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Interested committees:

Title: Draft BS EN IEC 61095 Electromechanical contactors for household and similar purposes

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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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UK Vote

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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/475/CD

COMMITTEE DRAFT (CD)

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IEC 61095 ED3

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SECRETARIAT:

France

SECRETARY:

Mr Michaël LAHEURTE

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 23B, SC 23E, TC 34

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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TITLE:

Electromechanical contactors for household and similar purposes

NOTE FROM TC/SC OFFICERS:

SC121A Officers support circulation of CD1 for project IEC 61095 ED3.

Secretary note: NC experts are kindly requested to refer their comments to line numbers.

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FOR HOUSEHOLD AND SIMILAR PURPOSES****FOREWORD**

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- This third edition cancels and replaces the second edition published in 2009 and constitutes a technical revision.
- This edition includes the following significant technical changes with respect to the previous edition:
- Addition of requirements for screwless terminals
 - Addition of requirements for the switching of LED lamps
 - Addition of requirements for contactors with electronically controlled electromagnet

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

FDIS	Report on voting

324
325 Full information on the voting for the approval of this standard can be found in the report on
326 voting indicated in the above table.

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

328 The committee has decided that the contents of this publication will remain unchanged until the
329 maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data
330 related to the specific publication. At this date, the publication will be

- 331 • reconfirmed;
332 • withdrawn;
333 • replaced by a revised edition, or
334 • amended.

335

336

INTRODUCTION

This International Standard gives requirements for contactors household and similar purposes, including contactors for distribution control in buildings.

Contactors for such purposes have particular requirements which include test sequences and sampling plans to facilitate testing.

Contactors according to this standard are limited in the range of operational currents and operational voltages to values appropriate to the applications. Such contactors are for use in circuits of limited prospective short-circuit fault current for which they need to be co-ordinated with an appropriate short-circuit protective device to provide suitable co-ordination.

This standard defines in a single document the specific utilization category for a described application and states the relevant requirements. As far as possible, it is in line with the requirements contained in IEC 60947-4-1 "Electromechanical contactors and motor-starters".

This standard also applies to contactors which are components of an appliance, unless otherwise stated in the standard covering the relevant appliance.

ELECTROMECHANICAL CONTACTORS FOR HOUSEHOLD AND SIMILAR PURPOSES

1 Scope

This International Standard applies to electromechanical air break contactors for household and similar purposes provided with main contacts intended to be connected to circuits the rated voltage of which does not exceed 440 V AC (between phases) with rated operational currents less than or equal to 63 A for utilization category AC-7a, and 32 A for utilization categories AC-7b, AC-7c and AC-7d (expressed in rated power), and rated conditional short-circuit current less than or equal to 6 kA.

Specific requirements apply to contactors equipped with screwless-type terminals, primarily suitable for connecting unprepared copper conductors of cross-section up to 10 mm².

The contactors dealt with in this standard are not normally designed to interrupt short-circuit currents. Therefore, suitable short-circuit protection (see 9.3.4) shall form part of the installation.

This standard does not apply to

- contactors complying with IEC 60947-4-1;
- semiconductor contactors;
- contactors designed for special applications;
- auxiliary contacts of contactors. These are dealt with in IEC 60947-5-1.

This standard states

- 1) the characteristics of contactors.
- 2) the conditions with which contactors shall comply with reference to:
 - a) their operation and behaviour;
 - b) their dielectric properties;
 - c) the degrees of protection provided by their enclosures, where applicable;
 - d) their construction;
 - e) their electromagnetic compatibility characteristics.
- 3) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests.
- 4) the test sequences and the number of samples.
- 5) the information to be given with contactors or in the manufacturer's literature.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60028:1925, *International standard of resistance for copper*

IEC 60050-151:2001, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

- 395 IEC 60050-441:1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441:*
396 *Switchgear, controlgear and fuses*
397 *Amendment 1 (2000)*
- 398 IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady*
399 *state*
- 400 IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and*
401 *identification – Coding principles for indicators and actuators*
- 402 IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*
- 403 IEC 60112:2020, *Method for the determination of the proof and the comparative tracking indices*
404 *of solid insulating materials*
- 405 IEC 60216 (all parts), *Electrical insulating materials – Properties of thermal endurance*
- 406 IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety –*
407 *Protection against voltage disturbances and electromagnetic disturbances*
408 *Amendment 1 (2015)*
409 *Amendment 2 (2018)*
- 410 IEC 60417, *Graphical symbols for use on equipment* (available at
411 <http://www.graphicalsymbols.info/equipment>)
- 412 IEC 60445:2021 *Basic and safety principles for man-machine interface, marking and*
413 *identification - Identification of equipment terminals, conductor terminations and conductors*
- 414 IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and*
415 *identification – Actuating principles*
- 416 IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
417 *Amendment 1 (1999)*
418 *Amendment 2 (2013)*
- 419 IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1:*
420 *Principles, requirements and tests*
- 421 IEC 60669-1:2017, *Switches for household and similar fixed electrical installations – Part 1:*
422 *General requirements*
- 423 IEC 60669-2-1:2021, *Switches for household and similar fixed electrical installations - Part 2-*
424 *1: Particular requirements - Electronic control devices*
- 425 IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods –*
426 *Glow-wire apparatus and common test procedure*
- 427 IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods –*
428 *Glow-wire flammability test method for end-products*
- 429 IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and*
430 *vertical flame test methods*
431 *Amendment 1 (2003)*
- 432 IEC 60947-1:2020, *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 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60998-2-2:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61180 (all parts), *High-voltage test techniques for low-voltage equipment*

ISO 7000:2019, *Graphical symbols for use on equipment – Index and synopsis*

ISO 2039-2:1999, *Plastics – Determination of hardness – Part 2: Rockwell hardness*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 General terms

3.1.1

over-current

current exceeding the rated current

[IEV 441-11-06]

3.1.2

short-circuit

accidental or intentional conductive path between two or more conductive parts forcing the electric potential differences between these conductive parts to be equal to or close to zero

[IEV 151-12-04]

3.1.3

short-circuit current

over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit

[IEV 441-11-07]

3.1.4

overload

operating conditions in an electrically undamaged circuit which cause an over-current

[IEV 441-11-08]

3.1.5**overload current**

over-current occurring in an electrically undamaged circuit

3.1.6**ambient air temperature**

temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse

NOTE For switching devices or fuses installed inside an enclosure, it is the temperature of the air outside the enclosure.

[IEV 441-11-13]

3.1.7**conductive part**

part which is capable of conducting current although it may not necessarily be used for carrying service current

[IEV 441-11-09]

3.1.8**exposed conductive part**

conductive part which can readily be touched and which is not normally alive, but which may become alive under fault conditions

NOTE Typical exposed conductive parts are walls of enclosures, operating handles, etc.

[IEV 441-11-10]

3.1.9**electric shock**

physiological effect resulting from an electric current through a human or animal body

[IEV 826-12-01]

3.1.10**live part**

conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

NOTE This concept does not necessarily imply a risk of electric shock.

[IEV 826-12-08]

3.1.11**protective conductor** (identification: PE)

conductor provided for purposes of safety, for example protection against electric shock

NOTE In an electrical installation, the conductor identified PE is normally also considered as protective earthing conductor.

[IEV 826-13-22]

3.1.12**neutral conductor**

conductor electrically connected to the neutral point and capable of contributing to the distribution of electric energy

[IEV 826-14-07]

3.1.13**PEN conductor**

conductor combining the functions of both a protective earthing conductor and a neutral conductor

[IEV 826-13-25]

3.1.14**PEM conductor**

conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[IEV 826-13-26]

3.1.15**PEL conductor**

conductor combining the functions of both a protective earthing conductor and a line conductor

[IEV 826-13-27]

3.1.16**enclosure**

part providing a specified degree of protection of equipment against certain external influences and a specified degree of protection against approach to or contact with live parts and moving parts

[IEV 441-13-01, modified]

NOTE This definition is similar to IEC 441-13-01, which applies to assemblies.

3.1.17**integral enclosure**

enclosure which forms an integral part of the equipment

3.1.18**utilization category (for a switching device or a fuse)**

combination of specified requirements related to the condition in which the switching device or the fuse fulfils its purpose, selected to represent a characteristic group of practical applications

NOTE The specified requirements may concern e.g. the values of making capacities (if applicable), breaking capacities and other characteristics, the associated circuits and the relevant conditions of use and behaviour.

[IEV 441-17-19]

3.2 Switching devices**3.2.1****switching device**

device designed to make or break the current in one or more electric circuits

[IEV 441-14-01]

NOTE A switching device may perform one or both of these operations.

3.2.2**mechanical switching device**

switching device designed to close and open one or more electric circuits by means of separable contacts

NOTE Any mechanical switching device may be designated according to the medium in which its contacts open and close, e.g. air, SF₆, oil.

[IEV 441-14-02]

3.2.3

semiconductor switching device

switching device designed to make and/or break the current in an electric circuit by means of the controlled conductivity of a semiconductor

NOTE This definition differs from IEV 441-14-03 since a semiconductor switching device is also designed for breaking the current.

[IEV 441-14-03, modified]

3.2.4

fuse

device that, by the fusing of one or more of its specifically designed and proportioned components, opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device

[IEV 441-18-01]

3.2.5

circuit-breaker

mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short circuit

[IEV 441-14-20]

3.2.6

(mechanical) contactor

mechanical switching device having only one position of rest, operated otherwise than by hand, capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions

[IEV 441-14-33]

NOTE 1 The term "operated otherwise than by hand" means that the device is intended to be controlled and kept in working position from one or more external supplies.

NOTE 2 In French, a contactor the main contacts of which are closed in the position of rest is usually called "rupteur". The word "rupteur" has no equivalent in the English language.

NOTE 3 A contactor is usually intended to operate frequently.

3.2.7

electromagnetic contactor

contactor, in which the force for closing the normally open main contacts or opening the normally closed main contacts is provided by an electromagnet

NOTE to entry: The electromagnet may be electronically controlled.

3.2.8

electronically controlled electromagnet

electromagnet in which the coil is controlled by a circuit with active electronic elements

3.2.9

latched contactor

contactor, the moving elements of which are prevented by means of a latching arrangement from returning to the position of rest when the operating means are de-energized

602 NOTE 1 The latching, and the release of the latching, may be mechanical, electromagnetic, pneumatic, etc.

603 NOTE 2 Because of the latching, the latched contactor actually acquires a second position of rest and, according
604 to 3.2.6 is not, strictly speaking, a contactor. However, since the latched contactor in both its utilization and its design
605 is more closely related to contactors in general than to any other classification of switching device, it is considered
606 proper to require that it complies with the specifications for contactors wherever they are appropriate.

607 [IEV 441-14-34]

608 3.2.10

609 semiconductor contactor

610 solid state contactor

611 device which performs the function of a contactor by utilizing a semiconductor switching device

612 NOTE A semiconductor contactor may also contain mechanical switching devices.

613 3.2.11

614 pilot switch

615 non-manual control switch actuated in response to specified conditions of an actuating quantity

616 NOTE The actuating quantity may be pressure, temperature, velocity, liquid level, elapsed time, etc.

617 [IEV 441-14-48]

618 3.2.12

619 push-button

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

622 [IEV 441-14-53]

623 3.2.13

624 short-circuit protective device

625 SCPD

626 device intended to protect a circuit or parts of a circuit against short-circuit currents by
627 interrupting them

628 3.2.14

629 surge arrester

630 device designed to protect the electrical apparatus from high transient over-voltages and to
631 limit the duration and frequently the amplitude of the follow-on current

632 [IEV 604-03-51]

633 3.3 Parts of switching devices

634 3.3.1

635 pole (of a switching device)

636 portion of a switching device associated exclusively with one electrically separated conducting
637 path of its main circuit and excluding those portions which provide a means for mounting and
638 operating all poles together

639 NOTE A switching device is called single-pole if it has only one pole. If it has more than one pole, it may be called
640 multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to operate
641 together.

642 [IEV 441-15-01]

643 3.3.2

644 main circuit (of a switching device)

645 all the conductive parts of a switching device included in the circuit which it is designed to close
646 or open

647 [IEV 441-15-02]

648 **3.3.3**

649 **control circuit (of a switching device)**

650 all the conductive parts (other than the main circuit) of a switching device which are included in
651 a circuit used for the closing operation or opening operation, or both, of the device

652 [IEV 441-15-03]

653 **3.3.4**

654 **auxiliary circuit (of a switching device)**

655 all the conductive parts of a switching device which are intended to be included in a circuit other
656 than the main circuit and the control circuits of the device

657 NOTE Some auxiliary circuits fulfil supplementary functions such as signalling, interlocking, etc., and, as such, they
658 may be part of the control circuit of another switching device.

659 [IEV 441-15-04]

660 **3.3.5**

661 **contact (of a mechanical switching device)**

662 conductive parts designed to establish circuit continuity when they touch and which, due to their
663 relative motion during an operation, open or close a circuit or, in the case of hinged or sliding
664 contacts, maintain circuit continuity

665 [IEV 441-15-05]

666 **3.3.6**

667 **contact (piece)**

668 one of the conductive parts forming a contact

669 [IEV 441-15-06]

670 **3.3.7**

671 **main contact**

672 contact included in the main circuit of a mechanical switching device, intended to carry, in the
673 closed position, the current of the main circuit

674 [IEV 441-15-07]

675 **3.3.8**

676 **auxiliary contact**

677 contact included in an auxiliary circuit and mechanically operated by the switching device

678 [IEV 441-15-10]

679 **3.3.9**

680 **auxiliary switch (of a mechanical switching device)**

681 switch containing one or more control and/or auxiliary contacts mechanically operated by a
682 switching device

683 [IEV 441-15-11]

684 **3.3.10**

685 **"a" contact**

686 **make contact**

687 control or auxiliary contact which is closed when the main contacts of the mechanical switching
688 device are closed and open when they are open

689 [IEV 441-15-12]

3.3.11**"b" contact****break contact**

control or auxiliary contact which is open when the main contacts of the mechanical switching device are closed and closed when they are open

[IEV 441-15-13]

3.3.12**release (of a mechanical switching device)**

device, mechanically connected to a mechanical switching device, which releases the holding means and permits the opening or the closing of the switching device

[IEV 441-15-17]

NOTE A release can have instantaneous, time-delay, etc. operation.

3.3.13**actuating system (of a mechanical switching device)**

whole of the operating means of a mechanical switching device which transmits the actuating force to the contact pieces

NOTE The operating means of an actuating system may be mechanical, electromagnetic, hydraulic, pneumatic, thermal, etc.

3.3.14**actuator**

part of the actuating system to which an external actuating force is applied

NOTE The actuator may take the form of a handle, knob, push-button, roller, plunger, etc.

[IEV 441-15-22]

3.3.15**position indicating device**

part of a mechanical switching device which indicates whether it is in the open, closed, or, where appropriate, earthed position

[IEV 441-15-25]

3.3.16**terminal**

conductive part of a device provided for electrical connection to external circuits

3.3.17**screw-type terminal**

terminal intended for the connection and disconnection of conductors or for the interconnection of two or more conductors, the connection being made, directly or indirectly, by means of screws or nuts of any kind

3.3.18**screwless-type terminal**

terminal intended for the connection and disconnection of conductors or for the interconnection of two or more conductors, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc.

3.3.19**universal terminal**

terminal for the connection and disconnection of all types of conductors (solid, stranded and flexible)

735 [SOURCE: IEC 60998-2-2:2002, 3.101.1, modified – “(rigid and flexible)” replaced with “(solid,
736 stranded and flexible)”.]

737 **3.3.20**

738 **non-universal terminal**

739 terminal for the connection and disconnection of a certain kind of conductor only (for example,
740 solid conductors only or solid and stranded conductors only)

741 [SOURCE: IEC 60998-2-2:2002, 3.101.2, modified – “rigid [solid and stranded]” replaced with
742 “solid and stranded”.]

743 **3.3.21**

744 **push-wire terminal**

745 non-universal terminal in which the connection is made by pushing in solid or stranded
746 conductors

747 [SOURCE: IEC 60998-2-2:2002, 3.101.3, modified – “rigid (solid or stranded)” replaced with
748 “solid or stranded”.]

749 **3.3.22**

750 **thread-forming tapping screw**

751 tapping screw having an uninterrupted thread. It is not a function of this thread to remove
752 material from the hole

753 NOTE An example of a thread-forming tapping screw is shown in Figure 1.

754

755 **3.3.23**

756 **thread-cutting tapping screw**

757 tapping screw having an interrupted thread. The thread is intended to remove material from the
758 hole

759 NOTE An example of a thread-cutting tapping screw is shown in Figure 2.

760

761 **3.3.24**

762 **clamping unit**

763 part of a terminal necessary for the mechanical clamping and the electrical connection of the
764 conductor(s)

765

766 **3.3.25**

767 **unprepared conductor**

768 conductor which has been cut and the insulation of which has been removed for insertion into
769 a terminal

770 NOTE A conductor, the shape of which is arranged for introduction into a terminal or the strands of which are twisted
771 to consolidate the end is considered to be an unprepared conductor.

772

773 **3.3.26**

774 **prepared conductor**

775 a conductor the end of which is fitted with an attachment such as eyelet, sleeve or cable lug”

776 [SOURCE: IEC 60050-442:1998, 442-01-27].

777 **3.3.27**

778 **solid conductor**

779 conductor consisting of a single wire

780 NOTE 1 to entry: The cross-section of the solid conductor can be circular or shaped.

781 NOTE 2 to entry: Solid conductor is defined as class 1 conductor in IEC 60228, or by IEC 60344, or equivalent
782 AWG/kcmil.

783 [SOURCE: IEC 60050-461:2008, 461-01-06, modified – In Note 1 to entry, “may” changed to
784 “can”, and Note 2 to entry has been added.]

785

786 **3.3.28**

787 **stranded conductor**

788 conductor consisting of a number of wires, all or some of which are wound in a helix

789 NOTE 1 to entry: Stranded conductor is defined as class 2 conductor in IEC 60228, or by IEC 60344, or equivalent
790 AWG/kcmil.

791 [SOURCE: IEC 60050-151:2001, 151-12-36, modified – Note 1 to entry has been added.]

792

793 **3.3.29**

794 **rigid conductor**

795 solid or stranded conductor having wires of such diameters, or so assembled, that the
796 conductor is not suitable for use in a flexible cable.

797 [SOURCE: IEC 60947-1:2020, 3-5-31.]

798

799 **3.3.30**

800 **flexible conductor**

801 stranded conductor having wires of diameters small enough and so assembled that the
802 conductor is suitable for use in a flexible cable

803 NOTE 1 to entry: Flexible conductor is defined as class 5 or class 6 conductor in IEC 60228, or by IEC 60344, or
804 equivalent AWG/kcmil.

805 [SOURCE: IEC 60050-461:2008, 461-01-11, modified – Note 1 to entry has been added.]

806

807 **3.4 Operation of switching devices**

808 **3.4.1**

809 **operation (of a mechanical switching device)**

810 transfer of the moving contact(s) from one position to an adjacent position

811 NOTE 1 For a circuit-breaker, this may be a closing operation or an opening operation.

812 NOTE 2 If distinction is necessary, an operation in the electrical sense, e.g. make or break, is referred to as a
813 switching operation, and an operation in the mechanical sense, e.g. close or open, is referred to as a mechanical
814 operation.

815 [IEV 441-16-01]

816 **3.4.2**

817 **operating cycle (of a mechanical switching device)**

818 succession of operations from one position to another and back to the first position through all
819 other positions, if any

820 [IEV 441-16-02]

3.4.3**operating sequence (of a mechanical switching device)**

succession of specified operations with specified time intervals

[IEV 441-16-03]

3.4.4**closing operation (of a mechanical switching device)**

operation by which the device is brought from the open position to the closed position

[IEV 441-16-08]

3.4.5**opening operation (of a mechanical switching device)**

operation by which the device is brought from the closed position to the open position

[IEV 441-16-09]

3.4.6**closed position (of a mechanical switching device)**

position in which the predetermined continuity of the main circuit of the device is secured

[IEV 441-16-22]

3.4.7**open position (of a mechanical switching device)**

position in which the predetermined dielectric withstand voltage requirements are satisfied between open contacts in the main circuit of the device

NOTE This definition differs from IEC 441-16-23 to meet the requirements of dielectric properties.

[IEV 441-16-23, modified]

3.4.8**position of rest (of a contactor)**

position which the moving elements of the contactor take up when its electromagnet or its compressed-air device is not energized

[IEV 441-16-24]

3.4.9**inching****jogging**

energizing a motor or solenoid repeatedly for short periods to obtain small movements of the driven mechanism

3.4.10**plugging**

stopping or reversing a motor rapidly by reversing the motor primary connections while the motor is running

3.5 Characteristic quantities**3.5.1****nominal value**

value of a quantity used to designate and identify a component, device, equipment, or system

NOTE The nominal value is generally a rounded value.

[IEV 151-16-09]

3.5.2**limiting value**

in a specification of a component, device, equipment, or system, the greatest or smallest admissible value of a quantity

[IEV 151-16-10]

3.5.3**rated value**

value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment, or system

[IEV 151-16-08]

3.5.4**rating**

set of rated values and operating conditions

[IEV 151-16-11]

3.5.5**prospective current (of a circuit and with respect to a switching device or a fuse)**

current that would flow in the circuit if each pole of the switching device or the fuse were replaced by a conductor of negligible impedance

NOTE The method to be used to evaluate and to express the prospective current is to be specified in the relevant publications.

[IEV 441-17-01]

3.5.6**prospective peak current**

peak value of a prospective current during the transient period following initiation

NOTE The definition assumes that the current is made by an ideal switching device, i.e. with instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different paths, e.g. polyphase circuits, it further assumes that the current is made simultaneously in all poles, even if only the current in one pole is considered.

[IEV 441-17-02]

3.5.7**maximum prospective peak current (of an AC circuit)**

prospective peak current when initiation of the current takes place at the instant which leads to the highest possible value

NOTE For a multipole device in a polyphase circuit, the maximum prospective peak current refers to a single pole only.

[IEV 441-17-04]

3.5.8**breaking current (of a switching device or a fuse)**

current in a pole of a switching device or in a fuse at the instant of initiation of the arc during a breaking process

[IEV 441-17-07]

NOTE For AC the current is expressed as the symmetrical RMS value of the AC component.

3.5.9**breaking capacity (of a switching device or a fuse)**

value of prospective current that a switching device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

[IEV 441-17-08]

NOTE 1 The voltage to be stated and the conditions to be prescribed are dealt with in the relevant product standard.

NOTE 2 For AC, the current is expressed as the symmetrical RMS value of the AC component.

NOTE 3 For short-circuit breaking capacity, see 3.5.11.

3.5.10**making capacity (of a switching device)**

value of prospective making current that a switching device is capable of making at a stated voltage under prescribed conditions of use and behaviour

[IEV 441-17-09]

NOTE 1 The voltage to be stated and the conditions to be prescribed are dealt with in the relevant product standard.

NOTE 2 For short-circuit making capacity, see 3.5.12.

3.5.11**short-circuit breaking capacity**

breaking capacity for which the prescribed conditions include a short-circuit at the terminals of the switching device

[IEV 441-17-11]

3.5.12**short-circuit making capacity**

making capacity for which prescribed conditions include a short circuit at the terminals of the switching device

[IEV 441-17-10]

3.5.13**joule integral (I^2t)**

integral of the square of the current over a given time interval

$$I^2t = \int_{t_0}^{t_1} i^2 dt$$

[IEV 441-18-23]

3.5.14**cut-off current****let-through current**

maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

NOTE This concept is of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

[IEV 441-17-12]

3.5.15**applied voltage (for a switching device)**

voltage which exists across the terminals of a pole of a switching device just before the making of the current

947 [IEV 441-17-24]

948 NOTE This definition applies to a single-pole device. For a multipole device it is the phase-to-phase voltage across
949 the supply terminals of the device.

950 **3.5.16**

951 **recovery voltage**

952 voltage which appears across the terminals of a pole of a switching device or a fuse after the
953 breaking of the current

954 [IEV 441-17-25]

955 NOTE 1 This voltage may be considered in two successive intervals of time, one during which a transient voltage
956 exists, followed by a second one during which the power frequency voltage or the steady-state recovery voltage
957 alone exists.

958 NOTE 2 This definition applies to a single-pole device. For a multipole device it is the phase-to-phase voltage
959 across the supply terminals of the device.

960 **3.5.17**

961 **transient recovery voltage**

962 **(TRV)**

963 recovery voltage during the time in which it has a significant transient character

964 [IEV 441-17-26]

965 NOTE The transient voltage may be oscillatory or non-oscillatory or a combination of these depending on the
966 characteristics of the circuit, the switching device or the fuse. It includes the voltage shift of the neutral of a polyphase
967 circuit.

968 **3.5.18**

969 **power-frequency recovery voltage**

970 recovery voltage after the transient voltage phenomena have subsided

971 [IEV 441-17-27]

972 **3.5.19**

973 **DC steady-state recovery voltage**

974 recovery voltage in a DC circuit after the transient voltage phenomena have subsided,
975 expressed by the mean value where ripple is present

976 [IEV 441-17-28]

977 **3.5.20**

978 **clearance**

979 distance between two conductive parts along a string stretched the shortest way between these
980 conductive parts

981 [IEV 441-17-31]

982 **3.5.21**

983 **creepage distance**

984 shortest distance along the surface of an insulating material between two conductive parts

985 NOTE A joint between two pieces of insulating material is considered part of the surface.

986 **3.5.22**

987 **working voltage**

988 highest RMS value of the AC voltage or the highest value of the DC voltage which may occur
989 (locally) across any insulation at rated supply voltage, transients being disregarded, in open
990 circuit conditions or under normal operating conditions

3.5.23**impulse withstand voltage**

highest peak value of an impulse voltage, of prescribed form and polarity, which does not cause breakdown under specified conditions of test

3.5.24**power-frequency withstand voltage**

RMS value of a power-frequency sinusoidal voltage which does not cause breakdown under specified conditions of test

3.5.25**pollution**

any addition of foreign matter, solid, liquid or gaseous (ionized gases) that may affect dielectric strength or surface resistivity

3.5.26**pollution degree (of environmental conditions)**

conventional number based on the amount of conductive or hygroscopic dust, ionized gas or salt and on the relative humidity and its frequency of occurrence, resulting in hygroscopic absorption or condensation of moisture leading to reduction in dielectric strength and/or surface resistivity

NOTE 1 The pollution degree of the micro-environment to which equipment is exposed may be different from that of the macro-environment where the equipment is located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture.

NOTE 2 For the purposes of this standard, the pollution degree is that of the micro-environment.

3.5.27**micro-environment (of a clearance or creepage distance)**

ambient conditions which surround the clearance or creepage distance under consideration

NOTE The micro-environment of the creepage distance or clearance and not the environment of the equipment determines the effect on the insulation. The micro-environment may be better or worse than the environment of the equipment. It includes all factors influencing the insulation such as climatic and electromagnetic conditions, generation of pollution, etc.

3.5.28**over-voltage category (of a circuit or within an electrical system)**

conventional number based on limiting (or controlling) the values of prospective transient over-voltages occurring in a circuit (or within an electrical system having different nominal voltages) and depending on the means employed to influence the over-voltages

NOTE In an electrical system, the transition from one over-voltage category to one of a lower category is obtained through appropriate means complying with interface requirements, such as an over-voltage protective device or a series-shunt impedance arrangement capable of dissipating, absorbing, or diverting the energy in the associated surge current, to lower the transient over-voltage value to that of the desired lower over-voltage category.

3.5.29**co-ordination of insulation**

correlation of insulating characteristics of electrical equipment with the expected over-voltages and the characteristics of over-voltage protective devices on the one hand, and with the expected micro-environment and the pollution protective means on the other hand

3.5.30**homogeneous field****uniform field**

electric field which has an essentially constant voltage gradient between electrodes, such as that between two spheres where the radius of each sphere is greater than the distance between them

3.5.31**inhomogeneous field****non-uniform field**

electric field which does not have an essentially constant voltage gradient between electrodes

3.5.32**tracking**

progressive formation of conducting paths which are produced on the surface of a solid insulating material, due to the combined effects of electric stress and electrolytic contamination on that surface

3.5.33**comparative tracking index****CTI**

numerical value of the maximum voltage in volts at which a material withstands 50 drops of a test solution without tracking

NOTE 1 The value of each test voltage and the CTI should be divisible by 25.

NOTE 2 This definition is based on 3.5 of IEC 60112:2003.

4 Classification

Subclause 5.2 gives all data which may be used as criteria for classification.

5 Characteristics of contactors**5.1 Summary of characteristics**

The characteristics shall be stated in the following terms, where such terms are applicable:

- type of contactor (see 5.2);
- rated and limiting values for main circuits (see 5.3);
- utilization category (see 5.4);
- control circuits (see 5.5);
- auxiliary circuits (see 5.6);
- co-ordination with short-circuit protective devices (see 5.7).

5.2 Type of contactor

The following shall be stated (see also Clause 6):

5.2.1 Number of poles**5.2.2 Method of control**

- automatic (by pilot switch or sequence control);
- non-automatic (e.g. by hand operation or by push-buttons);
- semi-automatic (i.e. partly automatic, partly non-automatic).

5.3 Rated and limiting values for main circuits**5.3.1 General**

The rated values established for a contactor shall be stated in accordance with 5.3.2 to 5.4 and 5.7, but it may not be necessary to establish all the listed values.

5.3.2 Rated voltages

A contactor is defined by the following rated voltages.

5.3.2.1 Rated operational voltage (U_e)

A rated operational voltage of a contactor is a value which, combined with a rated operational current, determines the application of the contactor and to which the relevant tests and the utilization categories are referred.

For a single-pole contactor, the rated operational voltage is generally stated as the voltage across the pole.

For a multipole contactor, it is generally stated as the voltage between phases.

NOTE 1 A contactor may be assigned a number of combinations of rated operational voltages and rated operational currents or powers for different duties and utilization categories.

NOTE 2 A contactor may be assigned a number of rated operational voltages and associated making and breaking capacities for different duties and utilization categories.

NOTE 3 Attention is drawn to the fact that the operational voltage may differ from the working voltage (see 3.5.22) within a contactor.

5.3.2.2 Rated insulation voltage (U_i)

The rated insulation voltage of a contactor is the value of voltage to which dielectric tests voltage and creepage distances are referred.

In no case shall the maximum value of the rated operational voltage exceed that of the rated insulation voltage.

NOTE For contactors without a specified rated insulation voltage, the highest value of the rated operational voltage is considered to be the rated insulation voltage.

5.3.2.3 Rated impulse withstand voltage (U_{imp})

The peak value of an impulse voltage of prescribed form and polarity which the contactor is capable of withstanding without failure under specified conditions of test and to which the values of the clearances are referred.

The rated impulse withstand voltage of a contactor shall be equal to or higher than the values stated for the transient over-voltages occurring in the circuit in which the contactor is fitted.

NOTE Preferred values of rated impulse withstand voltage are given in Table 16.

5.3.3 Currents or powers

A contactor is defined by the following currents.

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

The conventional free air thermal current is the maximum value of test current to be used for temperature-rise tests of an unenclosed contactor in free air (see 9.3.3.3).

The value of the conventional free air thermal current shall be at least equal to the maximum value of the rated operational current (see 5.3.3.3) of the unenclosed contactor in eight-hour duty (see 5.3.5.1).

Free air is understood to be air in normal indoor conditions, reasonably free from draughts and external radiation.

1117 NOTE 1 This current is not a rating and is not mandatorily marked on the contactor.

1118 NOTE 2 An unenclosed contactor is a contactor supplied by the manufacturer without an enclosure or a contactor
1119 supplied by the manufacturer with an integral enclosure which is not normally intended to be the sole contactor
1120 protective enclosure. An unenclosed contactor is characterised by IP00".

1121 5.3.3.2 Conventional enclosed thermal current (I_{the})

1122 The conventional enclosed thermal current is the value of current stated by the manufacturer
1123 to be used for the temperature-rise tests of the contactor when mounted in a specified
1124 enclosure. Such tests shall be in accordance with 9.3.3.3 and are mandatory if the contactor is
1125 described as an enclosed contactor in the manufacturer's catalogues and normally intended for
1126 use with one or more enclosures of specified type and size (see Note 2 of 5.3.3.2).

1127 The value of the conventional enclosed thermal current shall be at least equal to the maximum
1128 value of the rated operational current (see 5.3.3.3) of the enclosed contactor in eight-hour duty
1129 (see 5.3.5.1).

1130 If the contactor is normally intended for use in unspecified enclosures, the test is not mandatory
1131 if the test for conventional free air thermal current (I_{th}) has been made. In this case, the
1132 manufacturer shall be prepared to give guidance on the value of the enclosed thermal current
1133 or the derating factor.

1134 NOTE 1 This current is not a rating and is not mandatorily marked on the contactor.

1135 NOTE 2 An enclosed contactor is a contactor normally intended for use with a specified type and size of enclosure
1136 or intended for use with more than one type of enclosure.

1137 5.3.3.3 Rated operational currents (I_e) or rated operational powers

1138 A rated operational current of a contactor is stated by the manufacturer and takes into account
1139 the rated operational voltage (see 5.3.2.1), the conventional free air or enclosed thermal
1140 current, the rated frequency (see 5.3.4), the rated duty (see 5.3.5), the utilization category (see
1141 5.4) and the type of protective enclosure, if any.

1142 In the case of a contactor for the direct switching of individual motors or LED lamps, the
1143 indication of a rated operational current may be replaced or supplemented by an indication of
1144 the maximum rated power output, at the rated operational voltage considered, of the load for
1145 which the contactor is intended. The manufacturer shall be prepared to state the relationship
1146 assumed between the operational current and the operational power.

1147 5.3.4 Rated frequency

1148 The supply frequency for which a contactor is designed and to which the other characteristic
1149 values correspond.

1150 NOTE The same contactor may be assigned a number or a range of rated frequencies.

1151 5.3.5 Rated duties

1152 The rated duties considered as normal are the following.

1153 5.3.5.1 Eight-hour duty (continuous duty)

1154 A duty in which the main contacts of a contactor remain closed while carrying a steady current
1155 long enough for the contactor to reach thermal equilibrium but not for more than eight hours
1156 without interruption.

1157 NOTE 1 This is the basic duty on which the conventional thermal currents I_{th} and I_{the} of the contactor are
1158 determined.

1159 NOTE 2 Interruption means breaking the current by operating the contactor.

5.3.5.2 Intermittent periodic duty or intermittent duty

A duty with on-load periods, during which the main contacts of a contactor remain closed, having a definite relation to off-load periods, both periods being too short to allow the contactor to reach thermal equilibrium.

Intermittent duty is characterized by the value of the current, the duration of the current flow and by the on-load factor which is the ratio of the in-service period to the entire period, often expressed as a percentage.

According to the number of operating cycles which they are capable of carrying out per hour, contactors are divided into the following preferred classes:

– class	1:	1	operating cycle per hour;
– class	3:	3	operating cycles per hour;
– class	12:	12	operating cycles per hour;
– class	30:	30	operating cycles per hour;
– class	120:	120	operating cycles per hour;
– class	300:	300	operating cycles per hour;
– class	1 200:	1 200	operating cycles per hour.

A contactor intended for intermittent duty may be designated by the characteristics of intermittent duty.

EXAMPLE An intermittent duty comprising a current flow of 32 A for 2 min within every 5 min may be stated as: 32 A, class 12, 40 %.

5.3.5.3 Temporary duty

Duty in which the main contacts of a contactor remain closed for periods insufficient to allow the contactor to reach thermal equilibrium, the on-load periods being separated by off-load periods of sufficient duration to restore equality of temperature with the cooling medium.

5.3.5.4 Periodic duty

A type of duty in which operation, whether at constant or variable load, is regularly repeated.

5.3.6 Normal load and overload characteristics

This subclause gives general requirements concerning ratings under normal load and overload conditions.

Detailed requirements are given in 8.2.4.

5.3.6.1 Ability to withstand motor switching overload currents

A contactor intended for switching motors shall be capable of withstanding the thermal stresses due to starting and accelerating a motor to normal speed and due to operating overloads.

Requirements to meet these conditions are given in 8.2.4.4.

5.3.6.2 Rated making capacity

Requirements for the various utilization categories (see 5.4) are given in 8.2.4.2. The rated making and breaking capacities are only valid when the contactor is operated in accordance with the requirements of 8.2.1.1 and 8.2.1.2.

1198 5.3.6.3 Rated breaking capacity

1199 Requirements for the various utilization categories (see 5.4) are given in 8.2.4.2. The rated
1200 making and breaking capacities are only valid when the contactor is operated in accordance
1201 with the requirements of 8.2.1.1 and 8.2.1.2.

1202 5.3.6.4 Conventional operational performance

1203 Specified as a series of making and breaking operations in 8.2.4.3.

1204 5.3.7 Rated conditional short-circuit current

1205 The rated conditional short-circuit current of a contactor is the value of prospective current
1206 stated by the manufacturer, that the contactor, protected by a short-circuit protective device
1207 specified by the manufacturer, can withstand satisfactorily for the operating time of this device
1208 under the test conditions specified in 9.3.4.

1209 The details of the specified short-circuit protective device shall be stated by the manufacturer.

1210 NOTE The rated conditional short-circuit current is expressed by the RMS value of the AC component.

1211 5.4 Utilization category

1212 5.4.1 General

1213 The utilization category of a contactor defines the intended application and is characterized by
1214 one or more of the following service conditions:

- 1215 – current(s), expressed as multiple(s) of the rated operational current;
- 1216 – voltage(s), expressed as multiple(s) of the rated operational voltage;
- 1217 – power-factor.

1218 The standard utilization categories are given in Table 1.

1219 Each utilization category is characterized by the values of the currents, voltages, power-factors
1220 and other data of Table 7 and Table 9 and by the test conditions specified in this standard.

1221 It is therefore unnecessary to specify separately the rated making and breaking capacities as
1222 these values depend directly on the utilization category as shown in Table 7.

1223 Unless otherwise stated, contactors of utilization category AC-7b are designed on the basis of
1224 the starting characteristics of the motors compatible with the making capacities of Table 7.
1225 When the starting current of a motor, with stalled rotor, exceeds these values, the operational
1226 current should be decreased accordingly.

1227 5.4.2 Assignment of utilization categories based on the results of tests

1228 A contactor which has been tested for one utilization category or at any combination of
1229 parameters (such as highest operational voltage and current, etc.) can be assigned another
1230 utilization category without testing provided that the test currents, voltages, power-factors,
1231 number of operating cycles, ON and OFF times given in Table 7 and Table 9 and the test circuit
1232 for the assigned utilization category are not more severe than those at which the contactor has
1233 been tested and the temperature-rise has been verified at a current not less than the highest
1234 assigned rated operational current in continuous duty.

1235 **Table 1 – Utilization categories**

Utilization categories ^a	Typical loads
AC-7a	Slightly inductive

AC-7b	Motor ^b
AC-7c	Switching of compensated electric discharge lamp control ^c
AC-7d	LED lamp
^a Contactors may have other utilization categories, in which case they shall comply with the requirements of IEC 60947-4-1 for such categories. ^b The AC-7b category may be used for occasional inching (jogging) or plugging for limited time periods; during such limited time periods the number of operations should not exceed 5/min or more than 10 in a 10-minute period. ^c This category is similar to a capacitive switching category AC-6b as defined in IEC 60947-4-1 for the switching of capacitor banks, the characteristic being very dependent on the capacitance value of the lamp circuit.	

5.5 Control circuits

The characteristics of control circuits are:

- kind of current;
- rated frequency;
- rated control circuit voltage U_c (nature and frequency);
- rated control supply voltage U_s (nature and frequency), where applicable;
- suitability to be connected to SELV circuits.

NOTE A distinction has been made above between the control circuit voltage, which would appear across the "a" contacts (see 3.3.11) in the control circuit, and the control supply voltage, which is the voltage applied to the input terminals of the control circuit of the contactor and which may be different from the control circuit voltage owing to the presence of built-in transformers, rectifiers, resistors, etc.

The rated control circuit voltage and rated frequency, if any, are the values on which the operating and temperature-rise characteristics of the control circuit are based.

5.6 Auxiliary circuits

The characteristics of auxiliary circuits are the number and kind of contacts ("a" contact, "b" contact, etc.) in each of these circuits and their ratings according to IEC 60947-5-1.

The characteristics of auxiliary contacts and switches shall comply with the requirements of that standard.

5.7 Co-ordination with short-circuit protective devices

Contactors are characterized by the type, ratings and characteristics of the short-circuit protective devices (SCPD) to be used to provide adequate protection of the contactor against short-circuit currents. Requirements are given in 8.2.5.

6 Product information

6.1 Nature of information

The following information shall be given by the manufacturer.

6.1.1 Identification

- a) the manufacturer's name or trade mark;
- b) type designation or serial number;
- c) number of this document, if the manufacturer claims compliance.

6.1.2 Characteristics, basic rated values and utilization

- d) rated operational voltages (see 5.3.2.1);
- e) utilization category and rated operational currents (or rated powers), at the rated operational voltage (see 5.3.3.3 and 5.4);
- f) value of the rated frequency/frequencies, e.g.: 50 Hz or 50 Hz/60 Hz;
- g) rated duty with indication of the class of intermittent duty, if any (see 5.3.5).

Associated values:

- h) rated making and breaking capacities. These indications may be replaced, where applicable, by the indication of the utilization category (see Table 7);

Safety and installation:

- i) rated insulation voltage (see 5.3.2.2);
- j) rated impulse withstand voltage (see 5.3.2.3), the marking of U_{imp} is not required if equal to 4 kV;
- k) IP code, in case of an enclosed contactor (see 8.1.11);
- l) pollution degree (see 7.1.3.2);
- m) rated conditional short-circuit current (see 5.3.7) and the type, current rating and characteristics of the associated SCPD;
- n) 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

Control circuits (see 5.5):

The following information concerning control circuits shall be placed either on the coil or on the contactor:

- o) rated control circuit voltage (U_c), nature of current and rated frequency;
- p) if necessary, nature of current, rated frequency and rated control supply voltage (U_s);

For contactors, the control circuit of which is intended to be connected to a SELV supply:

- q) suitability of the control circuit to be connected to a SELV supply, the main circuit being supplied with a voltage having a value greater than that of the SELV circuit.

Auxiliary circuits:

- r) ratings of auxiliary circuits (see 5.6).

6.2 Marking

Markings shall be indelible and easily legible.

Marking of the manufacturer's name or trade mark and type designation or serial number is mandatory on the contactor, preferably on the nameplate if any, to enable complete data to be obtained from the manufacturer.

NOTE 1 In the USA and Canada, the rated operational voltage U_e may be marked as follows:

- a) on equipment for use on three-phase – four-wire systems, by both the value of phase-to-earth voltage and that of phase-to-phase voltage, e.g. 277/480 V;
- b) on equipment for use on three-phase – three-wire systems, by the value of phase-to-phase voltage, e.g. 480 V.

1305 The following information shall be marked and visible after mounting:

- 1306 – direction of movement of the actuator (see 8.1.5.3), if applicable;
- 1307 – indication of the position of the actuator (see also 8.1.6.1 and 8.1.6.2);
- 1308 – reference to this standard, if the manufacturer claims compliance.

1309 The following information shall be marked and visible after wiring, before installation of covers
1310 or lids:

- 1311 – for miniaturized contactors, symbol, colour code or letter code;
- 1312 – terminal identification and marking (see 8.1.7.4);
- 1313 – IP code and class of protection against electric shock, when applicable (marked preferably
1314 on the contactor as far as possible).

1315 Markings shall not be placed on screws, removable washers or other removable parts.

1316 Data under k) shall be indicated on the enclosure, if any.

1317 Data under c) shall be indicated on the nameplate.

1318 Data under n), if relevant, shall be indicated on the nameplate, or marked on the contactor or,
1319 if the space available is not sufficient, on the smallest package unit or in technical information
1320 provided with the product or in the manufacturer's published literature. In the case of a group
1321 of terminals located together, a single marking on the device is acceptable. An appropriate
1322 marking indicating the length of insulation to be removed before insertion of the conductor into
1323 the terminal shall be shown on the contactor.

1324 Data under d) to j), l), m) and o) to r) shall be included on the nameplate, or on the contactor,
1325 or in the manufacturer's published literature.

1326 Marking of terminals shall be in accordance with Annex A of this standard.

1327 NOTE 2 Additional utilization categories according to IEC 60947-4-1 may also be marked (see footnote a to Table 1
1328 of this document).

1329 **6.3 Instructions for installation, operation and maintenance**

1330 The manufacturer shall specify in his documents or catalogues the conditions, if any, for
1331 installation, operation and maintenance of the contactor during operation and after a fault.

1332 If necessary, the instructions for the transport, installation and operation of the contactor shall
1333 indicate the measures that are of particular importance for the proper and correct installation,
1334 commissioning, operation, decommissioning and dismantling of the contactor.

1335 For each relevant potential hazard especially when using electronic technology, the
1336 manufacturer shall provide safety signs, graphical symbols or safety notes of the hazard for
1337 example by using e.g., IEC 60417-5036. Signal words shall be defined according to ISO 3864-
1338 2.

1339 NOTE ISO/IEC 82079-1 provide guidance for developing safety instructions

1340 These documents shall indicate the recommended extent and frequency of maintenance, if any.

7 Normal service, mounting and transport conditions

7.1 Normal service conditions

Contactors complying with this standard shall be capable of operating under the following standard conditions.

7.1.1 Ambient air temperature

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.

The lower limit of the ambient air temperature is –5 °C.

Ambient air temperature is that existing in the vicinity of the contactor if supplied without enclosure, or in the vicinity of the enclosure if supplied with an enclosure.

Contactors intended to be used in ambient air temperatures above +40°C (particularly in tropical countries) or below –5 °C shall either be specially designed or be used according to the information given in the manufacturer's catalogue.

7.1.2 Altitude

The altitude of the site of installation does not exceed 2 000 m.

For installations at higher altitudes, it is necessary to take into account the reduction of the dielectric strength and the cooling effects of the air.

Contactors intended to be so used shall be designed especially or used according to an agreement between manufacturer and user.

Information in the manufacturer's catalogue may take the place of such an agreement.

7.1.3 Atmospheric conditions

7.1.3.1 Humidity

The relative humidity of the air does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidities may be permitted at lower temperatures, e.g. 90 % at +20 °C. Special measures may be necessary in cases of occasional condensation due to variation in temperature.

NOTE The pollution degrees given in 7.1.3.2 define the environmental conditions more precisely.

7.1.3.2 Pollution degree

The pollution degree (see 3.5.26) refers to the environmental conditions for which the contactor is intended.

NOTE The micro-environment of the creepage distance or clearance and not the environment of the contactor determines the effect on the insulation. The micro-environment may be better or worse than the environment of the contactor. It includes all the factors influencing the insulation, such as climatic and electromagnetic conditions, generation of pollution, etc.

For contactors intended for use within an enclosure or provided with an integral enclosure, the pollution degree of the environment in the enclosure is applicable.

For the purposes of evaluating clearances and creepage distances, the following four degrees of pollution of the micro-environment are established (the clearances and creepage distances being according to the different pollution degrees given in Table 17 and Table 18).

1380 *Pollution degree 1:*

1381 No pollution or only dry, non-conductive pollution occurs.

1382 *Pollution degree 2:*

1383 Normally, only non-conductive pollution occurs. Occasionally, however, a temporary
1384 conductivity caused by condensation may be expected.

1385 *Pollution degree 3:*

1386 Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive
1387 due to condensation.

1388 *Pollution degree 4:*

1389 The pollution generates persistent conductivity caused, for instance, by conductive dust or by
1390 rain or snow.

1391 *Standard pollution degree of household and similar applications:*

1392 Contactors for household and similar applications are generally for use in a pollution degree 2
1393 environment.

1394 **7.1.4 Normal electromagnetic environmental conditions**

1395 The normal electromagnetic environmental conditions are those which relate to low-voltage
1396 public networks such as residential, commercial and light industrial locations/installations.

1397 **7.2 Conditions during transport and storage**

1398 The conditions during transport and storage, e.g. temperature and humidity, are those defined
1399 in 7.1, except that, unless otherwise specified, the following temperature range applies during
1400 transport and storage: between $-25\text{ }^{\circ}\text{C}$ and $+55\text{ }^{\circ}\text{C}$ and, for short periods not exceeding 24 h,
1401 up to $+70\text{ }^{\circ}\text{C}$.

1402 **7.3 Mounting**

1403 The contactor shall be mounted in accordance with the manufacturer's instructions.

1404 **8 Constructional and performance requirements**

1405 **8.1 Constructional requirements**

1406 **8.1.1 General**

1407 The contactor with its enclosure, if any, whether integral or not, shall be designed and
1408 constructed to withstand the stresses occurring during installation and normal use and, in
1409 addition, shall provide a specified degree of resistance to abnormal heat and fire.

1410 NOTE An enclosed contactor is a contactor mounted in an enclosure, designed and dimensioned to contain one
1411 contactor only.

1412 Protection against hazards caused by the electronic circuits shall be maintained under normal
1413 and single fault conditions, as specified in this document.

1414 8.1.2 Materials

1415 8.1.2.1 General

1416 The suitability of materials used is verified by making the following tests on the contactor and/or,
1417 if not practicable, on parts taken from it.

- 1418 – resistance to ageing (see 8.1.2.2)
- 1419 – resistance to humidity (see 8.1.2.3)
- 1420 – resistance to heat (see 8.1.2.4)
- 1421 – resistance to abnormal heat and fire (see 8.1.2.5)
- 1422 – resistance to rusting (see 8.1.2.6)

1423 As far as resistance to heat, abnormal heat and fire hazard are concerned, priority shall be
1424 given to tests made on the contactor or on a suitable part taken from the contactor.

1425 However, in certain cases, tests on materials may be used, for practical reasons, as an
1426 alternative to tests on the contactor.

1427 8.1.2.2 Resistance to ageing

1428 Contactors shall be resistant to ageing.

1429 In general, it is only necessary to test contactors having (or supplied with) enclosures or parts
1430 of p.v.c. or similar thermoplastic material and parts of rubber such as sealing rings and gaskets.

1431 *Compliance is checked by inspection and, if necessary, by a test according to 9.2.2.1.*

1432 8.1.2.3 Resistance to humidity

1433 The contactor shall be protected against the effects of humidity which may occur in normal
1434 service.

1435 *Compliance shall be verified by the test specified in 9.2.2.2.*

1436 8.1.2.4 Resistance to heat

1437 All parts of enclosed, partially enclosed and unenclosed contactors intended to prevent access
1438 to live parts shall not be adversely affected by the highest temperature likely to be reached
1439 during normal service.

1440 *Compliance shall be verified by the tests specified in 9.2.2.3.1 and 9.2.2.3.2.*

1441 8.1.2.5 Resistance to abnormal heat and fire

1442 Parts of insulating material which might be exposed to thermal stresses due to electrical effects,
1443 the deterioration of which might impair the safety of the contactor, shall not be adversely
1444 affected by abnormal heat or fire.

1445 *Compliance shall be verified by the test specified in 9.2.2.4.*

1446 If a test has to be made at more than one place on the same sample, care shall be taken to
1447 ensure that any deterioration caused by previous tests does not affect the test to be made.
1448 Small parts with surface dimensions not exceeding 14 mm × 14 mm are not subjected to the
1449 test.

8.1.2.6 Resistance to rusting

Ferrous parts of the contactor including enclosures and covers, but excluding pole faces of electromagnets, shall be protected against rusting.

Compliance shall be verified by the test specified in 9.2.2.5.

8.1.3 Strength of screws or nuts other than those on terminals which are intended to be operated during installation or maintenance

Screws or nuts intended to be operated during installation or maintenance, as recommended by the manufacturer, shall withstand the mechanical stresses occurring in normal service.

Thread-forming tapping screws and thread-cutting tapping screws intended only for mechanical assembly may be used provided they are supplied together with the piece in which they are intended to be inserted.

An example of a thread-forming tapping screw is shown in Figure 1. An example of a thread-cutting tapping screw is shown in Figure 2. In addition, thread-cutting tapping screws intended to be operated by the installer shall be captive with the relevant part of the accessory.

Screws or nuts which transmit contact pressure shall be in engagement with metal threads.

For electrical connections, no contact pressure shall be transmitted through insulating material other than ceramic or other material with characteristics not less suitable and compensated for any possible shrinkage or yielding.

Compliance shall be verified by inspection and by the test of 9.2.3.

8.1.4 Vacant**8.1.5 Actuator****8.1.5.1 General**

The requirements of 8.1.5.2 and 8.1.5.3 apply to contactors provided with a manually operated actuator.

8.1.5.2 Insulation

The actuator of the contactor shall be insulated from the live parts for the rated insulation voltage and, if applicable, the rated impulse withstand voltage.

Moreover:

- if the activator is made of metal, it shall be capable of being satisfactorily connected to a protective conductor unless it is provided with additional reliable insulation;
- if it is made of or covered by insulating material, any internal metal part which might become accessible in the event of insulation failure shall also be insulated from live parts for the rated insulation voltage.

8.1.5.3 Direction of movement

The direction of operation for actuators of devices shall normally conform to IEC 60447. Where devices cannot conform to these requirements, e.g. due to special applications or alternative mounting positions, they shall be clearly marked such that there is no doubt as to the "I" and "O" positions and the direction of the operation.

8.1.5.4 Mounting

Actuators mounted on removable panels or opening doors shall be so designed that when the panels are replaced or the doors closed, the actuator will engage correctly with the associated mechanism.

8.1.6 Indication of the OFF and ON positions

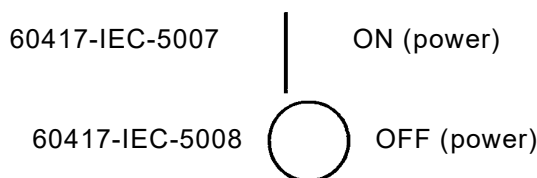
8.1.6.1 Indicating means

When a contactor is provided with means for indicating the closed and open positions, these positions shall be unambiguous and clearly indicated.

NOTE In the case of enclosed contactors, the indication may or may not be visible from the outside.

This is done by means of a position indicating device (see 3.3.16).

If symbols are used, they shall indicate the closed and open positions respectively, in accordance with IEC 60417:



For contactors operated by means of two push-buttons, only the push-button designated for the opening operation shall be red or marked with the symbol "O".

Red colour shall not be used for any other push-button.

The colours of other push-buttons, illuminated push-buttons and indicator lights shall be in accordance with IEC 60073.

8.1.6.2 Indication by the actuator

When the actuator is used to indicate the position of the contacts, it shall automatically take up or stay in, when released, the position corresponding to that of the moving contacts; in this case, the actuator shall have two distinct rest positions corresponding to those of the moving contacts, but for automatic opening, a third distinct position of the actuator may be provided.

8.1.7 Terminals

8.1.7.1 Constructional requirements

All parts of terminals which maintain contact and carry current shall be of metal having adequate mechanical strength.

Terminal connections shall be such that the force to connect the conductors may be applied by screws, screwless-type or other equivalent means to ensure that the necessary contact pressure is maintained.

Terminals shall be so constructed that the conductors can be clamped between suitable surfaces without any significant damage either to conductors or terminals.

Terminals shall not allow the conductors to be displaced or be displaced themselves in a manner detrimental to the operation of the contactor and the insulation voltage shall not be reduced below the rated values.

1523 Screwless terminals shall be so designed and constructed that each conductor is clamped
1524 individually.

1525 Screwless-type clamping units, unless otherwise specified by the manufacturer, shall accept
1526 solid, stranded and flexible conductors.

1527 On screwless-type clamping unit, the connection or disconnection of conductors shall be made
1528 as follows:

1529 – on universal clamping units by the use of a general-purpose tool or a convenient device,
1530 integral with the clamping unit to open it for the insertion or withdrawal of the conductors;

1531 – on push-wire clamping units by simple insertion. For the disconnection of the conductors
1532 an operation other than a pull only on the conductor shall be necessary. The use of a general-
1533 purpose tool or of a convenient device, integral with the clamping unit is allowed in order to
1534 "open" it and to assist the insertion or the withdrawal of the conductor.

1535 Examples of screwless terminals are given in Figure 23

1536 The requirements of this subclause shall be verified by the tests of 9.2.5.2, 9.2.5.3, 9.2.5.4,
1537 9.2.5.6 and 9.2.5.7 as applicable.

1538 NOTE North American countries have particular requirements for terminals suitable for aluminium conductors and
1539 marking to identify the use of aluminium conductors.

1540

1541 8.1.7.2 Connecting capacity

1542 The manufacturer shall state the type (rigid – solid or stranded – or flexible), the minimum and
1543 the maximum cross-sections of conductors for which the terminal is suitable and, if applicable,
1544 the number of conductors simultaneously connectable to the terminal. However, the maximum
1545 cross-section shall not be smaller than that stated in 9.3.3.3 for the temperature-rise test and
1546 the terminal shall be suitable for conductors of the same type (rigid – solid or stranded – or
1547 flexible) at least two sizes smaller, as given in the appropriate column of Table 2.

1548 Standard values of cross-sections of round copper conductors (both metric and AWG/MCM
1549 sizes) are shown in Table 2 which also gives the approximate relationship between ISO metric
1550 and AWG/MCM sizes.

1551 **Table 2 – Standard cross-sections of round copper conductors**

ISO cross-sections mm ²	AWG/MCM	
	Sizes	Equivalent cross-sections mm ²
0,2	24	0,205
–	22	0,324
0,5	20	0,519
0,75	18	0,82
1	–	–
1,5	16	1,3
2,5	14	2,1
4	12	3,3
6	10	5,3
10	8	8,4
16	6	13,3
25	4	21,2

35	2	33,6
NOTE The dash, when it appears, counts as a size when considering connecting capacity.		

1552

1553 **8.1.7.3 Connection**

1554 Terminals for connection to external conductors shall be readily accessible during installation.

1555 Clamping screws and nuts shall not serve to fix any other component although they may hold
1556 the terminals in place or prevent them from turning.

1557 **8.1.7.4 Terminal identification and marking**

1558 Terminals shall be clearly and permanently identified in accordance with IEC 60445.

1559 Terminals intended exclusively for the neutral conductor shall be identified by the letter "N", in
1560 accordance with IEC 60445.

1561 The protective earth terminal shall be identified in accordance with 8.1.9.3.

1562 Additional requirements for terminal identification and marking are given in Annex A.

1563 **8.1.8 Additional requirements for contactors provided with a neutral pole**

1564 When a contactor is provided with a pole intended only for connecting the neutral, this pole
1565 shall be clearly identified to that effect by the letter "N" (see 8.1.7.4).

1566 A switched neutral pole shall not break before and shall not make after the other poles.

1567 The value of the conventional thermal current shall be identical for all poles.

1568 **8.1.9 Provisions for earthing**1569 **8.1.9.1 Constructional requirements**

1570 The exposed conductive parts (e.g. chassis, framework and fixed parts of metal enclosures)
1571 other than those which cannot constitute a danger shall be electrically interconnected and
1572 connected to a protective earth terminal for connection to an earth electrode or to an external
1573 protective conductor.

1574 This requirement can be met by the normal structural parts providing adequate electrical
1575 continuity and applies whether the contactor is used on its own or incorporated in an assembly.

1576 Exposed conductive parts are not considered to constitute a danger if they cannot be touched
1577 on large areas or grasped with the hand or if they are of small size (approximately 50 mm × 50
1578 mm) or are so located as to exclude any contact with live parts.

1579 Examples of these are screws, rivets, nameplates, transformer cores, electromagnets and
1580 certain parts of releases, irrespective of their size.

1581 **8.1.9.2 Protective earth terminal**

1582 The protective earth terminal shall be readily accessible and so placed that the connection of
1583 the contactor to the earth electrode or to the protective conductor is maintained when the cover
1584 or any other removable part is removed.

1585 The protective earth terminal shall be suitably protected against corrosion.

1586 In the case of contactors with conductive structures, enclosures, etc., means shall be provided
1587 if necessary to ensure electrical continuity between the exposed conductive parts of the
1588 contactors and the metal sheathing of connecting conductors.

1589 The protective earth terminal shall have no other function, except when it is intended to be
1590 connected to a PEN conductor. In that case, it shall also have the function of a neutral terminal
1591 in addition to meeting the requirements applicable to the protective earth terminal.

1592 **8.1.9.3 Protective earth terminal marking and identification**

1593 The protective earth terminal shall be clearly and permanently identified by its marking.

1594 The identification shall be achieved by colour (green-yellow mark) or by the notation PE, or
1595 PEN as applicable, in accordance with Clause 7 of IEC 60445:2017, or, in the case of PEN, by
1596 a graphical symbol for use on contactors.

1597 The graphical symbol to be used is symbol:

1598 60417-IEC-5019  Protective earth (ground)

1599 of IEC 60417.

1600 NOTE The symbol  (60417-IEC-5017) previously recommended is progressively superseded by the preferred
1601 symbol 60417-IEC-5019 given above.

1602 **8.1.10 Enclosures**

1603 **8.1.10.1 General**

1604 The following requirements are applicable only to enclosures supplied or intended to be used
1605 with the contactor.

1606 **8.1.10.2 Design**

1607 The enclosure shall be so designed that when it is opened and other protective means, if any,
1608 have been removed, all parts requiring access for installation and maintenance, as prescribed
1609 by the manufacturer, are readily accessible.

1610 Sufficient space shall be provided inside the enclosure for the accommodation of external
1611 conductors from their point of entry into the enclosure to the terminals to ensure adequate
1612 connection.

1613 The fixed parts of a metal enclosure shall be electrically connected to the other exposed
1614 conductive parts of the contactor and connected to a terminal which enables them to be earthed
1615 or connected to a protective conductor.

1616 Under no circumstances shall a removable metal part of the enclosure be insulated from the
1617 part carrying the earth terminal when the removable part is in place.

1618 The removable parts of the enclosure shall be firmly secured to the fixed parts by a device such
1619 that they cannot be accidentally loosened or detached owing to the effects of operation of the
1620 contactor or its vibrations.

1621 For enclosures having a degree of protection IP1X up to and including IP4X, sufficient space
1622 shall be provided for establishing a drain-hole. Subclause 11.3 of IEC 60529 applies with the
1623 following addition: