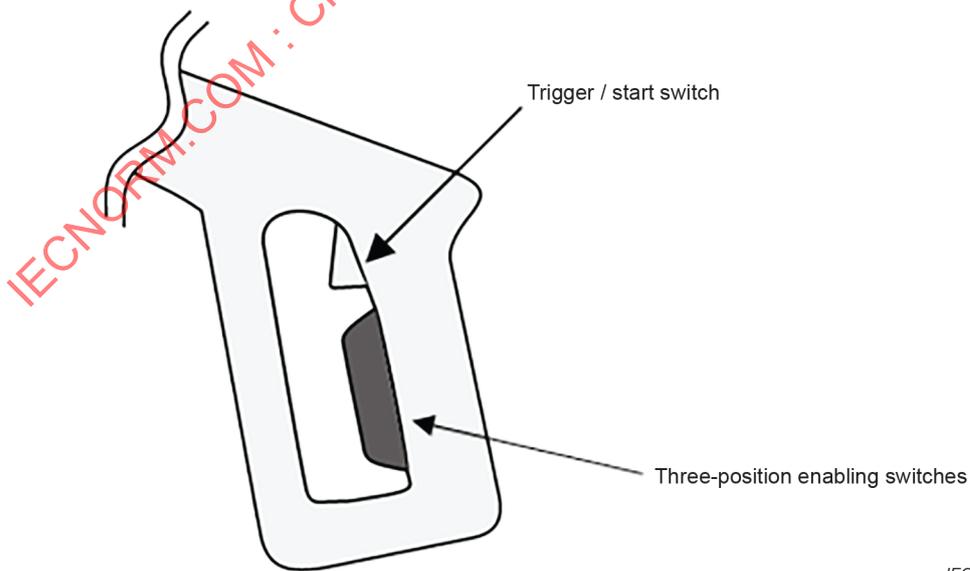
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Figure A.3 – Two hand teaching pendant type enabling device



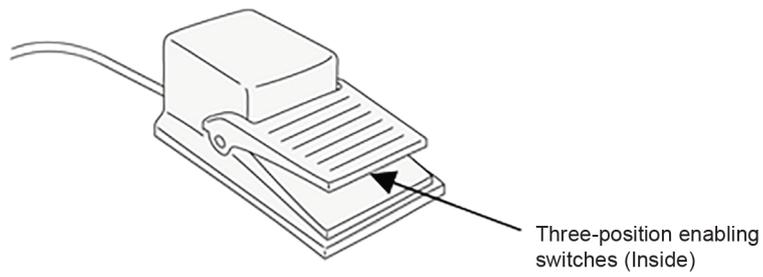
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Figure A.4 – Manual pulse generator



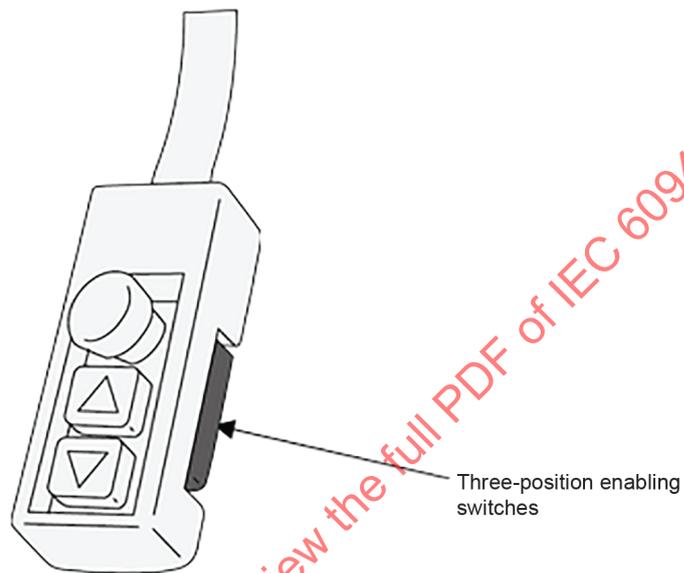
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Figure A.5 – Grip type enabling device for hand-held machine



