

Australian Standard™

Low-voltage switchgear and controlgear

Part 5.1: Control circuit devices and switching elements—Electromechanical control circuit devices



This Australian Standard was prepared by Committee EL-006, Industrial Switchgear and Controlgear. It was approved on behalf of the Council of Standards Australia on 22 July 2004.

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Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturers Association
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Electricity Supply Association of Australia
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Australian Standard™

Low-voltage switchgear and controlgear

Part 5.1: Control circuit devices and switching elements—Electromechanical control circuit devices

Originated as part of AS 1431.1—1974, AS 1431.2—1977 and AS 1431.7—1989.

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PREFACE

This Standard was prepared by the Standards Australia Committee EL-006, Industrial Switchgear and Controlgear.

The objective of this Standard, in addition to that stated in Clause 1, is to bring Australian requirements into line with Edition 3.0 (2003-11) of IEC 60947-5-1.

This Standard is Part 5.1 of a series which, when complete, will consist of the following:

AS 60947	Low-voltage switchgear and controlgear
AS 60947.1*	Part 1: General rules
AS 60947.2*	Part 2: Circuit-breakers
AS 60947.3	Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
AS 60947.3 Suppl	Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units, Supplement 1: Fuse-switch-disconnectors and switch-disconnectors for use with low-voltage aerial bundled cables
AS 60947.4.1*	Part 4.1: Contactors and motor-starters—Electromechanical contactors and motor-starters
AS 60947.4.2*	Part 4.2: Contactors and motor-starters—A.C. semiconductor motor controllers and starters
AS 60947.4.3	Part 4.3: Contactors and motor-starters—A.C. semiconductor controllers and contactors for non-motor loads
AS 60947.5.1*	Part 5.1: Control circuit devices and switching elements—Electromechanical control circuit devices (this standard)
AS 60947.5.2*	Part 5.2: Control circuit devices and switching elements—Proximity switches
AS 60947.5.3	Part 5.3: Control circuit devices and switching elements—Requirements for proximity devices with defined behaviour under fault conditions
AS 60947.5.4*	Part 5.4: Control circuit devices and switching elements—Methods of assessing the performance of low-energy contacts—Special tests
AS 60947.5.5	Part 5.5: Control circuit devices and switching elements—Electrical emergency stop devices with mechanical latching function
AS 60947.5.6	Part 5.6: Control circuit devices and switching elements—D.C. interface for proximity sensors and switching amplifiers (NAMUR)
AS 60947.5.7*	Part 5.7: Control circuit devices and switching elements—Requirements for proximity devices with analogue output
AS 60947.6.1	Part 6.1: Multiple function equipment—Automatic transfer switching equipment
AS 60947.6.2*	Part 6.2: Multiple function equipment—Control and protective switching devices (or equipment) (CPS)
AS 60947.7.1*	Part 7.1: Ancillary equipment—Terminal blocks for copper conductors
AS 60947.7.2*	Part 7.2: Ancillary equipment—Protective conductor terminal blocks for copper conductors

AS 60947.7.3*	Part 7.3:	Ancillary equipment—Safety requirements for terminal blocks for the reception of cartridge fuse-links
AS 60947.8*	Part 8:	Control units for built-in thermal protection for rotating machines

It is the intention of the Committee to align the numbering of this series of Standards with that of the corresponding IEC 60947 series of Standards.

Standards from the list above that are marked with an asterisk (*) are, at the time of publication of this document, available as a part of the AS 60947 series of Standards.

Standards that are not so marked remain as AS(/NZS) 3947 series Standards. Following the next amendment or revision of the corresponding IEC Standard, each of these Standards remaining in the AS(/NZS) 3947 series will be revised and renumbered as a part of the AS 60947 series.

This Standard is identical with and has been reproduced from Edition 3.0 (2003-11) of IEC 60947-5-1:2003, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*.

This Standard differs from AS/NZS 3947.5.1:2000 in the following areas:

- (a) Normative references have been updated and several editorial corrections made.
- (b) The performance and test requirements in AS 60947.1 for dielectric properties (except for Class II control circuit devices insulated by encapsulation, which are separately covered in Annex F) now apply to all control circuit devices, not only those for which the manufacturer has declared a value of the rated impulse voltage (U_{imp}). Application of the test voltage remains as in AS/NZS 3947.5.1:2000 but the test voltage duration is now 5 seconds and not 1 minute as previously.
- (c) EMC requirements and tests have been updated.
- (d) Requirements and tests for indicating towers are now included in Annex J.

As this Standard is reproduced from an International Standard, the following applies:

- (i) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (ii) In the source text ‘this standard’ should read ‘this Australian Standard’.
- (iii) A full point should be substituted for a comma when referring to a decimal marker.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a Standard, whereas an ‘informative’ annex is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard
Low-voltage switchgear and controlgear
Part 5.1: Control circuit devices and switching elements—
Electromechanical control circuit devices

1 General

The provisions of the general rules, ~~IEC 60947-1~~ AS 60947.1 (hereinafter referred to as **Part 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~~ **Part 1**, for example 1.2.3, Table 4 or Annex A of Part 1.

1.1 Scope and object

This part of ~~IEC 60947~~ AS 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 a.c. (at a frequency not exceeding 1 000 Hz) or 600 V d.c.

However, for operational voltages below 100 V a.c. or d.c., see note 2 of 4.3.1.1.

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

- manual control switches, for example pushbuttons, 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 may 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 shall also meet the requirements and tests of ~~IEC 60947-4-1~~ AS 60947.4.1 (hereinafter referred to as **Part 4.1**) except for the utilization category which shall comply with this standard.

This standard does not include the relays covered in IEC 60255 or automatic electrical control devices for household and similar purposes.

The colour requirements of indicator lights, pushbuttons, etc., are found in IEC 60073 and also in publication 2 of the International Commission of Illumination (CIE).

The object of this standard is to state:

- a) The characteristics of control circuit devices.
- b) The electrical and mechanical requirements with respect to:
 - 1) The various duties to be performed.
 - 2) The significance of the rated characteristics and of the markings.
 - 3) The tests to verify the rated characteristics.
- c) The functional requirements to be satisfied by the control circuit devices with respect to:
 - 1) Environmental conditions, including those of enclosed equipment.
 - 2) Dielectric properties.
 - 3) Terminals.

1.2 Normative references

The following referenced documents are indispensable for the application 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 60050(441):1984, *International Electrotechnical Vocabulary (IEV) — Chapter 441: Switchgear, controlgear and fuses* — Amendment 1 (2000)~~

AS 1852.441, *International Electrotechnical Vocabulary (IEV)—Switchgear, controlgear and fuses*

~~IEC 60050(446):1983, *International Electrotechnical Vocabulary (IEV) — Chapter 446: Electrical relays*~~

AS 1852.446, *International Electrotechnical Vocabulary (IEV)—Electrical relays* (identical to IEC 60050-446:1983)

~~IEC 60068-2-6:1995, *Environmental testing — Part 2: Tests — Test Fc: Vibration (sinusoidal)*~~

AS 60068.2.6, *Environmental testing—Tests—Test Fc: Vibration (sinusoidal)* (identical to IEC 60068-2-6:1995 and includes its Corrigendum 1:1995)

~~IEC 60068-2-14:1984, *Environmental testing — Part 2: Tests — Test N: Change of temperature* — Amendment 1 (1986)~~

AS 60068.2.14, *Environmental testing—Tests—Test N: Change of temperature* (identical to IEC 60068-2-14:1984 and includes its Amendment 1:1986)

~~IEC 60068-2-27:1987, *Environmental testing — Part 2: Tests — Test Ea and guidance: Shock*~~

AS 60068.2.27, *Environmental testing—Tests—Test Ea and guidance: Shock* (identical to IEC 60068-2-27:1987)

