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Responsible committee: PEL/121/1 Low voltage switchgear and controlgear

Interested committees:

Title: Draft BS EN IEC 60947-5-1 Low-voltage switchgear and controlgear

Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices

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- iii) requires additional national guidance or information

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Responsible Committee Secretary: **Mr Simon Bounds (BSI)**Direct tel: **0208 996 7281**E-mail: simon.bounds@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



121A/330/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 60947-5-1 ED5

DATE OF CIRCULATION:

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SUPERSEDES DOCUMENTS:

121A/328/RR

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

SECRETARIAT:

France

SECRETARY:

Mr Eric Bettega

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 44, TC 94

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☒ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

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Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices

NOTE FROM TC/SC OFFICERS:

SC121A Officers support circulation of CD1 for project IEC 60947-5-1 future ED5.

Secretary note about references to future IEC 60947-1 ED6: for the time being this CD has to be read in conjunction with 121A/223/CDV. However, FDIS for 60947-1 ED1 should be circulating in near future, superseding 121A/223/CDV.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 5-1: Control circuit devices and switching elements –
Electromechanical control circuit devices**

FOREWORD

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International Standard IEC 60947-5-1 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 fifth edition cancels and replaces the fourth edition published in 2016 and its Corrigendum 1:2016. This edition constitutes a technical revision.

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

- update of the scope structure and exclusions;
- requirements for control circuits;
- update of the normal service conditions (e.g. shock and vibration);

- update of information and marking requirements including environmental information requirements referencing Annexes O and W of IEC 60947-1: —¹;
- update of the constructional requirements and the corresponding tests considering safety aspects (e.g. artificial optical radiation, safety related security, limited energy source, stored charge energy circuit);
- update of the EMC requirements according to the basic safety standards;
- requirements for Class II circuit devices achieved by double or reinforced insulation in Annex F;
- update of pull-out tests in Annex G;
- information requirements for audible signalling device in Annex J;
- insertion of new Annex O (Additional requirements for control circuit devices incorporating a built-in communication interface complying with IEC 61131-9).

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

FDIS	Report on voting
121A/XXX/FDIS	121A/XXX/RVD

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

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

This International Standard should be used in conjunction with IEC 60947-1.

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, Table 4 or Annex A of IEC 60947-1: —.

The following differing practices of a less permanent nature exist in the countries indicated below.

- 8.2.4.1: Making and breaking capacities (United States of America and Canada)
- 9.3.3.5.2: Test circuits and connections (United States of America and Canada)

A list of all the 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 publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

Secretary note: for reader's convenience, essential updates regarding IEC 60947-5-1:2016+CORR1 2016 have been highlighted in blue colour.

¹ Sixth edition under preparation. Stage at time of circulation: RFDIS.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices

1 Scope

This part of IEC 60947 applies to control circuit devices and switching elements intended for controlling, signalling, interlocking, etc., of switchgear and controlgear.

It applies to control circuit devices having a rated voltage not exceeding 1 000 V AC (at a frequency not exceeding 1 000 Hz) or 600 V DC.

However, for operational voltages below 100 V AC or DC, see 5.3.2.2.

This document applies to specific types of control circuit devices such as:

- manual control switches, for example push-buttons, rotary switches, foot switches, etc.;
- electromagnetically operated control switches, either time-delayed or instantaneous, for example contactor relays;
- pilot switches, for example pressure switches, temperature sensitive switches (thermostats), programmers, etc.;
- position switches, for example control switches operated by part of a machine or mechanism;
- associated control circuit equipment, for example indicator lights, etc.

NOTE 1 A control circuit device includes (a) control switch(es) and associated devices such as (an) indicator light(s).

NOTE 2 A control switch includes (a) switching element(s) and an actuating system.

NOTE 3 A switching element can be a contact element or a semiconductor element.

It also applies to specific types of switching elements associated with other devices (whose main circuits are covered by other standards) such as:

- auxiliary contacts of a switching device (e.g. contactor, circuit breaker, etc.) which are not dedicated exclusively for use with the coil of that device;
- interlocking contacts of enclosure doors;
- control circuit contacts of rotary switches;
- control circuit contacts of overload relays.

Contactor relays also comply with the requirements and tests of IEC 60947-4-1 except for the utilization category which comply with this standard.

This document does not apply to:

- relays covered in IEC 60255 or in IEC 61810 series;
- automatic electrical control devices for household and similar purposes;
- colour requirements of indicator lights, push-buttons, etc. These are given in IEC 60073 and also in CIE S004/E-2001;
- the use of control circuit devices and switching elements with additional measure within explosive atmospheres. These are given in IEC 60079 series;
- embedded software design rules, where IEC TR 63201 gives guidance.

The object of this document is to state for control circuit devices and switching elements:

- definitions;
- classification;
- characteristics;
- product information;
- normal service, mounting and transport conditions;
- constructional, product safety and performance requirements;
- tests to verify the requirements and the rated characteristics.

Products covered by the scope of this document are expected to be selected, installed, and maintained by skilled personnel only.

2 Normative references

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

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

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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 60730-1, *Automatic electrical controls - Part 1: General requirements*

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

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

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

- 736 IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements*
737 *for screw-type and screwless-type clamping units – Part 1: General requirements and*
738 *particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm²*
739 *(included)*
- 740 IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measure-*
741 *ment techniques – Electrostatic discharge immunity test*
- 742 IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and*
743 *measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
744 IEC 61000-4-3:2006/AMD1:2007
745 IEC 61000-4-3:2006/AMD2:2010
- 746 IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and*
747 *measurement techniques – Electrical fast transient/burst immunity test*
- 748 IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and*
749 *measurement techniques – Surge immunity test*
750 IEC 61000-4-5:2014/AMD1:2017
- 751 IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and*
752 *measurement techniques – Immunity to conducted disturbances, induced by radio-frequency*
753 *fields*
- 754 IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measure-*
755 *ment techniques – Power frequency magnetic field immunity test*
- 756 IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and*
757 *measurement techniques – Voltage dips, short interruptions and voltage variations immunity*
758 *tests*
759 IEC 61000-4-11:2004/AMD1:2017
- 760 IEC 61140:2016, *Protection against electric shock – Common aspects for installation and*
761 *equipment*
- 762 IEC 62443 (series), *Industrial communication networks - Network and system security*
- 763 IEC 62471 (all parts), *Photobiological safety of lamps and lamp systems*
- 764 IEC TR 62471-2:2009, *Photobiological safety of lamps and lamp systems - Part 2: Guidance*
765 *on manufacturing requirements relating to non-laser optical radiation safety*
- 766 CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance*
767 *characteristics – Limits and methods of measurement*
768 CISPR 11:2015/AMD1:2016
769 CISPR 11:2015/AMD2:2019
- 770 ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: sampling*
771 *schemes indexed by acceptance quality limit AQL) for lot-by-lot inspection*
- 772 ISO 14159, *Safety of machinery — Hygiene requirements for the design of machinery*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

3.1.1 General

For the purposes of document, the terms and definitions given in Clause 3 of IEC 60947-1:—, as well as the following terms, definitions, symbols and abbreviations 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>

3.1.2 Basic terms and definitions

3.1.2.1

control circuit device

an electrical device intended for the controlling, signalling, interlocking, etc., of switchgear and controlgear

Note 1 to entry: Control circuit devices can include associated devices dealt with in other standards, such as instruments, potentiometers, relays, in so far as associated devices are used for the purposes specified above.

3.1.2.2

control switch (for control and auxiliary circuits)

a mechanical switching device which serves the purpose of controlling the operation of switchgear or controlgear, including signalling, electrical interlocking, etc.

Note 1 to entry: A control switch consists of one or more contact elements with a common actuating system.

Note 2 to entry: A control switch may include semiconductor elements or contact elements (see 3.1.5.2 and 3.1.5.3).

[SOURCE: IEC 60050-441:1984, 441-14-46, modified – Addition of a new Note 2 to entry.]

3.1.2.3

control switch suitable for isolation

a control switch which, in the open position, complies with the requirements specified for the isolating function (see 3.3.19 and 8.1.7 of IEC 60947-1:—)

Note 1 to entry: Such control switches are intended to provide a higher degree of safety to personnel when working on the equipment controlled. For this reason, they have to be manually actuated relying on the intelligence of instructed persons to react in case they would fail to operate, e.g. in case of insufficiently opened contacts.

3.1.2.4

control station

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

Note 1 to entry: A control station panel or enclosure may also contain related equipment, e.g. potentiometers, signal lamps, instruments, etc.

[SOURCE: IEC 60050-441:1984, 441-12-08]

3.1.2.5

limited energy source

source that is designed and protected that, under both normal operating conditions and single fault conditions, the current that can be delivered is not hazardous with respect to fire hazard

[SOURCE: IEC 60947-4-1:2018]

3.1.2.6**single fault condition**

condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or a device one means of protection against hazards is defective, or one fault is present which could cause a hazard

Note 1 to entry: If a single fault condition results in one or more other fault conditions, all are considered as one single fault condition.

[SOURCE: IEC Guide 104, 3.8]

3.1.3 Terms and definitions concerning automatic control switches

NOTE: Automatic control switches are operated by automatic control (see 3.6.5 of IEC 60947-1:—). They are also designated as *pilot switches* (see 3.4.18 of IEC 60947-1:—).

3.1.3.1**instantaneous contactor relay**

a contactor relay operating without any intentional time delay

Note 1 to entry: Unless otherwise stated, a contactor relay is an instantaneous contactor relay.

[SOURCE: IEC 60050-441:1984, 441-14-36]

3.1.3.2**time-delay contactor relay**

a contactor relay with specified time-delay characteristics

Note 1 to entry: The time-delay may be associated with energization (*e*-delay) or with de-energization (*d*-delay) or both.

Note 2 to entry: A time-delay contactor relay may also incorporate instantaneous contact elements.

[SOURCE: IEC 60050-441:1984, 441-14-37, modified – addition of a new Note 2 to entry.]

3.1.3.3**position switch**

a pilot switch the actuating system of which is operated by a moving part of the machine, when this part reaches a predetermined position

[SOURCE: IEC 60050-441:1984, 441-14-49]

3.1.3.4**programmer**

a control switch having a multiplicity of switching elements which, after initiation, operates in a defined sequence

3.1.4 Terms and definitions concerning manually operated control switches

Note 1 to entry: Manually operated control switches are operated by manual control (see 3.6.4 of IEC 60947-1:—).

3.1.4.1**push-button**

a control switch having an actuator intended to be operated by force exerted by a part of the human body, usually the finger or palm of the hand, and having stored energy (spring) return

[SOURCE: IEC 60050-441:1984, 441-14-53]

3.1.4.2**pull-button**

a control switch having an actuator intended to be operated by manual pull, and having stored energy (spring) return

3.1.4.3**push-pull button**

a control switch having an actuator intended to be operated by manual push and returned to its initial position by manual pull, or vice versa

Note 1 to entry: There are also «push-push» or «push-turn» or other combinations of buttons.

3.1.4.4**rotary button**

a combination of push-button type switching elements having an actuator operated by a manual rotation (see also 3.1.4.15 to 3.1.4.18 inclusive)

EXAMPLE A selector switch.

Note 1 to entry: A rotary push-button may have more than two positions; it may or may not have a spring return.

3.1.4.5**latched push-button**

a push-button with spring return, but which remains in the actuated position until a latch is released by a separate action

Note 1 to entry: The latching may be released by subsequent actuation (such as pushing, turning, etc.) of the same or of an adjacent push-button or by the action of an electromagnet, etc.

3.1.4.6**locked push-button**

a push-button which may be secured in one or more of its positions by a separate action

Note 1 to entry: The locking may be obtained by turning the button, by turning a key, by operating a lever, etc.

3.1.4.7**key-operated push-button**

a push-button which can only be operated as long as a key remains inserted

Note 1 to entry: Key withdrawal may be provided at any position.

3.1.4.8**time-delay push-button**

a push-button the contacts of which return to the initial position only after a pre-determined interval of time following the release of the actuating force

3.1.4.9**delayed action push-button**

a push-button in which the switching operation does not occur until after the force on the button has been maintained for a pre-determined interval of time

3.1.4.10**illuminated push-button**

a push-button incorporating a signalling lamp in the button

3.1.4.11**covered push-button**

a push-button in which the button is protected against inadvertent operation by a lid or a cover

3.1.4.12**shrouded push-button**

a push button in which the button is protected against inadvertent operation in certain directions

3.1.4.13**free push-button**

a push-button in which the rotation of the actuator around its axis is not limited

3.1.4.14**guided push-button**

a push-button in which the rotation of the actuator around its axis is prevented

Note 1 to entry: Examples of guided push-buttons: the actuators of which are keyed, square or rectangular, etc.

3.1.4.15**rotary control switch****rotary switch**

a control switch having an actuator intended to be operated by rotation

3.1.4.16**key-operated rotary switch**

a rotary switch where a key is used as the actuator

Note 1 to entry: Key withdrawal may be provided at any position.

3.1.4.17**limited movement rotary switch**

a rotary switch with a restricted angular movement of its actuator

3.1.4.18**unidirectional movement rotary switch**

a rotary switch in which the actuating system allows rotation in one direction only

3.1.4.19**joy stick**

a control switch having an actuator consisting of a pin or stick projecting essentially at a right angle from the panel or enclosure when in one of its positions and intended to be operated by angular displacement

Note 1 to entry: A joy stick may have more than two positions associated with different directions of the displacement of the stick and operating the contact elements differently: such a joy stick is referred to as a joy stick selector.

Note 2 to entry: The pin or stick may or may not have a spring return.

3.1.4.20**wobble stick**

a joy stick which operates all contact elements alike, whatever be the direction of the displacement

3.1.4.21**foot switch****pedal**

a control switch having an actuator intended to be operated by force exerted by a foot

[SOURCE: IEC 60050-441:1984, 441-14-52, modified – insertion of "force exerted by".]

3.1.5 Terms and definitions concerning parts of control switches**3.1.5.1****switching element**

a switching element may be a semiconductor element (see 3.1.5.2) or a contact element (see 3.1.5.3)

3.1.5.2**semiconductor element**

an element designed to switch the current of an electric circuit by means of the controlled conductivity of a semiconductor

3.1.5.3**contact element**

<control switch> the parts, fixed and movable, conducting and insulating, of a control switch necessary to close and open one single conducting path of a circuit

Note 1 to entry: The contact element and the actuating system may form an indivisible unit, but frequently one or more contact elements may be combined with one or more actuating system or systems. The actuating systems may be different.

Note 2 to entry: Terms and definitions relating to various kinds of single contact elements of a control switch are given in 3.1.5.4 to 3.1.5.13 inclusive.

Note 3 to entry: This definition does not include control coils and magnet systems.

3.1.5.4**single gap contact element**

a contact element which opens or closes the conducting path of its circuit on one location only

Note 1 to entry: See Figures 4 a) and 4 c).

3.1.5.5**double gap contact element**

a contact element which opens or closes the conducting path of its circuit in two locations in series

Note 1 to entry: See Figures 4 b), 4 d) and 4 e).

3.1.5.6**make-contact element****normally open**

a contact element which closes a conducting path when the control switch is actuated

3.1.5.7**break-contact element****normally closed**

a contact element which opens a conducting path when the control switch is actuated

3.1.5.8**change-over contact elements**

a contact element combination which includes one make-contact element and one break-contact element

Note 1 to entry: See Figures 4 c), 4 d) and 4 e).

3.1.5.9**pulse contact element****fleeting contact element**

a contact element which opens or closes a circuit for a part of the travel during the transition of the actuator from one position to another

3.1.5.10**electrically separated contact elements**

contact elements belonging to the same control switch, but adequately insulated from each other so that they can be connected into electrically separated circuits, which can be either same polarity or opposite polarity

[SOURCE: IEC 60050-441:1984, 441-15-24, modified – supplemented by polarity statement]

3.1.5.11**independent action contact element****snap action contact element**

a contact element of a manual or automatic control device in which the velocity of contact motion is substantially independent of the velocity of motion of the actuator

3.1.5.12**dependent action contact element**

a contact element of a manual or automatic control device in which the velocity of contact motion depends on the velocity of motion of the actuator

3.1.5.13**contact unit**

a contact element or contact element combination which can be combined with similar units operated by a common actuating system

3.1.5.14**button**

the external end of the actuator of a push-button, to which the actuating force is applied

3.1.5.15**flush-button**

a button which is substantially level with the adjacent fixed surrounding surface when in its initial position and is below this surface when it is operated

3.1.5.16**recessed button**

a button which is below the adjacent fixed surrounding surface in both its initial and operated positions

3.1.5.17**extended button**

a button which protrudes above the adjacent fixed surrounding surface both in its initial position and in its operated position

3.1.5.18**mushroom button**

a button, the protruding end of which has an enlarged diameter

3.1.5.19**locating mechanism**

<rotary switch> that part of the actuating system which retains the actuator and/or the contact elements in their positions

Note 1 to entry: Other devices (e.g. a push-button with two positions, or an emergency stop) can also have such a function.

3.1.5.20**end stop**

a device that limits the travel of a moving part

Note 1 to entry: An end stop may relate either to the actuator or to the contact element.

3.1.6 Terms and definitions concerning operation of contactor relays**3.1.6.1****e-delay**

<contact element> a delay in the operation of a contact element of a contactor relay, following the energization of the coil of the electromagnet of this contactor relay

EXAMPLE: Delay to close make-contacts (ON delay).

1042 Note 1 to entry: The terms 'e-delay" and "d-delay" may be applied to any kind of contact elements (see 3.1.5.3).

1043 **3.1.6.2**

1044 **d-delay**

1045 <contact element> a delay in the operation of a contact element of a contactor relay, following
1046 the de-energization of the coil of the electromagnet of this contactor relay

1047 EXAMPLE: Delay to open make-contacts (OFF delay)

1048 Note 1 to entry: The terms 'e-delay" and "d-delay" may be applied to any kind of contact elements (see 3.1.5.3).

1049 **3.1.6.3**

1050 **fixed delay**

1051 <contact element> a delay in the operation of a contact element of a contactor relay, which is
1052 not intended to be adjusted in value

1053 **3.1.6.4**

1054 **adjustable delay**

1055 <contact element> a delay in the operation of a contact element of a contactor relay, which is
1056 intended to be adjusted to different values after the installation of the contactor relay

1057 **3.1.7 Terms and definitions concerning operation of pilot switches**

1058 **3.1.7.1**

1059 **actuating quantity**

1060 the physical quantity, the value of which is decisive for the actuation or non-actuation of a
1061 pilot switch

1062 **3.1.7.2**

1063 **operating value**

1064 the value of the actuating quantity which is sufficient to cause a pilot switch to be actuated

1065 **3.1.7.3**

1066 **return value**

1067 the value of the actuating quantity which has to be re-established in order to cause an
1068 actuated pilot switch to return to its position of rest

1069 **3.1.7.4**

1070 **differential value**

1071 the difference between the operating value and the return value

1072 **3.1.8 Terms and definitions concerning operation of rotary switches**

1073 **3.1.8.1**

1074 **definite position** (of a rotary switch)

1075 a position into which the locating mechanism pulls the rotary switch and retains it as long as
1076 the actuating moment does not exceed a certain value

1077 **3.1.8.2**

1078 **position of rest**

1079 a stable (definite) position into which the locating mechanism tends to move back and retain
1080 the rotary switch by stored energy

1081 **3.1.8.3**

1082 **transit position**

1083 a (definite) position in which the locating mechanism produces an intended marked change in
1084 the operating moment, but in which the actuator cannot remain by itself

3.1.8.4**biased position**

a (definite) position of a rotary switch in which the actuator is pulled against a stop from which it will return to a position of rest by means of stored energy (for example, by means of a spring)

Note 1 to entry: During the transfer from a biased position to the adjacent position of rest, the rotary switch may pass through one or more transit positions.

3.1.8.5**latched position**

a biased position in which the return mechanism is held by a latching arrangement

Note 1 to entry: The latching arrangement may be released manually or otherwise.

3.1.8.6**locked position**

a (definite) position in which a rotary switch is secured by separate action

Note 1 to entry: The locking may be obtained by turning a key, operating a lever, etc.

3.1.8.7**operating diagram**

the representation of the intended order in which the contact elements of a rotary switch operate as a result of actuation

3.1.9 Terms and definitions concerning operation of mechanically operated control switches**3.1.9.1****pre-travel of the actuator**

the maximum travel of the actuator which causes no travel of the contact elements

Note 1 to entry: See Dimension a on Figure 2.

3.1.9.2**over-travel of the actuator**

the travel of the actuator after all the contacts have reached their closed (open) position

3.1.9.3**direct drive**

a connection between actuator and contact element that excludes any pre-travel of the actuator

3.1.9.4**positive drive**

a connection between actuator and contact element such that the force applied to the actuator is directly transmitted to the contact element

3.1.9.5**limited drive**

a connection between actuator and contact element that limits the force transmitted to the contact element

3.1.9.6**actuating moment**

the moment applied to an actuator necessary to complete the intended operation

[SOURCE: IEC 60050-441:1984, 441-16-18]

1129 **3.1.9.7**
 1130 **restoring moment**
 1131 the moment provided to restore an actuator or a contact element to its initial position

1132 [SOURCE: IEC 60050-441:1984, 441-16-20]

1133 **3.1.9.8**
 1134 **minimum starting force**
 1135 the smallest value of force initiating the pre-travel of the actuator

1136 **3.1.9.9**
 1137 **minimum starting moment**
 1138 the smallest value of moment initiating the pre-travel of the actuator

1139 **3.1.9.10**
 1140 **minimum actuating force**
 1141 the minimum value of the force to be applied to the actuator that will cause all contacts to
 1142 reach their closed (open) position

1143 **3.1.9.11**
 1144 **minimum actuating moment**
 1145 the minimum value of the moment to be applied to the actuator that will cause all contacts to
 1146 reach their closed (open) position

1147 **3.1.9.12**
 1148 **pre-travel of the contact element**
 1149 the relative movement which occurs within the contact element before the contacts make
 1150 (break)

1151 Note 1 to entry: See Dimension *b* on Figure 2.

1152 **3.1.9.13**
 1153 **over-travel of the contact element**
 1154 the relative movement which occurs within the contact element after the contacts have
 1155 reached the make (break) position

1156 Note 1 to entry: See Dimension *d* on Figure 2.

1157 **3.1.9.14**
 1158 **bounce time**
 1159 for a contact which is closing/opening its circuit, time interval between the instant when the
 1160 contact circuit first closes/opens and the instant when the circuit is finally closed/opened

1161 [SOURCE: IEC 60050-444:2002, 444-05-04, modified – Figure 1 deleted]

1162 **3.1.10 Alphabetical index of definitions**

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3.2 Symbols and abbreviated terms

EMC Electromagnetic compatibility

I_e Rated operational current

I_{th} Conventional free air thermal current

I_{the} Conventional enclosed thermal current

SCPD short-circuit protective device

$T_{0,95}$ Time to reach 95 % of the steady-state current

U_e Rated operational voltage

U_i Rated insulation voltage

U_{imp} Rated impulse withstand voltage

U_s Rated control circuit supply voltage

4 Classification

4.1 Contact elements

Contact elements may be classified as follows:

- a) Utilization categories (see 5.4).
- b) Electrical ratings based on utilization categories (see Annex A).
- c) One of the following form letters (see Figure 4):
 - 1) Form A – Single gap make-contact element;
 - 2) Form B – Single gap break-contact element;
 - 3) Form C – Single gap make-break three terminal change-over contact element;

- 1284 4) Form X – Double gap make-contact element;
1285 5) Form Y – Double gap break-contact element;
1286 6) Form Z – Double gap make-break four terminal change-over contact element.
1287 d) Other types not included in c).

1288 NOTE 1 Regarding Figure 4e) the two moving contact elements are electrically separated (see 3.1.5.10).

1289 NOTE 2 Distinction is made between make before break (overlap) change-over contact elements where the two
1290 circuits are both closed for a part of the travel of the moving contacts from one position to the other, and break
1291 before make (non-overlap) change-over contact elements where the two circuits are both open for a part of the
1292 travel of the moving contacts from one position to the other. Unless otherwise stated, change-over contact
1293 elements are break before make.

1294 4.2 Control switches

1295 Control switches may be classified according to the contact element and the nature of the
1296 actuating system, e.g. push-buttons, form X.

1297 4.3 Control circuit devices

1298 Control circuit devices may be classified according to the control switch and the associated
1299 control circuit equipment, e.g. push-buttons plus indicator lights.

1300 4.4 Time delay switching elements

1301 Distinction is made according to how the time delay of a switching element is achieved, e.g.
1302 electrical delay, magnetic delay, mechanical delay, or pneumatic delay.

1303 4.5 Control switch mounting

1304 The control switch mounting may be classified by the mounting hole size, e.g. D12, D16, D22,
1305 D30 (see 6.3.1).

1306 5 Characteristics

1307 5.1 Summary of characteristics

1308 5.1.1 General

1309 The characteristics of control circuit devices and switching elements should be stated in the
1310 following terms, where such terms are applicable:

- 1311 – type of equipment (see 5.2);
- 1312 – rated and limiting values for switching elements (see 5.3);
- 1313 – utilization categories of switching elements (see 5.4);
- 1314 – normal and abnormal load characteristics (see 5.3.6);
- 1315 – items subject to agreement between manufacturer and user (see Annex E).

1316 5.1.2 Operation of a control switch

1317 5.1.2.1 Principal application of a control switch

1318 The principal application of a control switch is the switching of loads as indicated for the
1319 various utilization categories in Table 1.

1320 Other applications, e.g. the switching of tungsten filament lamps, small motors, etc., are not
1321 dealt with in detail in this document, but are mentioned in 5.3.6.2.

1322 5.1.2.2 Normal conditions of use

1323 The normal use of a control switch is to close, maintain and open circuits in accordance with
1324 the utilization category shown in Table 1. Also refer to Table 4.

1325 5.1.2.3 Abnormal conditions of use

1326 Abnormal conditions may arise, for example, when an electromagnet, although energized, has
1327 failed to close. Refer to Table 5.

1328 A control switch shall be able to break the current corresponding to such conditions of use.

1329 5.2 Type of control circuit device or switching element**1330 5.2.1 Kind of control circuit device**

1331 The kind of control circuit device shall be stated:

- 1332 • manual control switches, e.g. push-buttons, rotary switches, foot switches, etc.;
- 1333 • electromagnetically operated control switches, either time delayed or instantaneous, e.g.
1334 contactor relays;
- 1335 • pilot switches, e.g. pressure switches, temperature sensitive switches (thermostats),
1336 programmers, etc.;
- 1337 • position switches;
- 1338 • associated control equipment, e.g. indicator lights, etc.

1339 5.2.2 Kind of switching elements

1340 The kind of switching elements shall be stated:

- 1341 • auxiliary contacts of a switching device (e.g. contactor, circuit breaker, etc.) which are not
1342 dedicated exclusively for use with the coil of that device;
- 1343 • interlocking contacts of enclosure doors;
- 1344 • control circuit contacts of rotary switches;
- 1345 • control circuit contacts of overload relays.

1346 5.2.3 Number of poles

1347 The number of poles shall be stated.

1348 5.2.4 Kind of current

1349 The kind of current shall be stated:

1350 Alternating current or direct current.

1351 5.2.5 Interrupting medium

1352 The interrupting medium shall be stated:

1353 Air, oil, gas, vacuum, etc.

1354 5.2.6 Operating conditions**1355 5.2.6.1 Method of operation**

1356 The method of operation shall be stated:

1357 Manual, electromagnetic, pneumatic, electro-pneumatic.

1358 5.2.6.2 Method of control

1359 The method of control shall be stated:

- 1360 • automatic;
- 1361 • non-automatic;
- 1362 • semi-automatic.

1363 5.3 Rated and limiting values for switching elements**1364 5.3.1 General**

1365 The rated values established for the switching elements of a control circuit device shall be
1366 stated in accordance with 5.3.2 to 5.3.6 inclusive but it is not necessary to specify all the
1367 values listed.

1368 5.3.2 Rated voltages (of a switching element)**1369 5.3.2.1 General**

1370 A switching element is defined by the rated voltages described in 5.3.2.2 to 5.3.2.4.

1371 5.3.2.2 Rated operational voltage (U_e)

1372 Subclause 5.3.1.1 of IEC 60947-1:— applies with the following additions:

1373 For three-phase circuits, U_e is stated as RMS voltage between phases.

1374 NOTE A switching elements can be assigned a number of combinations of rated operational voltage and rated
1375 operational current.

1376 Control switches dealt with in this document are not normally intended to be used at very low
1377 voltages and they may not be suitable for such a service. It is therefore recommended to seek
1378 the advice of the manufacturer concerning any application with a low value of operational
1379 voltage, e.g. below 100 V AC or DC.

1380 5.3.2.3 Rated insulation voltage (U_i)

1381 Subclause 5.3.1.2 of IEC 60947-1:— applies.

1382 5.3.2.4 Rated impulse withstand voltage (U_{imp})

1383 Subclause 5.3.1.3 of IEC 60947-1:— applies.

1384 5.3.3 Currents**1385 5.3.3.1 General**

1386 A switching element is characterized by the currents described in 5.3.3.2 to 5.3.3.4.

1387 5.3.3.2 Conventional free air thermal current (I_{th})

1388 Subclause 5.3.2.1 of IEC 60947-1:— applies.

1389 5.3.3.3 Conventional enclosed thermal current (I_{the})

1390 Subclause 5.3.2.2 of IEC 60947-1:— applies.

1391 **5.3.3.4 Rated operational current (I_e)**

1392 The first paragraph of 5.3.2.3 of IEC 60947-1:— applies.

1393 **5.3.4 Rated frequency**

1394 Subclause 5.3.3 of IEC 60947-1:— applies.

1395 **5.3.5 Vacant**

1396 **5.3.6 Characteristics under normal and abnormal load conditions**

1397 **5.3.6.1 Rated making and breaking capacities and behaviour of switching elements**
1398 **under normal conditions**

1399 A switching element shall comply with both requirements given in Table 4 corresponding to
1400 the assigned utilization category and the requirements according to the rated operational
1401 voltage.

1402 NOTE For a switching element to which a utilization category is assigned, it is not necessary to specify separately
1403 a making and breaking capacity.

1404 A switching element designated for the switching of small motors and tungsten filament lamp
1405 loads shall be assigned a utilization category given in IEC 60947-4-1 and comply with the
1406 appropriate corresponding requirements in that publication.

1407 **EXAMPLE 1** A typical example for a small motor load is the motor-load for household or similar application (AC-
1408 7a, AC-7b), see table 1 of IEC 60947-4-1:2018.

1409 **EXAMPLE 2** Typical examples for lamp loads are electric discharge lamp or incandescent lamp (AC-5a, AC-5b),
1410 see Table 1 of IEC 60947-4-1:2018.

1411 **5.3.6.2 Making and breaking capacities under abnormal conditions**

1412 A switching element shall comply with the requirements given in Table 5 corresponding to the
1413 assigned utilization category.

1414 NOTE An example of an abnormal condition of use is one where the electromagnet does not operate and the
1415 switching elements have to interrupt the making current.

1416 **5.3.7 Short-circuit characteristics**

1417 **5.3.7.1 Rated conditional short-circuit current**

1418 Subclause 5.3.6.4 of IEC 60947-1:— applies.

1419 **5.4 Utilization categories for switching elements**

1420 The utilization categories as given in Table 1 are considered standard. Any other types of
1421 application shall be based on agreement between manufacturer and user, but information
1422 given in the manufacturer's catalogue or tender may constitute such an agreement.

1423

Table 1 – Utilization categories for switching elements

Kind of current	Category	Typical applications
Alternating current	AC-12	Control of resistive loads and solid state loads with isolation by optocouplers
	AC-13	Control of solid state loads with transformer isolation
	AC-14	Control of small electromagnetic loads (≤ 72 VA)
	AC-15	Control of electromagnetic loads (> 72 VA)
Direct current	DC-12	Control of resistive loads and solid state loads with isolation by optocouplers
	DC-13	Control of electromagnets
	DC-14	Control of electromagnetic loads having economy resistors in circuit

1424

5.5 Control circuits

1425 **Subclause 5.5.1 of IEC 60947-1:— applies with the following additions.**

1426 **The list of characteristics given in 5.5.1 of IEC 60947-1:— shall be completed by:**

- 1427 **– limited energy (if the source is in accordance with 8.1.18);**
- 1428 **– SELV (PELV) supply (in accordance with Annex N of IEC 60947-1:—)**
- 1429 **– the power consumption of the electromagnet of a contactor relay, necessary for**
- 1430 **determining the characteristics of the power supply of the control circuit, which is given by:**
- 1431 **– holding power,**
- 1432 **– pick-up power.**

1433 **NOTE** In the USA and Canada, control circuits are characterized as Class 2 sources as defined in NFPA 70, National Electrical Code and CSA C22.1, Canadian Electrical Code in lieu of or in addition to SELV (PELV) sources.

5.6 Vacant**5.7 Vacant****5.8 Vacant****5.9 Vacant****5.10 Electrically separated contact elements**

1442 The manufacturer shall state whether the contact elements of a control circuit device are

1443 electrically separated or not (see 3.5.3.7). Separated contact elements shall be assumed to

1444 be opposite polarity unless otherwise stated by the manufacturer.

5.11 Actuating quantities for pilot switches

1446 The operating value and return value of the actuating quantity are to be determined on

1447 uniform rising values and normal falling values of the actuating quantity. Unless otherwise

1448 stated, the rate of change shall be regular and such that the operating (or return) value is

1449 reached in not less than 10 s.

1450 The operating value and the return value may both be fixed values, or one of them or both

1451 may be adjustable (or the differential value may be adjustable).

1452 Where appropriate, the manufacturer shall indicate a withstand value, either a maximum value

1453 higher than the highest setting of the operating value or a minimum value lower than the

1454 lowest setting of the return value. A withstand value implies no damage to the pilot switch or

1455 no change in its characteristics.

5.12 Pilot switches having two or more contact elements

Pilot switches having two or more contact elements which are not individually adjustable may have different operating and return values for each contact element.

A pilot switch having two or more contact elements which are individually adjusted is considered as a combination of pilot switches.

6 Product information

6.1 Nature of information

The following information shall be given by the manufacturer:

Identification

- a) manufacturer's name or trade mark;
- b) 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 or from his catalogue or by selection from Annex A;
- c) IEC 60947-5-1 if the manufacturer claims compliance with this document;

Basic rated values and utilization

- d) rated operational voltages (see 5.3.2.2);
- e) utilization category and rated operational currents at the rated operational voltages of the control circuit device. Dedicated auxiliary contacts of a switching device shall identify the intended controlled load (i.e. switching device coil);
- f) rated insulation voltage (see 5.3.2.3);
- g) rated impulse withstand voltage (see 5.3.2.4);
- h) rated control circuit supply voltage U_s (see 5.5), where applicable;
- i) value of the rated frequency/frequencies (see 5.3.4), where applicable, e.g.: 50 Hz, 50 Hz/60 Hz, and/or the indication "DC" or the symbol  (IEC 60417-5031:2002-10);
- j) IP code (see Annex C of IEC 60947-1:—);
- k) pollution degree (see 7.1.3.2);
- l) type and maximum ratings of short-circuit protective device (see 9.3.4.3);
- m) conditional short-circuit current;
- n) suitability for isolation, where applicable, with the symbol S00288:2001-07 of IEC 60617;
- o) indication of contact elements of same polarity;
- p) material declaration according to Annex W of IEC 60947-1:— (see 6.4.2);
- q) length of insulation to be removed before insertion of the conductor into the terminal;
- r) for non-universal screwless terminals:
 - "s" or "sol" for terminals declared for solid conductors;
 - "r" for terminals declared for solid and stranded conductors;
 - "f" for terminals declared for flexible conductors.
- s) for each relevant circuit, suitability for use with SELV/PELV circuit with the corresponding maximum rated operational voltage (see IEC 61140 and Annex N of IEC 60947-1:—);
- t) for light sources of the equipment the risk group or exempt group according to IEC TR 62471-2:2009

1497 **6.2 Marking**

1498 **6.2.1 General**

1499 Markings shall be indelible and easily legible and shall not be placed on screws and
1500 removable washers.

1501 Marking of data under a) and b) of 6.1 is mandatory on the nameplate of the control circuit
1502 device in order to permit the complete information to be obtained from the manufacturer.

1503 Marking of data under o) of 6.1 shall be included on the nameplate of the control circuit
1504 device in order to ensure proper wiring at installation.

1505 Whenever space permits, data under c) to n) and p) to t) of 6.1 shall be included on the
1506 nameplate, or on the control circuit device or otherwise in the manufacturer's published
1507 literature.

1508 The indication "s", "sol", "r" or "f" for non-universal screwless terminals shall be marked on the
1509 device or, if the space available is not sufficient, on the smallest package unit or in technical
1510 information provided with the product.

1511 Additional marking requirements are specified in the annexes of this document and shall be
1512 considered, where applicable.

1513 **6.2.2 Terminal identification and marking**

1514 Subclause 8.1.8.4 of IEC 60947-1:— applies, with the additional requirements stated in
1515 Annex M.

1516 **6.2.3 Functional markings**

1517 Actuators may be identified indelibly by symbols. If a stop-button carries any symbol on the
1518 actuator, it shall be a circle or an oval (signifying the value zero). The symbols circle or oval
1519 shall be used for stop-buttons only.

1520 Letters or words may be used where the space available is sufficient to ensure a clear
1521 identification. In all other cases, identification markings shall be placed on permanent labels
1522 surrounding each actuator or closely adjacent to it.

1523 Symbols shall be in accordance with IEC 60417.

1524 **6.2.4 Emergency stop**

1525 Actuator shape and colour, background colour and direction of unlatching for emergency stop
1526 devices with mechanical latching function shall be in accordance with 4.2 of IEC 60947-5-
1527 5:1997/AMD2:2016.

1528 **6.2.5 Operating diagram**

1529 **6.2.5.1 General**

1530 As rotary switches may have a multiplicity of contact elements and a multiplicity of actuator
1531 positions, it is necessary that the manufacturer indicates the relationship between the
1532 actuator positions and the associated contact element positions.

1533 It is recommended that the relationship be given in the form of an operating diagram,
1534 examples of which are shown in Figure 1 together with explanatory notes.