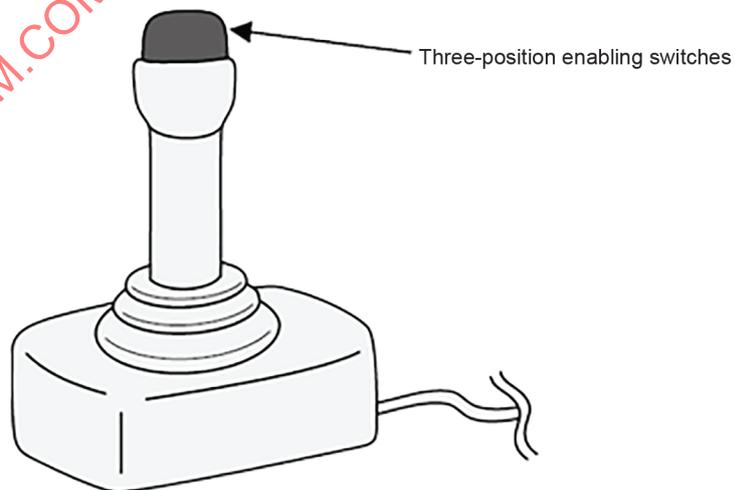
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Figure A.6 – Foot actuated enabling device



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Figure A.7 – Hoist controller



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Figure A.8 – Joystick type enabling device

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Annex B (normative)

Procedure to determine reliability data for three-position enabling switches used in functional safety applications

B.1 General

B.1.1 Object

Subclause K.1.2 of IEC 60947-1:2020 applies with the following addition:

This annex only addresses the electromechanical contacts in three-position enabling switches intended for use in functional safety applications.

EXAMPLE The intended use for enabling contacts is to open the circuit.

B.1.2 General requirements

Subclause K.1.3 of IEC 60947-1:2020 applies.

B.2 Terms, definitions and symbols

Clause K.2 of IEC 60947-1:2020 applies.

B.3 Method based on durability test results

Clause N.3 of IEC 60947-5-1:2016 applies.

B.4 Data information

Clause K.4 of IEC 60947-1:2020 applies.

B.5 Examples

Clause K.5 of IEC 60947-1:2020 applies.

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Bibliography

IEC 60050-441:1984, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses*
IEC 60050-441:1984/AMD1:2000

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

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

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWF) test method for materials*
IEC 60695-2-12:2010/AMD1:2014

IEC 60947-5-5:1997, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function*

IEC 60947-5-5:1997/AMD1:2005

IEC 60947-5-5:1997/AMD2:2016

ISO 7000, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

APPAREILLAGE À BASSE TENSION –

Partie 5-8: Appareils et éléments de commutation pour circuits de commande – Interrupteurs de commande de validation à trois positions

AVANT-PROPOS

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La Norme internationale IEC 60947-5-8 a été établie par le sous-comité 121A: Appareillage à basse tension, du comité d'études 121 de l'IEC: Appareillages et ensembles d'appareillages basse tension.

Cette deuxième édition annule et remplace la première édition parue en 2006. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) en raison du nombre croissant d'applications utiles possibles avec les interrupteurs de commande de validation à trois positions, le domaine d'application, les caractéristiques de fonctionnement et les essais sont revus;

- b) des figures représentant des exemples d'appareils incorporant un interrupteur de commande de validation sont ajoutées dans l'Annexe A;
- c) une nouvelle Annexe B est ajoutée, incluant une procédure visant à déterminer des données de fiabilité pour l'interrupteur utilisé dans des applications de sécurité fonctionnelle.

Le texte de ce document est issu des documents suivants:

FDIS	Rapport de vote
121A/358/FDIS	121A/369/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de ce document.

La version française de la norme n'a pas été soumise au vote.

Il convient que le présent document soit utilisé conjointement avec l'IEC 60947-1:2020 et l'IEC 60947-5-1:2016.

Les dispositions des règles générales, données dans l'IEC 60947-1, s'appliquent à la présente norme, lorsque celle-ci le précise. Les articles et paragraphes des règles générales ainsi rendus applicables, ainsi que les tableaux, figures et annexes, sont identifiés par référence à l'IEC 60947-1, par exemple 1.2.3 ou Annexe A de l'IEC 60947-1:2020.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60947, publiées sous le titre général *Appareillage à basse tension*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
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APPAREILLAGE À BASSE TENSION –

Partie 5-8: Appareils et éléments de commutation pour circuits de commande – Interrupteurs de commande de validation à trois positions

1 Domaine d'application

La présente partie de la série IEC 60947 spécifie les exigences pour les interrupteurs de commande de validation à trois positions.

Ces interrupteurs sont utilisés comme composants dans les appareils de commande de validation pour fournir des signaux qui:

- a) lorsqu'ils sont activés, permettent la mise en marche de la machine par une commande séparée de démarrage; et
- b) lorsqu'ils sont désactivés:
 - initient une fonction d'arrêt; et
 - évitent la mise en marche de la machine.

NOTE 1 La fonction de commande de validation est décrite en 9.2.3.9 de l'IEC 60204-1:2016 mais l'application d'interrupteurs de commande de validation à trois positions n'est pas limitée à un composant de l'appareil de commande de validation décrit dans l'IEC 60204-1.

NOTE 2 Le présent document ne traite pas des appareils de commande de validation.

Ces interrupteurs sont destinés à être connectés aux circuits dont la tension assignée ne dépasse pas 250 V en courant alternatif 50 Hz/60 Hz ou 300 V en courant continu.

Exemples d'appareils incorporant des interrupteurs de commande de validation à trois positions:

- boutons-poussoirs de commande de validation,
- poignée de commande de validation,
- pédale de commande de validation.

Voir l'Annexe A pour plus d'exemples types.

Le présent document ne s'applique pas aux:

- interrupteurs de commande de validation à trois positions pour des circuits de commande non électriques, par exemple hydrauliques, pneumatiques,
- interrupteurs de commande de validation sans mécanisme à trois positions,
- appareils d'arrêt d'urgence (voir l'IEC 60947-5-5).

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-1:2007, *Essais d'environnement — Partie 2-1: Essais — Essai A: Froid*

IEC 60068-2-2:2007, *Essais d'environnement — Partie 2-2: Essais — Essai B: Chaleur sèche*

IEC 60068-2-6:2007, *Essais d'environnement — Partie 2-6: Essais — Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-27:2008, *Essais d'environnement — Partie 2-27: Essais — Essai Ea et guide: Chocs*

IEC 60947-1:2020, *Appareillage à basse tension — Partie 1: Règles générales*

IEC 60947-5-1:2016, *Appareillage à basse tension — Partie 5-1: Appareils et éléments de commutation pour circuits de commande – Appareils électromécaniques pour circuits de commande*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions donnés dans l'Article 3 de l'IEC 60947-1:2020 et l'Article 2 de l'IEC 60947-5-1:2016 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>;
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>.

Index alphabétique des définitions

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O	
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3.1

appareil de commande de validation

appareil de commande manuelle utilisé en conjonction avec une commande démarrage et qui permet la mise en marche d'une machine, lorsqu'il est activé de manière continue

3.2

interrupteur de commande de validation à trois positions

interrupteur à trois positions disposant d'un ou plusieurs contacts de commande de validation

3.3

mécanisme transmetteur

<d'un interrupteur de commande de validation à trois positions> ensemble des parties mécaniques qui transmettent l'effort de manœuvre aux éléments de contact

[SOURCE: IEC 60050-441:2000, 441-15-21, modifié – Remplacement de "(d'un auxiliaire de commande)" par "<d'un interrupteur de commande de validation à trois positions>"; remplacement de "ensemble des moyens de manœuvre d'un auxiliaire de commande" par "ensemble des parties mécaniques"; suppression de la note à l'article.]

3.4

organe de commande

<d'un interrupteur de commande de validation à trois positions> partie du mécanisme transmetteur qui est activée par une partie du corps humain

EXEMPLE Un bouton.

3.5

contact auxiliaire

contact d'un interrupteur de commande de validation à trois positions qui fournit une fonction auxiliaire

Note 1 à l'article: Les contacts auxiliaires peuvent être normalement ouverts et/ou normalement fermés.

3.6

contact de commande de validation

contact pour l'interrupteur de commande de validation à trois positions, fermé lorsque l'organe de commande est dans la position intermédiaire (partiellement enfoncé, position 2 représentée à la Figure 1) et ouvert lorsque l'organe de commande est dans la position repos (non enfoncé, position 1 représentée à la Figure 1) et dans la position totalement enfoncée (position 3 représentée à la Figure 1)

4 Classification

4.1 Eléments de contact

Le paragraphe 3.1 de l'IEC 60947-5-1:2016 s'applique.

4.2 Interrupteur de commande de validation à trois positions

Les interrupteurs de commande de validation à trois positions peuvent être classés en fonction de leur élément de contact et de la nature de leur mécanisme transmetteur, par exemple interrupteurs de commande de validation à trois positions, forme B.

5 Caractéristiques

5.1 Enumération des caractéristiques

5.1.1 Généralités

Le paragraphe 4.1.1 de l'IEC 60947-5-1:2016 s'applique, à l'exception du type d'équipement suivant (voir 5.2).

5.1.2 Fonctionnement d'un interrupteur de commande de validation

Le paragraphe 4.1.2 de l'IEC 60947-5-1:2016 s'applique.

5.2 Type d'interrupteur de commande de validation à trois positions

5.2.1 Nombre de pôles

Le nombre de pôles doit être déclaré par le fabricant.

5.2.2 Nature du courant

Courant alternatif ou courant continu.

5.3 Valeurs assignées et valeurs limites pour les éléments de commutation

Le paragraphe 4.3 de l'IEC 60947-5-1:2016 s'applique.

5.4 Catégories d'emploi des éléments de commutation

Le paragraphe 4.4 de l'IEC 60947-5-1:2016 s'applique.

5.5 Disponible

5.6 Disponible

5.7 Disponible

5.8 Disponible

5.9 Disponible

5.10 Séparation électrique des éléments de contact

Le paragraphe 4.10 de l'IEC 60947-5-1:2016 s'applique.

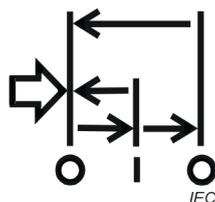
6 Informations sur le matériel

6.1 Nature des informations

Les informations suivantes doivent être données par le fabricant:

Identification

- Nom du fabricant ou marque de fabrique.
- Désignation du type ou numéro de série permettant d'obtenir les renseignements relatifs à l'élément de commutation (ou à l'auxiliaire de commande complet) auprès du fabricant.
- Mention "IEC 60947-5-8" si le fabricant déclare la conformité au présent document.
- Les interrupteurs de commande de validation à trois positions doivent être marqués d'une manière indélébile et lisible par le symbole suivant:



NOTE Si, pour des raisons de taille, il n'est pas possible d'apposer le marquage sur l'interrupteur, alors le symbole peut être inséré dans les instructions d'installation, de fonctionnement et d'entretien.

Valeurs assignées et emplois fondamentaux

- e) Efforts de manœuvre et course de l'organe de commande.
- f) Tension(s) assignée(s) d'emploi (voir 4.3.2.2 de l'IEC 60947-5-1:2016).
- g) Catégorie d'emploi et courants assignés d'emploi aux tensions assignées d'emploi de l'élément de commutation.
- h) Tension assignée d'isolement (voir 4.3.2.3 de l'IEC 60947-5-1:2016).
- i) Tension assignée de tenue aux chocs U_{imp} conformément à 5.3.1.3 de l'IEC 60947-1:2020.
- j) Code IP (voir Annexe C de l'IEC 60947-1:2020).
- k) Degré de pollution (voir 6.1.3.2 de l'IEC 60947-5-1:2016).
- l) Type et valeurs maximales des caractéristiques assignées des dispositifs de protection contre les courts-circuits (voir 8.3.4.3 de l'IEC 60947-5-1:2016).
- m) Courant de court-circuit conditionnel, s'il est inférieur à 1 000 A.
- n) Indication des éléments de contact de même polarité.
- o) Durabilité mécanique et/ou électrique.

6.2 Marquage

6.2.1 Généralités

Le marquage des données spécifiées aux points a), b), c) et d) de 6.1 est obligatoire sur la plaque signalétique de l'interrupteur de commande de validation à trois positions, de manière à pouvoir obtenir des informations complètes auprès du fabricant.

Le marquage doit être indélébile et facilement lisible, et ne doit pas être placé sur des vis et sur des parties facilement démontables.

Lorsqu'il y a une place suffisante, les données des points e) à o) de 6.1 doivent figurer sur la plaque signalétique, ou sur l'interrupteur de commande de validation à trois positions ou alors dans les documents publiés par le fabricant.

6.2.2 Identification et marquage des bornes

Le paragraphe 5.2.2 de l'IEC 60947-5-1:2016 s'applique.

6.2.3 Repères de fonction

Pour éviter toute confusion avec les appareils d'arrêt d'urgence, l'organe de commande d'un interrupteur de commande de validation ne doit pas être coloré en rouge (voir l'IEC 60204-1).

6.3 Instructions d'installation, de fonctionnement et d'entretien

Le paragraphe 6.3 de l'IEC 60947-1:2020 s'applique avec les ajouts suivants.

Les fabricants sont encouragés à utiliser des symboles graphiques définis dans les Normes internationales. L'ISO 7000 et l'IEC 60417 en sont des exemples.

EXEMPLE Les symboles suivants peuvent être utilisés pour représenter une "personne qualifiée".

**IEC 60417-6182 (2013-09)**

Installation, expertise électrotechnique

**IEC 60417-6183 (2013-09)**

Installation, expertise mécanique

6.4 Informations supplémentaires

Le paragraphe 5.4 de l'IEC 60947-5-1:2016 s'applique.

7 Conditions normales de service, de montage et de transport

7.1 Généralités

L'Article 7 de l'IEC 60947-1:2020 s'applique avec les ajouts suivants.

7.1.3.2 Degré de pollution

Un interrupteur de commande de validation est destiné à être installé dans les conditions d'environnement du degré de pollution 3. S'il peut être démontré qu'un microenvironnement d'appareil auquel l'interrupteur de commande de validation (ou une partie de celui-ci) est exposé présente un degré de pollution autre que le degré de pollution 3, alors le degré de pollution de l'interrupteur de commande de validation peut être adapté.

7.3 Montage

Les moyens doivent être fournis pour permettre à l'interrupteur de commande de validation à trois positions d'être installé de façon sûre dans sa position de montage prévue.

7.4 Application spéciale

Des conditions d'environnement (par exemple l'humidité, une atmosphère corrosive, des rayonnements ultraviolets) peuvent demander des exigences supplémentaires.

8 Dispositions relatives à la construction et au fonctionnement

8.1 Dispositions relatives à la construction

8.1.1 Généralités

Le paragraphe 8.1.1 de l'IEC 60947-1:2020 s'applique.

8.1.2 Matériaux

8.1.2.1 Exigences générales relatives aux matériaux

Le paragraphe 7.1.2.1 de l'IEC 60947-5-1:2016 s'applique.

8.1.2.2 Essai au fil incandescent

Le paragraphe 7.1.2.2 de l'IEC 60947-5-1:2016 s'applique.

8.1.2.3 Essai basé sur la catégorie d'inflammabilité

Le paragraphe 7.1.2.3 de l'IEC 60947-5-1:2016 s'applique.

8.1.2.4 Effets biologiques et chimiques

Dans le cadre d'un accord entre fabricant et utilisateur, le fabricant peut fournir une liste des matériaux appropriés afin que l'utilisateur puisse vérifier si le produit convient à l'application.

NOTE 1 Des exigences supplémentaires peuvent être utilisées pour des applications/branches spéciales, par exemple pour le secteur des aliments et boissons, l'industrie chimique, le secteur naval.

NOTE 2 Les interrupteurs de commande de validation à trois positions peuvent être utilisés pour des applications au sein desquelles un opérateur humain est susceptible d'être en contact avec l'appareil pendant de longues périodes, à mains nues. Une attention particulière peut être accordée aux effets chimiques et biochimiques en cas de contact corporel avec des matériaux émettant des substances une fois touchés, par exemple les hydrocarbures aromatiques polycycliques (HAP).

8.1.3 Parties transportant le courant et leurs connexions

Le paragraphe 7.1.3 de l'IEC 60947-5-1:2016 s'applique.

8.1.4 Distances d'isolement et lignes de fuite

Le paragraphe 8.1.4 de l'IEC 60947-1:2020 s'applique.

8.1.5 Organe de commande

8.1.5.1 Isolement

Le paragraphe 8.1.5.1 de l'IEC 60947-1:2020 s'applique.

8.1.5.2 Direction du mouvement

Le paragraphe 8.1.5.2 de l'IEC 60947-1:2020 s'applique.

8.1.5.3 Effort de manœuvre (ou couple)

L'effort (ou le couple) exigé pour actionner l'organe de commande doit être compatible avec l'usage prévu, en prenant en considération la taille de l'organe de commande, le type de l'enveloppe ou du panneau, l'environnement de l'installation et l'usage auquel elle est destinée.

Voir 8.1.17 pour l'effort de manœuvre de chaque opération.

8.1.6 Indication de la position de contact

Le paragraphe 8.1.6 de l'IEC 60947-1:2020 s'applique.

8.1.7 Disponible

8.1.8 Bornes

Le paragraphe 8.1.8 de l'IEC 60947-1:2020 s'applique.

8.1.9 Disponible

8.1.10 Dispositions pour assurer la mise à la terre de protection