~~IEC 60068-2-30:1980, Environmental testing — Part 2: Tests — Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle) —
Amendment 1 (1985)~~

AS 60068.2.30, Environmental testing—Tests—Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle) (identical to IEC 60068-2-30:1980 and includes its Amendment 1:1985)

IEC 60073:2002, Basic and safety principles for man-machine interface, marking and identification – Coding principles for indications and actuators

~~IEC 60112:2003, Method for the determination of the proof and the comparative tracking indices of solid insulating materials~~

AS/NZS 60112, Method for the determination of the proof and the comparative tracking indices of solid insulating materials (identical to IEC 60112:2003)

IEC 60255 (all parts), Electrical relays

~~IEC 60617 (all parts), Graphical symbols for diagrams~~

AS 1102 (all parts), Graphical symbols for electrotechnical documentation

~~IEC 60947-1:1999, Low-voltage switchgear and controlgear — Part 1: General rules —
Amendment 1 (2000) —
Amendment 2 (2001)~~

AS 60947.1, Low-voltage switchgear and controlgear—General rules

~~IEC 60947-4-1:2000, Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor starters — Electromechanical contactors and motor starters~~

AS 60947.4.1, Low-voltage switchgear and controlgear, Part 4.1: Contactors and motor-starters – Electromechanical contactors and motor-starters

~~IEC 61000-4-2:1995, Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test —
Amendment 1 (1998) —
Amendment 2 (2000)~~

AS/NZS 61000.4.2, Electromagnetic compatibility (EMC), Part 4.2: Testing and measurement techniques—Electrostatic discharge immunity test (identical to Consolidated Edition 1.2(2001) of IEC 61000-4-2, which includes IEC 61000-4-2:1995 and its Amendments 1:1998 and 2:2000)

~~IEC 61000-4-3:2002, Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test~~

AS/NZS 61000.4.3, Electromagnetic compatibility (EMC), Part 4.3: Testing and measurement techniques—Radiated, radio-frequency, electromagnetic field immunity test

IEC 61000-4-4:1995, Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test
Amendment 1 (2000)
Amendment 2 (2001)

~~IEC 61000-4-5:1995, Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity tests — Amendment 1 (2000)~~

AS/NZS 61000.4.5, *Electromagnetic compatibility (EMC), Part 4.5: Testing and measurement techniques—Surge immunity tests*

~~IEC 61000-4-6:1996, Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields — Amendment 1 (2000)~~

AS/NZS 61000.4.6, *Electromagnetic compatibility (EMC), Part 4.6: Testing and measurement techniques—Immunity to conducted disturbances, induced by radio-frequency fields*

~~IEC 61000-4-8:1993, Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test — Amendment 1 (2000)~~

AS/NZS 61000.4.8, *Electromagnetic compatibility (EMC), Part 4.8: Testing and measurement techniques—Power frequency magnetic field immunity test* (identical to Consolidated Edition 1.1(2001) of IEC 61000-4-8, which includes IEC 61000-4-8:1993 and its Amendment 1:2000)

IEC 61000-4-11:1994, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests* Amendment 1 (2000)

IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) — Part 4-13: Testing and measurement techniques — Harmonics and interharmonics including mains signalling at a.c. power port, low-frequency immunity tests*

IEC 61140:2001, *Protection against electric shock — Common aspects for installation and equipment*

~~CISPR 11:1997, Industrial, scientific and medical (ISM) radio-frequency equipment — Electromagnetic disturbance characteristics — Limits and methods of measurement — Amendment 1 (1999)~~

AS/NZS CISPR 11, *Industrial, scientific and medical (ISM) radio-frequency equipment — Electromagnetic disturbance characteristics — Limits and methods of measurement*

2 Definitions

For the purposes of this part of ~~IEC 60947~~ **AS 60947** the definitions of Part 1 and the following additions apply:

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2.1 Basic definitions

2.1.1

control circuit device

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

NOTE Control circuit devices may 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.

2.1.2

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 A control switch consists of one or more contact elements with a common actuating system.

NOTE 2 This definition differs from IEC 441-14-46 since a control switch may include semiconductor elements or contact elements (see 2.3.2 and 2.3.3).

2.1.3

control switch suitable for isolation

a control switch which, in the open position, complies with the requirements specified for the isolating function (see 2.1.19 and 7.2.3.1 b) of Part 1)

NOTE 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.

2.1.4

control station

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

[IEV 441-12-08]

NOTE A control station panel or enclosure may also contain related equipment, e.g. potentiometers, signal lamps, instruments, etc.

2.2 Control switches

2.2.1

automatic control switches

NOTE Automatic control switches are operated by automatic control (see 2.4.5 of Part 1). They are also designated as *pilot switches* (see 2.2.18 of Part 1).

2.2.1.1

instantaneous contactor relay

a contactor relay operating without any intentional time delay

[IEV 441-14-36]

NOTE Unless otherwise stated, a contactor relay is an instantaneous contactor relay.

2.2.1.2

time-delay contactor relay

a contactor relay with specified time-delay characteristics

[IEV 441-14-37]

NOTE 1 The time-delay may be associated with energization (*e*-delay) or with de-energization (*d*-delay) or both.

NOTE 2 A time-delay contactor relay may also incorporate instantaneous contact elements.

2.2.1.3

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

[IEV 441-14-49]

2.2.1.4

programmer

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

2.2.2

manually operated control switches

NOTE Manually operated control switches are operated by manual control (see 2.4.4 of Part 1).

2.2.2.1

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

[IEV 441-14-53]

2.2.2.2**pull-button**

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

2.2.2.3**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 There are also «push-push» or «push-turn» or other combinations of buttons.

2.2.2.4**rotary button (e.g.: selector switch)**

a combination of push-button type switching elements having an actuator operated by a manual rotation (see also 2.2.2.15 to 2.2.2.18 inclusive)

NOTE A rotary push-button may have more than two positions; it may or may not have a spring return.

2.2.2.5**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 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.

2.2.2.6**locked push-button**

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

NOTE The locking may be obtained by turning the button, by turning a key, by operating a lever, etc.

2.2.2.7**key-operated push-button**

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

NOTE Key withdrawal may be provided at any position.

2.2.2.8**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

2.2.2.9**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

2.2.2.10**illuminated push-button**

a push-button incorporating a signalling lamp in the button

2.2.2.11**covered push-button**

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

2.2.2.12**shrouded push-button**

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

2.2.2.13**free push-button**

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

2.2.2.14**guided push-button**

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

NOTE Examples of guided push-buttons: the actuators of which are keyed, square or rectangular, etc.

2.2.2.15**rotary control switch (abbreviation: rotary switch)**

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

2.2.2.16**key-operated rotary switch**

a rotary switch where a key is used as the actuator

NOTE Key withdrawal may be provided at any position.

2.2.2.17**limited movement rotary switch**

a rotary switch with a restricted angular movement of its actuator

2.2.2.18**unidirectional movement rotary switch**

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

2.2.2.19**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 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 The pin or stick may or may not have a spring return.

2.2.2.20**wobble stick**

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

2.2.2.21**foot switch (pedal)**

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

[IEV 441-14-52 modified]

2.3 Parts of control switches**2.3.1****switching element**

a switching element may be a semiconductor element (see 2.3.2) or a contact element (see 2.3.3)

2.3.2**semiconductor element**

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

2.3.3**contact element (of a 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 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 Definitions relating to various kinds of contact elements are given in 2.3.3.1 to 2.3.3.10 inclusive.

NOTE 3 This definition does not include control coils and magnet systems.

The following definitions refer to a single contact element of a control switch:

2.3.3.1**single gap contact element** (see Figures 4 a) and 4 c))

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

2.3.3.2**double gap contact element** (see Figures 4 b), 4 d) and 4 e))

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

2.3.3.3**make-contact element (normally open)**

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

2.3.3.4**break-contact element (normally closed)**

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

2.3.3.5**change-over contact elements** (see Figures 4 c), 4 d) and 4 e))

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

2.3.3.6**pulse (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

2.3.3.7**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

[IEV 441-15-24]

2.3.3.8**independent (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

2.3.3.9**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

2.3.3.10**contact unit**

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

2.3.4 button

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

2.3.4.1 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

2.3.4.2 recessed button

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

2.3.4.3 extended button

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

2.3.4.4 mushroom button

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

2.3.5 locating mechanism (of a rotary switch)

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

2.3.6 end stop

a device that limits the travel of a moving part

NOTE An end stop may relate either to the actuator or to the contact element.

2.4 Operation of control switches

2.4.1 Operation of contactor relays

2.4.1.1 e-delay (of a 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).

2.4.1.2 d-delay (of a contact element)

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

Example: delay to open make-contacts (OFF delay)

Note for 2.4.1.1 and 2.4.1.2 – The terms 'e-delay' and 'd-delay' may be applied to any kind of contact elements (see 2.3.3).

2.4.1.3 fixed delay (of a contact element)

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

2.4.1.4**adjustable delay (of a contact element)**

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

2.4.2 Operation of pilot switches**2.4.2.1****actuating quantity**

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

2.4.2.2**operating value**

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

2.4.2.3**return value**

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

2.4.2.4**differential value**

the difference between the operating value and the return value

2.4.3 Operation of rotary switches**2.4.3.1****definite position (abbreviation: position) (of a rotary switch)**

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

2.4.3.2**position of rest**

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

2.4.3.3**transit position**

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

2.4.3.4**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 During the transfer from a biased position to the adjacent position of rest, the rotary switch may pass through one or more transit positions.

2.4.3.5**latched position**

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

NOTE The latching arrangement may be released manually or otherwise.

2.4.3.6**locked position**

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

NOTE The locking may be obtained by turning a key, operating a lever, etc.

2.4.3.7**operating diagram**

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

2.4.4 Operation of mechanically operated control switches**2.4.4.1****pre-travel of the actuator** (dimension *a* on Figure 2)

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

2.4.4.2**over-travel of the actuator**

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

2.4.4.3**direct drive**

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

2.4.4.4**positive drive**

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

2.4.4.5**limited drive**

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

2.4.4.6**minimum starting force (or moment)**

the smallest value of force (or moment) initiating the pre-travel of the actuator

2.4.4.7**minimum actuating force (or moment)**

the minimum value of the force (or moment) to be applied to the actuator that will cause all contacts to reach their closed (open) position

2.4.4.8**pre-travel of the contact element** (dimension *b* on Figure 2)

the relative movement which occurs within the contact element before the contacts make (break)

2.4.4.9**over-travel of the contact element** (dimension *d* on Figure 2)

the relative movement which occurs within the contact element after the contacts have reached the make (break) position

2.4.4.10**bounce time**

for a contact which is closing (opening) its circuit, the time interval between the instant when the contact circuit first closes (opens) and the instant when the circuit is finally closed (opened)

[IEV 446-17-13]

3 Classification

3.1 Contact elements

Contact elements may be classified as follows:

- a) Utilization categories (see 4.4).
- 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;
 - 4) Form X – Double gap make-contact element;
 - 5) Form Y – Double gap break-contact element;
 - 6) Form Z – Double gap make-break four terminal change-over contact element.
- d) Other types not included in c).

NOTE 1 Regarding Figure 4e). the two moving contact elements are electrically separated (see 2.3.3.7).

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

3.2 Control switches

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

3.3 Control circuit devices

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

3.4 Time delay switching elements

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

3.5 Control switch mounting

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

4 Characteristics

4.1 Summary of characteristics

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

- type of equipment (see 4.2);
- rated and limiting values for switching elements (see 4.3);
- utilization categories of switching elements (see 4.4);
- normal and abnormal load characteristics (see 4.3.5);
- switching overvoltages (see 4.9).

4.1.1 Operation of a control switch

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

Other applications, e.g. the switching of tungsten filament lamps, small motors, etc., are not dealt with in detail in this standard, but are mentioned in 4.3.5.2.

4.1.1.1 Normal conditions of use

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

4.1.1.2 Abnormal conditions of use

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

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

4.2 Type of control circuit device or switching element

The following shall be stated:

4.2.1 Kind of control circuit device

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

4.2.2 Kind of switching elements

- 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.

4.2.3 Number of poles

4.2.4 Kind of current

Alternating current or direct current.

4.2.5 Interrupting medium

Air, oil, gas, vacuum, etc.

4.2.6 Operating conditions

4.2.6.1 Method of operation

Manual, electromagnetic, pneumatic, electro-pneumatic.

4.2.6.2 Method of control

- automatic;
- non-automatic;
- semi-automatic.

4.3 Rated and limiting values for switching elements

The rated values established for the switching elements of a control circuit device shall be stated in accordance with 4.3.1 to 4.3.5 inclusive but it is not necessary to specify all the values listed.

4.3.1 Rated voltages (of a switching element)

A switching element is defined by the following rated voltages:

4.3.1.1 Rated operational voltage (U_e)

Subclause 4.3.1.1 of Part 1 applies with the following additions:

For three-phase circuits, U_e is stated as r.m.s. voltage between phases.

NOTE 1 A switching elements may be assigned a number of combinations of rated operational voltage and rated operational current.

NOTE 2 Control switches dealt with in this standard are not normally intended to be used at very low voltages and they may not be suitable for such a service. It is therefore recommended to seek the advice of the manufacturer concerning any application with a low value of operational voltage, e.g. below 100 V a.c. or d.c.

4.3.1.2 Rated insulation voltage (U_i)

Subclause 4.3.1.2 of Part 1 applies.

4.3.1.3 Rated impulse withstand voltage (U_{imp})

Subclause 4.3.1.3 of Part 1 applies.

4.3.2 Currents

A switching element is characterized by the following currents:

4.3.2.1 Conventional free air thermal current (I_{th})

Subclause 4.3.2.1 of Part 1 applies.

4.3.2.2 Conventional enclosed thermal current (I_{the})

Subclause 4.3.2.2 of Part 1 applies.

4.3.2.3 Rated operational current (I_e)

The first paragraph of 4.3.2.3 of Part 1 applies.

4.3.3 Rated frequency

Subclause 4.3.3 of Part 1 applies.

4.3.4 Vacant

4.3.5 Normal and abnormal load characteristics

4.3.5.1 Rated making and breaking capacities and behaviour of switching elements under normal conditions

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

NOTE 1 For a switching element to which a utilization category is assigned, it is not necessary to specify separately a making and breaking capacity.

NOTE 2 A switching element used for the switching of small motors and tungsten filament lamp loads shall be assigned a utilization category given in Part 4.1 and comply with the appropriate corresponding requirements in that publication.

4.3.5.2 Making and breaking capacities under abnormal conditions

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

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

4.3.6 Short-circuit characteristics

4.3.6.1 Rated conditional short-circuit current

Subclause 4.3.6.4 of Part 1 applies.

4.4 Utilization categories for switching elements

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

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

4.5 Vacant

4.6 Vacant

4.7 Vacant

4.8 Vacant

4.9 Switching overvoltages

Subclause 4.9 of Part 1 applies.

4.10 Electrically separated contact elements

The manufacturer shall state whether the contact elements of a control circuit device are electrically separated or not (see 2.3.3.7).

4.11 Actuating quantities for pilot switches

The operating value and return value of the actuating quantity are to be determined on uniform rising values and normal falling values of the actuating quantity. Unless otherwise stated, the rate of change shall be regular and such that the operating (or return) value is reached in not less than 10 s.

The operating value and the return value may both be fixed values, or one of them or both may be adjustable (or the differential value may be adjustable).

Where appropriate, the manufacturer shall indicate a withstand value, either a maximum value higher than the highest setting of the operating value or a minimum value lower than the lowest setting of the return value. A withstand value implies no damage to the pilot switch or no change in its characteristics.

4.12 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.

5 Product information

5.1 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 or from his catalogue or by selection from Annex A.
- c) ~~IEC 60947-5-1~~ AS 60947.5.1 if the manufacturer claims compliance with this standard.

Basic rated values and utilization

- d) Rated operational voltages (see 4.3.1.1).
- e) Utilization category and rated operational currents at the rated operational voltages of the control circuit device.
- f) Rated insulation voltage (see 4.3.1.2).
- g) Rated impulse withstand voltage (see 4.3.1.3), when determined.
- h) Switching overvoltage, if applicable (see 4.9).
- i) IP code, in case of an enclosed control circuit device (see 5.1 and Annex C of Part 1).
- j) Pollution degree (see 6.1.3.2).

- k) Type and maximum ratings of short-circuit protective device (see 8.3.4.3).
- l) Conditional short-circuit current if less than 1 000 A.
- m) Suitability for isolation, where applicable, with the symbol 07-13-06 of IEC 60617-7 AS 1102.
- n) Indication of contact elements of same polarity.

5.2 Marking

5.2.1 General

Marking of data under a) and b) of 5.1 is mandatory on the nameplate of the control circuit device 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 removable washers.

Whenever space permits, data under c) to n) shall be included on the nameplate, or on the control circuit device or otherwise in the manufacturer's published literature.

5.2.2 Terminal identification and marking

Subclause 7.1.7.4 of Part 1 applies.

5.2.3 Functional markings

Actuators may be identified by symbols in the form of engravings. If a stop-button carries any symbol engraved or marked on the actuator, then this symbol shall be a circle or an oval (signifying the value zero). The symbols circle or oval shall be used for stop-buttons only.

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

5.2.4 Emergency stop

Control switch actuators intended to be used as "stop" control for emergency use shall be coloured red and, in the case of a push-button, be of mushroom shape.

5.2.5 Operating diagram

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

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

5.2.5.1 Position indication

The position indication shall be clear, and the associated text or symbols shall be indelible and easily legible.

5.2.5.2 Terminal markings for operating diagrams

Terminal markings shall be clearly identifiable with respect to the operating diagram.

5.2.6 Time delay markings

For time-delay contactor relays, the markings shall include the value of the time delay in the case of a fixed delay and the range of time delay in the case of an adjustable delay.

In the case of more than one time-delay contact element, the relative delay between the operation of each contact element and the following one may be indicated for contact elements that follow the first delay.

If two or more contact elements have adjustable delays, it shall be indicated whether they are individually adjustable or not.

The manufacturer shall indicate, for each time-delay contact element, the characteristics of the delay, according to 2.4.1.1 or 2.4.1.2.

5.3 Instructions for installation, operation and maintenance

Subclause 5.3 of Part 1 applies.

5.4 Additional information

Additional information necessary for certain types of control circuit devices shall appear according to the relevant rules of the appropriate Annexes J and K.

Such additional information shall be supplied by the manufacturer and may be in the form of a wiring diagram or in the instruction sheet supplied with the control circuit device.

6 Normal service, mounting and transport conditions

Clause 6 of Part 1 applies with the following additions:

6.1.3.2 Pollution degree

Unless otherwise stated by the manufacturer, a control circuit device is intended for installation under environmental conditions of pollution degree 3. However, other pollution degrees may apply, depending upon the micro-environment.

6.3.1 Mounting of single hole mounted devices

The single hole mounted push-buttons and indicator lights are located in a circular hole of the panel, which may have a rectangular recess for a key.

The dimensions are indicated in Table 2: