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

Interested committees:

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

Part 1: General rules

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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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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/586A/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

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121A/540/CD, 121A/550A/CC

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

SECRETARIAT:

France

SECRETARY:

Mr Michaël LAHEURTE

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 18, SC 23E, SC 121B

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:

Low-voltage switchgear and controlgear - Part 1: General rules

NOTE FROM TC/SC OFFICERS:

Officers of SC121A supports circulation of CD2 for project IEC 60947-1 ED7.

Secretary note 1: NCs are kindly requested to refer their comments to line numbers.

Secretary note 2: terms and definitions in annexes will be moved to clause 3 at a later stage...

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: General rules

FOREWORD

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International Standard IEC 60947-1 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This edition cancels and replaces the sixth edition published in 2020, This edition constitutes a technical revision.

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

- introduction of different EMC environments;
- improvement of Annex R (new Figure R.5);
- Reference to IEC 62683 DB;
- Reference to MPSD;
- Safety aspects related to:
 - General aspects;

- 616 – Limited energy sources;
- 617 – Breakdown of components analysis and test
- 618 – Use of voltage limiting components, including particular routine test;
- 619 – Minimum creepage distances and flammability of printed wiring board
- 620 – Mention of dedicated wiring accessories;
- 621 – Rub test for mandatory marking
- 622 – Reference environmental conditions for transport, storage and services
- 623 – Material selection methods harmonised with IEC 61800-5-1
- 624 – Introduction the PCB terminal block according to IEC 60947-7-4;
- 625 – Requirements for the connection of aluminium conductors in Annex B;
- 626 – Replacement of the annexes O and W by the reference to IEC TS 63058;
- 627 – Determination of critical DC load current;
- 628 – DC utilization categories added to Annex A;
- 629 – Determination of power losses in the main circuit;
- 630 – IP ratings and testing of components intended to be mounted to enclosure walls;
- 631 – Update of Table 4 with reduced head diameter screw;
- 632 – Built-in single-drop digital communication interface in Annex Y.

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

FDIS	Report on voting
121A/337/FDIS	121A/344/RVD

634
635 Full information on the voting for the approval of this standard can be found in the report on
636 voting indicated in the above table.

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

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

640 The committee has decided that the contents of this publication will remain unchanged until
641 the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data
642 related to the specific publication. At this date, the publication will be

- 643 • reconfirmed,
- 644 • withdrawn,
- 645 • replaced by a revised edition, or
- 646 • amended.

647

648 The National Committees are requested to note that for this publication the stability date
649 is 202X.

650 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED
651 AT THE PUBLICATION STAGE.

652

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

653

654

655

INTRODUCTION

656 The purpose of this document is to harmonize as far as practicable all rules and requirements
657 of a general nature applicable to low-voltage switchgear and controlgear in order to obtain
658 uniformity of requirements and tests throughout the corresponding range of equipment and to
659 avoid the need for testing to different standards.

660 All those parts of the various equipment standards which can be considered as general have
661 therefore been gathered in this document together with specific subjects of wide interest and
662 application, e.g. temperature-rise, dielectric properties, etc.

663 For each type of low-voltage switchgear and controlgear, only two main documents are
664 necessary to determine all requirements and tests:

- 665 1) this document, referred to as "Part 1" or "IEC 60947-1" in the specific standards covering
666 the various types of low-voltage switchgear and controlgear;
- 667 2) the relevant equipment standard hereinafter referred to as the "relevant product standard"
668 or "product standard of this series".

669 For a general rule to apply to a specific product standard, it will be explicitly referred to by the
670 latter, by quoting the relevant clause or subclause number of this document followed by
671 "IEC 60947-1" e.g. "7.2.3 of IEC 60947-1:20xx".

672 A specific product standard will only deviate from the general rules when there is substantial
673 technical justification.

674 NOTE All references to "product standards" in this document means "product standards of IEC 60947 series".

675

676

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: General rules

1 Scope

This document applies, when required by the relevant product standard, to low-voltage switchgear and controlgear hereinafter referred to as "equipment" or "device" and intended to be connected to circuits, the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC.

This document states the general rules and common safety requirements for low-voltage switchgear and controlgear, including:

- definitions;
- characteristics;
- information supplied with the equipment;
- normal service, mounting and transport conditions, decommissioning and dismantling;
- constructional and performance requirements, including electromagnetic compatibility (EMC), safety measures against electric shock, fire hazard and mechanical hazard;
- use of aluminium conductors (Annex B);
- verification of characteristics and performance;

This document does not apply to:

- low-voltage switchgear and controlgear assemblies

Note Low-voltage switchgear and controlgear assemblies are dealt with in IEC 61439 series, as applicable.

- use within explosive atmospheres (see IEC 60079 series) ;

–

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 60038:2009, *IEC standard voltages*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

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

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

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

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

- 715 IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic*
716 *(12 h + 12 h cycle)*
- 717 IEC 60068-2-52:2017, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic*
718 *(sodium chloride solution)*
- 719 IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat,*
720 *steady state*
- 721 IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and*
722 *identification – Coding principles for indicators and actuators*
- 723 IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*
- 724 IEC 60092-504:2016, *Electrical installations in ships – Part 504: Automation, control and*
725 *instrumentation*
- 726 IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2:*
727 *Determination of thermal endurance properties of electrical insulating materials – Choice of*
728 *test criteria*
- 729 IEC 60228:2004, *Conductors of insulated cables*
- 730 IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*
731 IEC 60269-1:2006/AMD1:2009
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- 733 IEC 60300-3-5:2001, *Dependability management – Part 3-5: Application guide – Reliability*
734 *test conditions and statistical test principles*
- 735 IEC TR 60344:2007, *Calculation of d.c. resistance of plain and coated copper conductors of*
736 *low-frequency cables and wires – Application guide*
- 737 IEC 60417, *Graphical symbols for use on equipment* (available at [http://www.graphical-](http://www.graphical-symbols.info/equipment)
738 [symbols.info/equipment](http://www.graphical-symbols.info/equipment))
- 739 IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and*
740 *identification – Identification of equipment terminals, conductor terminations and conductors*
- 741 IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and*
742 *identification – Actuating principles*
- 743 IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
744 IEC 60529:1989/AMD1:1999
745 IEC 60529:1989/AMD2:2013
- 746 IEC 60617, *Graphical symbols for diagrams* (available at <http://std.iec.ch/iec60617>)
- 747 IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1:*
748 *Principles, requirements and tests*
- 749 IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods –*
750 *Glow-wire apparatus and common test procedure*
- 751 IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods –*
752 *Glow-wire flammability test method for end-products (GWEPT)*

- 753 IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods –*
754 *Glow-wire flammability index (GWFI) test method for materials*
- 755 IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and*
756 *vertical flame test methods*
- 757 IEC 60715:2017, *Dimensions of low-voltage switchgear and controlgear – Standardized*
758 *mounting on rails for mechanical support of switchgear, controlgear and accessories*
- 759 IEC 60721-3-1, *Classification of environmental conditions – Part 3-1: Classification of groups*
760 *of environmental parameters and their severities – Storage*
- 761 IEC 60721-3-2, *Classification of environmental conditions – Part 3-2: Classification of groups*
762 *of environmental parameters and their severities – Transportation and Handling*
- 763 IEC 60730-1, *Automatic electrical controls – Part 1: General requirements*
- 764 IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*
765 *IEC 60947-2:2016/AMD1:2019*
- 766 IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices*
767 *and switching elements – Electromechanical control circuit devices*
- 768 IEC 60947-5-2, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices*
769 *and switching elements - Proximity switches*
- 770 IEC 60947-8, *Low-voltage switchgear and controlgear – Part 8: Control units for built-in*
771 *thermal protection (PTC) for rotating electrical machines*
- 772 IEC 60981:2019, *Extra heavy-duty electrical rigid steel conduits*
- 773 IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements*
774 *for screw-type and screwless-type clamping units – Part 1: General requirements and*
775 *particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm²*
776 *(included)*
- 777 IEC 60999-2:2003, *Connecting devices – Electrical copper conductors – Safety requirements*
778 *for screw-type and screwless-type clamping units – Part 2: Particular requirements for*
779 *clamping units for conductors above 35 mm² up to 300 mm² (included)*
- 780 IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement*
781 *techniques – Electrostatic discharge immunity test*
- 782 IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement*
783 *techniques – Radiated, radio-frequency, electromagnetic field immunity test*
- 784 IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement*
785 *techniques – Electrical fast transient/burst immunity test*
- 786 IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement*
787 *techniques – Surge immunity test*
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789 *techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
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791 *techniques – Power frequency magnetic field immunity test*

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793 *techniques – Voltage dips, short interruptions and voltage variations immunity tests*
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795 *techniques – Voltage dips, short interruptions and voltage variations immunity tests for*
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800 *Immunity for equipment used in power station and substation environment*
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- 802 IEC 61051-2:1991, *Varistors for use in electronic equipment – Part 2: Sectional specification*
803 *for surge suppression varistors*
- 804 IEC 61131-2:2017, *Industrial-process measurement and control – Programmable controllers –*
805 *Part 2: Equipment requirements and tests*
- 806 IEC 61131-9:2022, *Programmable controllers - Part 9: Single-drop digital communication*
807 *interface for small sensors and actuators (SDCI)*
- 808 IEC 61140:2016, *Protection against electric shock – Common aspects for installation and*
809 *equipment*
- 810 IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test*
811 *and procedure requirements, test equipment*
- 812 IEC 61238-1, *Compression and mechanical connectors for power cables for rated voltages up*
813 *to 30 kV ($U_m = 36$ kV) – Part 1: Test methods and requirements*
- 814 IEC 61238-1-1, *Compression and mechanical connectors for power cables – Part 1-1: Test*
815 *methods and requirements for compression and mechanical connectors for power cables for*
816 *rated voltages up to 1 kV ($U_m = 1,2$ kV) tested on non-insulated conductors*
- 817 IEC 61439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*
- 818 IEC 61508-4, *Functional safety of electrical/electronic/programmable electronic safety-related*
819 *systems – Part 4: Definitions and abbreviations*
- 820 IEC 61545, *Connecting devices – Devices for the connection of aluminium conductors in*
821 *clamping units of any material and copper conductors in aluminium bodied clamping units*
- 822 IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1 000 V AC and*
823 *1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 2:*
824 *Insulation resistance*
- 825 IEC 61643-331:2020, *Components for low-voltage surge protection – Part 331: Performance*
826 *requirements and test methods for metal oxide varistors (MOV)*
- 827 IEC 61649:2008, *Weibull analysis*
- 828 IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical,*
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- 832 IEC 62208:2011, *Empty enclosures for low-voltage switchgear and controlgear assemblies –*
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- 835 IEC 62474:2018, *Material declaration for products of and for the electrotechnical industry*
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- 838 IEC TS 63058, *Environmental aspects for low-voltage switchgear and controlgear and their*
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- 842 IEC TS 63208, *Low-voltage switchgear and controlgear – Security aspects*
- 843 IEC 63404, *Switchgear and controlgear and their assemblies for low voltage – Integration*
844 *method of radiocommunication device into an equipment*
- 845 CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance*
846 *characteristics – Limits and methods of measurement*
- 847 ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles*
848 *for product safety labels*
- 849 ISO 7000DB, *Graphical symbols for use on equipment – Registered symbols* (available at
850 <http://www.graphical-symbols.info/equipment>)
- 851 ISO 13849-1:2015, *Safety of machinery – Safety-related parts of control systems – Part 1:*
852 *General principles for design*

853 **3 Terms, definitions, symbols and reference clauses**

854 **3.1 General**

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

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

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

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3.3 General terms and definitions

3.3.1

switchgear and controlgear

general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures

[SOURCE: IEC 60050-441:1984, 441-11-01]

1178 **3.3.2**
1179 **switchgear**
1180 general term covering switching devices and their combination with associated control,
1181 measuring, protective and regulating equipment, also assemblies of such devices and
1182 equipment with associated interconnections, accessories, enclosures and supporting
1183 structures, intended in principle for use in connection with generation, transmission,
1184 distribution and conversion of electric energy

1185 [SOURCE: IEC 60050-441:1984, 441-11-02]

1186 **3.3.3**
1187 **controlgear**
1188 general term covering switching devices and their combination with associated control,
1189 measuring, protective and regulating equipment, also assemblies of such devices and
1190 equipment with associated interconnections, accessories, enclosures and supporting
1191 structures, intended in principle for the control of electric energy consuming equipment

1192 [SOURCE: IEC 60050-441:1984, 441-11-03]

1193 **3.3.4**
1194 **overcurrent**
1195 current exceeding the rated current

1196 [SOURCE: IEC 60050-441:1984, 441-11-06]

1197 **3.3.5**
1198 **short-circuit**
1199 accidental or intentional conductive path between two or more conductive parts forcing the
1200 electric potential differences between these conductive parts to be equal to or close to zero

1201 [SOURCE: IEC 60050-195:2021, 195-04-11]

1202 **3.3.6**
1203 **short-circuit current**
1204 overcurrent resulting from a short-circuit due to a fault or an incorrect connection in an
1205 electric circuit

1206 [SOURCE: IEC 60050-441:1984, 441-11-07, modified – “short circuit” has been replaced by
1207 “short-circuit”.]

1208 **3.3.7**
1209 **overload**
1210 operating conditions in an electrically undamaged circuit, which cause an overcurrent

1211 [SOURCE: IEC 60050-441:1984, 441-11-08]

1212 **3.3.8**
1213 **overload current**
1214 overcurrent occurring in an electrically undamaged circuit

1215 **3.3.9**
1216 **ambient air temperature**
1217 temperature, determined under prescribed conditions, of the air surrounding the complete
1218 switching device or fuse

1219 Note 1 to entry: For switching devices or fuses installed inside an enclosure, it is the temperature of the air
1220 outside the enclosure.

1221 [SOURCE: IEC 60050-441:1984, 441-11-13, modified – “the” has been deleted.]

1222 **3.3.10**
1223 **utilization category**
1224 <for a switching device or a fuse> combination of specified requirements related to the
1225 condition in which the switching device or the fuse fulfils its purpose, selected to represent a
1226 characteristic group of practical applications

1227 Note 1 to entry: The specified requirements can concern e.g. the values of making capacities (if applicable),
1228 breaking capacities and other characteristics, the associated circuits and the relevant conditions of use and
1229 behaviour.

1230 [SOURCE: IEC 60050-441:1984, 441-17-19, modified – In Note 1 to entry, “may” changed to
1231 “can”.]

1232 **3.3.11**
1233 **galvanic separation**

1234 prevention of electric conduction between two electric circuits intended to exchange power and/or
1235 signals

1236 Note 1 to entry: Galvanic separation can be provided e.g. by an isolating transformer or a photocoupler.

1237 Note 2 to entry: A galvanic separation is only functional and not safety related like a protective separation or isolation (see
1238 3.3.16).

1239 [SOURCE: IEC 60050-151:2001, 151-12-26]

1240 **3.3.12**
1241 **manufacturer**

1242 any person, company or organisation with ultimate responsibility as follows:

- 1243 – to verify compliance with the appropriate standard or standards;
- 1244 – to provide the product information according to Clause 6

1245 Note 1 to entry: For instance, in the case of “protected starters” assembled according to the instructions of the
1246 component providers, the manufacturer will be the entity that undertook the assembly.

1247 **3.3.13**
1248 **solid insulation**

1249 solid insulating material interposed between two conductive parts

1250 **3.3.14**
1251 **insulation coordination barrier**

1252 solid insulating material that is not an integral part, provided for the purpose of increasing
1253 either creepage distances or clearance distances or both

1254 **3.3.15**
1255 **isolating distance**

1256 <of a pole of a mechanical switching device> clearance between open contacts meeting the
1257 safety requirements specified for disconnectors

1258 [SOURCE: IEC 60050-441:1984, 441-17-35, modified – “the” has been deleted.]

1259 **3.3.16**
1260 **protective separation**
1261 **electrically protective separation**

1262 separation of one electric circuit from another by means of:

- 1263 – double insulation, or
- 1264 – basic insulation and electrically protective screen, or
- 1265 – reinforced insulation

1266 **3.3.17**1267 **line conductor**

1268 conductor intended to be energized and capable of contributing to the transmission or
1269 distribution of electric energy but which is not a neutral conductor or mid-point conductor

1270 Note 1 to entry: A definition restricted to polyphase systems is given in IEC 141-03-02.

1271 [SOURCE: IEC 60050-195:2021, 195-02-08]

1272 **3.3.18**1273 **mid-point conductor**

1274 conductor electrically connected to the mid-point and capable of contributing to the
1275 distribution of electric energy

1276 [SOURCE: IEC 60050-195:2021, 195-02-07]

1277 **3.3.19**1278 **PEM conductor**

1279 conductor combining the functions of both a protective earthing conductor and a mid-point
1280 conductor

1281 [SOURCE: IEC 60050-195:2021, 195-02-13]

1282 **3.3.20**1283 **PEN conductor**

1284 conductor combining the functions of both a protective earthing conductor and a neutral
1285 conductor

1286 [SOURCE: IEC 60050-195:2021, 195-02-12]

1287 **3.3.21**1288 **PEL conductor**

1289 conductor combining the functions of both a protective earthing conductor and a line
1290 conductor

1291 [SOURCE: IEC 60050-195:2021, 195-02-14]

1292 **3.3.22**1293 **maintenance**

1294 combination of all technical actions intended to retain an item in, or restore it to, a state in
1295 which it can perform as required

1296 [SOURCE: IEC 60050-192:2015, 192-06-01, modified – “and management” and Note 1 to entry
1297 have been deleted.]

1298 **3.3.23**1299 **single-drop digital communication interface**1300 **SDCI**

1301 digital communication interface for switching 24 V devices implemented as a point-to-point
1302 communication link for connecting sensors and actuators to a master unit

1303 EXAMPLE: IO-Link™

1304 **3.3.24**1305 **product documentation**

1306 information required for proper selection, installation, service, maintenance, decommissioning
1307 and disassembly of equipment provided in printed, electronic or other formats

1308 Note 1 to entry: Information in electronic format is often distributed via websites.

1309 Note 2 to entry: Regulations can apply to the provision of product documentation.

1310 **3.3.25**

1311 **printed wiring board**

1312 **printed circuit board**

1313 **printed board**

1314 **PWB**

1315 **PCB**

1316 base material cut to size containing all required holes and bearing at least one conductive
1317 pattern.

1318 Note 1 to entry: Printed boards are typically subdivided according to:

1319 - their structure (e.g., single- and double-sided, multilayers)

1320 - the nature of the base material (e.g., rigid, flexible)

1321 [SOURCE: IEC 60050-541:1990, 541-01-03, modified – synonymous terms added, text from
1322 the second paragraph changed into a Note to entry.]

1323 **3.3.26**

1324 **printed wiring board assembly**

1325 **printed circuit board assembly**

1326 **PWBA**

1327 **PCBA**

1328 assembly that uses a printed wiring board for component mounting and interconnecting
1329 purposes.

1330 [SOURCE: IEC 60194-1:2021, 3.16.140, modified – synonymous terms added]

1331 **3.4 Switching devices**

1332 **3.4.1**

1333 **switching device**

1334 device designed to make or break the current in one or more electric circuits

1335 Note 1 to entry: A switching device can perform one or both of these operations.

1336 [SOURCE: IEC 60050-441:1984, 441-14-01, modified – Note 1 to entry has been added.]

1337 **3.4.2**

1338 **mechanical switching device**

1339 switching device designed to close and open one or more electric circuits by means of
1340 separable contacts

1341 Note 1 to entry: Any mechanical switching device can be designated according to the medium in which its
1342 contacts open and close, e.g.: air, SF₆, oil.

1343 [SOURCE: IEC 60050-441:1984, 441-14-02, modified – In Note 1 to entry, “may” changed to
1344 “can”.]

1345 **3.4.3**

1346 **semiconductor switching device**

1347 switching device designed to make and/or break the current in an electric circuit by means of
1348 the controlled conductivity of a semiconductor

1349 [SOURCE: IEC 60050-441:1984, 441-14-03, modified – Addition of “and/or break”.]

1350 **3.4.4**

1351 **fuse**

1352 device that, by the operating of one or more of its specifically designed and proportioned
1353 components, opens the circuit in which it is inserted by breaking the current when this
1354 exceeds a given value for a sufficient time

1355 Note 1 to entry: The fuse comprises all the parts that form the complete device.

1356 [SOURCE: IEC 60050-441:1984, 441-18-01, modified- “a” has been deleted and “fusing has
1357 been replaced by “operating”, “The fuse comprises all the parts that form the complete device”
1358 has been moved from the definition to Note 1 to entry.]

1359 **3.4.5**

1360 **fuse-link**

1361 part of a fuse (including the fuse-element(s)) intended to be replaced after the fuse has
1362 operated

1363 [SOURCE: IEC 60050-441:1984, 441-18-09]

1364 **3.4.6**

1365 **fuse-element**

1366 part of the fuse-link designed to melt under the action of current exceeding some definite
1367 value for a definite period of time

1368 [SOURCE: IEC 60050-441:1984, 441-18-08]

1369 **3.4.7**

1370 **fuse-combination unit**

1371 combination of a mechanical switching device and one or more fuses in a composite unit,
1372 assembled by the manufacturer or in accordance with their instructions

1373 [SOURCE: IEC 60050-441:1984, 441-14-04, modified – “his instructions” has been replaced
1374 by “their instructions” and Note 1 to entry has been deleted.]

1375 **3.4.8**

1376 **disconnecter**

1377 mechanical switching device which, in the open position, complies with the requirements
1378 specified for isolation

1379 **3.4.9**

1380 **switch**

1381 **mechanical switch**

1382 mechanical switching device capable of making, carrying and breaking currents under normal
1383 circuit conditions which can include specified operating overload conditions and also carrying
1384 for a specified time currents under specified abnormal circuit conditions such as those of
1385 short-circuit

1386 Note 1 to entry: A switch can be capable of making but not breaking short-circuit currents.

1387 [SOURCE: IEC 60050-441:1984, 441-14-10, modified – In Note 1 to entry, “may” changed to
1388 “can”.]

1389 **3.4.10**

1390 **switch-disconnector**

1391 switch which, in the open position, satisfies the isolating requirements specified for a
1392 disconnector

1393 [SOURCE: IEC 60050-441:1984, 441-14-12]

1394 **3.4.11**

1395 **circuit-breaker**

1396 switching device, capable of making, carrying and breaking currents under normal circuit
1397 conditions and making, carrying for a specified time and breaking currents under specified
1398 abnormal circuit conditions such as those of short-circuit, and provides isolation

1399 [SOURCE: IEC 60050-441:1984, 441-14-20, modified – “mechanical” and “also” deleted,
1400 “duration” has been replaced by “time”, short circuit” has been replaced by “short-circuit” and
1401 “, and provides isolation” added.]

1402 **3.4.12**

1403 **contactor**

1404 **mechanical contactor**

1405 mechanical switching device having only one position of rest, operated otherwise than by
1406 hand, capable of making, carrying and breaking currents under normal circuit conditions
1407 including operating overload conditions

1408 Note 1 to entry: Contactors can be designated according to the method by which the force for closing the main
1409 contacts is provided.

1410 [SOURCE: IEC 60050-441:1984, 441-14-33, modified – In term, “contactor” has been added
1411 as synonym for “mechanical contactor”, and in Note 1 to entry, “Mechanical” has been deleted
1412 and “may” changed to “can”.]

1413 **3.4.13**

1414 **semiconductor contactor**

1415 **solid-state contactor**

1416 device which performs the function of a contactor by utilizing a semiconductor switching
1417 device

1418 Note 1 to entry: A semiconductor contactor can also contain mechanical switching devices.

1419 **3.4.14**

1420 **contactor relay**

1421 contactor used as a control switch

1422 [SOURCE: IEC 60050-441:1984, 441-14-35]

1423 **3.4.15**

1424 **starter**

1425 combination of all the switching means necessary to start and stop a motor, in combination
1426 with suitable overload protection

1427 Note 1 to entry: Starters can be designated according to the method by which the force for closing the main
1428 contacts is provided.

1429 [SOURCE: IEC 60050-441:1984, 441-14-38, modified – In Note 1 to entry, “may” changed to
1430 “can”.]

1431 **3.4.16**

1432 **motor protective switching device**

1433 **MPSD**

1434 manually operated motor starter additionally providing resettable short-circuit protection to the
1435 motor and the circuit

1436 Note 1 to entry: A MPSD can also be used as a manual starter, a protected starter or a combination starter.

1437 Note 2 to entry: A MPSD is a short-circuit protective device (SCPD).

1438 Note 3 to entry: In the United states of America, this device can be qualified as a motor controller suitable for tap
1439 conductor protection.

1440

1441 **3.4.17**

1442 **control circuit device**

1443 electrical device, intended for the controlling, signalling, interlocking, etc. of switchgear and
1444 controlgear

1445 Note 1 to entry: Control circuit devices can include associated devices dealt with in other standards, such as
1446 instruments, potentiometers, relays, in so far as such associated devices are used for the purposes specified.

1447 **3.4.18**

1448 **control switch**

1449 <for control and auxiliary circuits> mechanical switching device which serves the purpose of
1450 controlling the operation of switchgear or controlgear, including signalling, electrical
1451 interlocking, etc.

1452 Note 1 to entry: A control switch consists of one or more contact elements with a common actuating system.

1453 [SOURCE: IEC 60050-441:1984, 441-14-46]

1454 **3.4.19**

1455 **pilot switch**

1456 non-manual control switch actuated in response to specified conditions of an actuating
1457 quantity

1458 Note 1 to entry: The actuating quantity can be pressure, temperature, velocity, liquid level, elapsed time, etc.

1459 [SOURCE: IEC 60050-441:1984, 441-14-48, modified – In Note 1 to entry, “may” changed to
1460 “can”.]

1461 **3.4.20**

1462 **push-button**

1463 control switch having an actuator intended to be operated by force exerted by a part of the
1464 human body, usually the finger or palm of the hand, and having stored energy (spring) return

1465 [SOURCE: IEC 60050-441:1984, 441-14-53]

1466 **3.4.21**

1467 **terminal block**

1468 insulating part carrying one or more mutually insulated terminal assemblies and intended to
1469 be fixed to a support

1470 **3.4.22**

1471 **short-circuit protective device**

1472 **SCPD**

1473 device intended to protect a circuit or parts of a circuit against short-circuit currents by
1474 interrupting them

1475 **3.4.23**

1476 **surge arrester**

1477 device designed to protect the electrical apparatus from high transient overvoltages and to
1478 limit the duration and frequently the amplitude of the follow-on current

1479 **3.4.24**

1480 **individual enclosure**

1481 enclosure designed and dimensioned to contain one equipment only

1482 **3.4.25**

1483 **control and protective switching device**

1484 **CPS**

1485 mechanical switching device with a control function operated other than by hand capable of:

- 1486 – making, carrying and breaking currents under normal conditions;
- 1487 – making, carrying currents for a specified time in overload conditions;
- 1488 – breaking currents under specified abnormal conditions such as those of short-circuits;
- 1489 – continuity of service,

1490 with or without local manual operating means

1491 [SOURCE: IEC 60947-6-2:2020, 3.2.1]

1492 **3.5 Parts of switching devices**

1493 **3.5.1**

1494 **pole of a switching device**

1495 portion of a switching device associated exclusively with one electrically separated conducting
1496 path of its main circuit and excluding those portions which provide a means for mounting and
1497 operating all poles together

1498 Note 1 to entry: A switching device is called single-pole if it has only one pole. If it has more than one pole, it can
1499 be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to
1500 operate together.

1501 [SOURCE: IEC 60050-441:1984, 441-15-01, modified – In Note 1 to entry, “may” changed to
1502 “can”.]

1503 **3.5.2**

1504 **main circuit**

1505 <of a switching device> all the conductive parts of a switching device included in the circuit
1506 which it is designed to close or open

1507 [SOURCE: IEC 60050-441:1984, 441-15-02]

1508 **3.5.3**

1509 **control circuit**

1510 <of a switching device> all the conductive parts (other than the main circuit) of a switching
1511 device which are included in a circuit used for the closing operation or opening operation, or
1512 both, of the device

1513 [SOURCE: IEC 60050-441:1984, 441-15-03]

1514 **3.5.4**

1515 **auxiliary circuit**

1516 <of a switching device> all the conductive parts of a switching device which are intended to
1517 be included in a circuit other than the main circuit and the control circuits of the device

1518 Note 1 to entry: Some auxiliary circuits fulfil supplementary functions such as signalling, interlocking, etc., and, as
1519 such, they can be part of the control circuit of another switching device.

1520 [SOURCE: IEC 60050-441:1984, 441-15-04, modified – In Note 1 to entry, “may” changed to
1521 “can”.]

1522 **3.5.5**

1523 **contact**

1524 <of a mechanical switching device> conductive parts designed to establish circuit continuity
1525 when they touch and which, due to their relative motion during an operation, open or close a
1526 circuit or, in the case of hinged or sliding contacts, maintain circuit continuity

1527 [SOURCE: IEC 60050-441:1984, 441-15-05]

1528 **3.5.6**

1529 **contact**

1530 **contact piece**

1531 one of the conductive parts forming a contact

1532 [SOURCE: IEC 60050-441:1984, 441-15-06]

1533 **3.5.7**
1534 **main contact**
1535 contact included in the main circuit of a mechanical switching device, intended to carry, in the
1536 closed position, the current of the main circuit

1537 [SOURCE: IEC 60050-441:1984, 441-15-07]

1538 **3.5.8**
1539 **arcing contact**
1540 contact on which the arc is intended to be established

1541 Note 1 to entry: An arcing contact can serve as a main contact; it can be a separate contact so designed that it
1542 opens after and closes before another contact which it is intended to protect from deterioration.

1543 [SOURCE: IEC 60050-441:1984, 441-15-08, modified – “injury” has been replaced by
1544 “deterioration” and In Note 1 to entry, “may” changed to “can”.]

1545 **3.5.9**
1546 **control contact**
1547 contact included in a control circuit of a mechanical switching device and mechanically
1548 operated by this device

1549 [SOURCE: IEC 60050-441:1984, 441-15-09]

1550 **3.5.10**
1551 **auxiliary contact**
1552 contact included in an auxiliary circuit and mechanically operated by the switching device

1553 [SOURCE: IEC 60050-441:1984, 441-15-10]

1554 **3.5.11**
1555 **auxiliary switch**
1556 <of a mechanical switching device> switch containing one or more control and/or auxiliary
1557 contacts mechanically operated by a switching device

1558 [SOURCE: IEC 60050-441:1984, 441-15-11]

1559 **3.5.12**
1560 **"a" contact**
1561 **make contact**
1562 control or auxiliary contact which is closed when the main contacts of the mechanical
1563 switching device are closed and open when they are open

1564 [SOURCE: IEC 60050-441:1984, 441-15-12]

1565 **3.5.13**
1566 **"b" contact**
1567 **break contact**
1568 control or auxiliary contact which is open when the main contacts of the mechanical switching
1569 device are closed and closed when they are open

1570 [SOURCE: IEC 60050-441:1984, 441-15-13]

1571 **3.5.14**
1572 **relay**
1573 **electrical relay**
1574 device designed to produce sudden, predetermined changes in one or more electric output
1575 circuits when certain conditions are fulfilled in the electric input circuits controlling the device

1576 [SOURCE: IEC 60050-151:2001, 151-13-31, modified – “electric relay” changed to “electrical
1577 relay”.]

1578 **3.5.15**

1579 **release**

1580 <of a mechanical switching device> device, mechanically connected to a mechanical
1581 switching device, which releases the holding means and permits the opening or the closing of
1582 the switching device

1583 Note 1 to entry: A release can have instantaneous, time-delay, etc., operation. The various types of releases are
1584 defined in 3.6.24 to 3.6.35.

1585 [SOURCE: IEC 60050-441:1984, 441-15-17, modified – Note 1 to entry has been added.]

1586 **3.5.16**

1587 **actuating system**

1588 <of a mechanical switching device> whole of the operating means of a mechanical switching
1589 device which transmit the actuating force to the contact pieces

1590 Note 1 to entry: The operating means of an actuating system can be mechanical, electromagnetic, hydraulic,
1591 pneumatic, thermal, etc.

1592 **3.5.17**

1593 **actuator**

1594 part of the actuating system to which an external actuating force is applied

1595 Note 1 to entry: The actuator can take the form of a handle, knob, push-button, roller, plunger, etc.

1596 [SOURCE: IEC 60050-441:1984, 441-15-22]

1597 **3.5.18**

1598 **position indicating device**

1599 part of a mechanical switching device which indicates whether it is in the open, closed, or,
1600 where appropriate, earthed position

1601 [SOURCE: IEC 60050-441:1984, 441-15-25]

1602 **3.5.19**

1603 **indicator light**

1604 light signal giving information either by lighting or extinguishing

1605 **3.5.20**

1606 **anti-pumping device**

1607 device which prevents reclosing after a close-open operation as long as the device initiating
1608 closing is maintained in the position for closing

1609 [SOURCE: IEC 60050-441:1984, 441-16-48]

1610 **3.5.21**

1611 **interlocking device**

1612 device which makes the operation of a switching device dependent upon the position of
1613 operation of one or more other pieces of equipment

1614 [SOURCE: IEC 60050-441:1984, 441-16-49]

1615 **3.5.22**

1616 **connecting device**

1617 device for the electrical connection of one (or more) conductor(s), comprising one (or more)
1618 terminal(s), either fixed to a base or forming an integral part of the equipment

1619 [SOURCE: IEC 60999-1:1999, 3.3]

1620 **3.5.23**

1621 **terminal**

1622 conductive part of one pole of a device for electrical connection to external circuit, composed
1623 of one or more clamping unit(s) and insulation if necessary

1624 [SOURCE: IEC 60999-1:1999, 3.2, modified – “of a device for electrical connection to external
1625 circuit” has been added.]

1626 **3.5.24**

1627 **screw-type terminal**

1628 terminal intended for the connection and disconnection of conductors or for the inter-
1629 connection of two or more conductors, the connection being made, directly or indirectly, by
1630 means of screws or nuts of any kind

1631 Note 1 to entry: Examples are given in Annex D.

1632 **3.5.25**

1633 **screwless-type terminal**

1634 terminal intended for the connection and disconnection of conductors or for the
1635 interconnection on two or more conductors, the connection being made, directly or indirectly,
1636 by means of springs, wedges, eccentrics or cones, etc.

1637 Note 1 to entry: Examples are given in Annex D.

1638 **3.5.25.1**

1639 **universal terminal**

1640 terminal for the connection and disconnection of all types of conductors (solid, stranded and
1641 flexible)

1642 [SOURCE: IEC 60998-2-2:2002, 3.101.1, modified – “(rigid and flexible)” replaced with “(solid,
1643 stranded and flexible)”.]

1644 **3.5.25.2**

1645 **non-universal terminal**

1646 terminal for the connection and disconnection of a certain kind of conductor only (for example,
1647 solid conductors only or solid and stranded conductors only)

1648 [SOURCE: IEC 60998-2-2:2002, 3.101.2, modified – “rigid [solid and stranded]” replaced with
1649 “solid and stranded”.]

1650 **3.5.25.3**

1651 **push-wire terminal**

1652 non-universal terminal in which the connection is made by pushing in solid or stranded
1653 conductors

1654 [SOURCE: IEC 60998-2-2:2002, 3.101.3, modified – “rigid (solid or stranded)” replaced with
1655 “solid or stranded”.]

1656 **3.5.25.4**

1657 **PCB terminal block**

1658 part intended to be mounted on a printed circuit board and carrying one or more mutually
1659 insulated contacts units and which provides an electrical and mechanical connection between
1660 copper conductor and printed circuit board

1661 [SOURCE: IEC 60947-7-4:2019, 3.2.]

1662 **3.5.26**

1663 **clamping unit**

1664 part(s) of the terminal necessary for the mechanical clamping and the electrical connection of
1665 the conductor(s), including the parts which are necessary to ensure the correct contact
1666 pressure

1667 [SOURCE: IEC 60999-1:1999, 3.1]

1668 **3.5.26.1**

1669 **universal clamping unit**

1670 clamping unit intended for all types of conductors

1671 **3.5.26.2**

1672 **non-universal clamping unit**

1673 clamping unit intended for certain types of conductors only, for example:

- 1674 – push-wire clamping unit for solid conductors only
- 1675 – push-wire clamping unit for solid and stranded conductors only

1676 Note 1 to entry: On push-wire clamping unit the connection is made by simple insertion of solid or stranded
1677 conductors (see 8.1.8.1).

1678 Note 2 to entry: Examples of non-universal clamping units are push-wire clamping unit for solid conductors only,
1679 push-wire clamping unit for solid and stranded conductors only, etc.

1680 **3.5.27**

1681 **unprepared conductor**

1682 conductor which has been cut and the insulation of which has been removed for insertion into
1683 a terminal

1684 Note 1 to entry: A conductor the shape of which is arranged for introduction into a terminal or the strands of which
1685 are twisted to consolidate the end is considered to be an unprepared conductor.

1686 [SOURCE: IEC 60050-442:1998, 442-01-26]

1687 **3.5.28**

1688 **solid conductor**

1689 <as used to describe wiring> conductor consisting of a single wire

1690 Note 1 to entry: The solid conductor can be circular or shaped.

1691 Note 2 to entry: Solid conductor is defined as class 1 conductor in IEC 60228, or by IEC 60344, or equivalent
1692 AWG/kcmil.

1693 [SOURCE: IEC 60050-461:2008, 461-01-06, modified – In Note 1 to entry, “may” changed to
1694 “can”, and Note 2 to entry has been added.]

1695 **3.5.29**

1696 **stranded conductor**

1697 <as used to describe wiring> conductor consisting of a number of wires, all or some of which
1698 are wound in a helix

1699 Note 1 to entry: Stranded conductor is defined as class 2 conductor in IEC 60228, or by IEC 60344, or equivalent
1700 AWG/kcmil.

1701 [SOURCE: IEC 60050-151:2001, 151-12-36, modified – Note 1 to entry has been added.]

1702 **3.5.30**

1703 **rigid conductor**

1704 solid or stranded conductor having wires of such diameters, or so assembled, that the
1705 conductor is not suitable for use in a flexible cable

1706 3.5.31**1707 flexible conductor**

1708 stranded conductor having wires of diameters small enough and so assembled that the
1709 conductor is suitable for use in a flexible cable

1710 Note 1 to entry: Flexible conductor is defined as class 5 or class 6 conductor in IEC 60228, or by IEC 60344, or
1711 equivalent AWG/kcmil.

1712 [SOURCE: IEC 60050-461:2008, 461-01-11, modified – Note 1 to entry has been added.]

1713 3.5.32**1714 multiple tip contact system**

1715 contact system comprising more than one contact gap per pole, which can be switched, in
1716 series and/or in parallel

1717 3.5.33**1718 minimum cross-section**

1719 <in reference to conductors for terminations> value of the smallest connectable conductor
1720 cross-section stated by the manufacturer as suitable for the terminal

1721 Note 1 to entry: The manufacturer can declare several minimum cross-sections depending on the type of
1722 conductor, for example solid, stranded, flexible, with or without ferrule.

1723 3.5.34**1724 maximum cross-section**

1725 <in reference to conductors for terminations> value of the largest connectable conductor
1726 cross-section stated by the manufacturer as suitable for the terminal

1727 Note 1 to entry: The manufacturer can declare several maximum cross-sections depending on the type of
1728 conductor, for example solid, stranded, flexible, with or without ferrule.

1729 Note 2 to entry: The term “rated cross-section” used in IEC 60947-7-1 and IEC 60999-2 and the term “rated
1730 connecting capacity” of a clamping unit used in IEC 60999-1 are considered equivalent when referring to certain
1731 thermal, mechanical and electrical requirements, as stated by the manufacturer and as specified in their relevant
1732 product standard.

1733 3.5.35**1734 electronically controlled electromagnet**

1735 electromagnet in which the coil is controlled by a circuit with active electronic elements

1736 3.5.36**1737 current-carrying part**

1738 conductive part which carries the electric current under normal conditions

1739 Note 1 to entry: The line conductor (L), the neutral conductor (N), the mid-point conductor (M), the PEN
1740 conductor, the PEM conductor and the PEL conductor are the current-carrying parts. The protective conductor (PE)
1741 is not a current-carrying part.

1742 3.6 Operation of switching devices**1743 3.6.1****1744 operation**

1745 <of a mechanical switching device> transfer of the moving contact(s) from one position to an
1746 adjacent position

1747 Note 1 to entry: For example, for a circuit-breaker, this can be a closing operation or an opening operation.

1748 Note 2 to entry: If distinction is necessary, an operation in the electrical sense, e.g., make or break, is referred to
1749 as a switching operation, and an operation in the mechanical sense, e.g., close or open, is referred to as a
1750 mechanical operation.

1751 [SOURCE: IEC 60050-441:1984, 441-16-01, modified – in Note 1 to entry, “for example” has
1752 been added and “may” changed to “can”.]

1753 **3.6.2**
1754 **operating cycle**
1755 <of a mechanical switching device> succession of operations from one position to another
1756 and back to the first position through all other positions, if any

1757 [SOURCE: IEC 60050-441:1984, 441-16-02]

1758 **3.6.3**
1759 **operating sequence**
1760 <of a mechanical switching device> succession of specified operations with specified time
1761 intervals

1762 [SOURCE: IEC 60050-441:1984, 441-16-03]

1763 **3.6.4**
1764 **manual control**
1765 control of an operation by human intervention

1766 [SOURCE: IEC 60050-441:1984, 441-16-04]

1767 **3.6.5**
1768 **automatic control**
1769 control of an operation without human intervention, in response to the occurrence of
1770 predetermined conditions

1771 [SOURCE: IEC 60050-441:1984, 441-16-05]

1772 **3.6.6**
1773 **local control**
1774 control of an operation at a point on or adjacent to the controlled switching device

1775 [SOURCE: IEC 60050-441:1984, 441-16-06]

1776 **3.6.7**
1777 **remote control**
1778 control of an operation at a point distant from the controlled switching device

1779 [SOURCE: IEC 60050-441:1984, 441-16-07]

1780 **3.6.8**
1781 **closing operation**
1782 <of a mechanical switching device> operation by which the device is brought from the open
1783 position to the closed position

1784 [SOURCE: IEC 60050-441:1984, 441-16-08]

1785 **3.6.9**
1786 **opening operation**
1787 <of a mechanical switching device> operation by which the device is brought from the closed
1788 position to the open position

1789 [SOURCE: IEC 60050-441:1984, 441-16-09]

1790 **3.6.10**
1791 **positive opening operation**
1792 <of a mechanical switching device> opening operation which, in accordance with specified
1793 requirements, ensures that all the main contacts are in the open position when the actuator is
1794 in the position corresponding to the open position of the device

1795 [SOURCE: IEC 60050-441:1984, 441-16-11]

1796 **3.6.11**

1797 **positively driven operation**

1798 operation which, in accordance with specified requirements, is designed to ensure that
1799 auxiliary contacts of a mechanical switching device are in the respective positions
1800 corresponding to the open or closed position of the main contacts

1801 [SOURCE: IEC 60050-441:1984, 441-16-12]

1802 **3.6.12**

1803 **dependent manual operation**

1804 <of a mechanical switching device> operation solely by means of directly applied manual
1805 energy such that the speed and force of the operation are dependent upon the action of the
1806 operator

1807 [SOURCE: IEC 60050-441:1984, 441-16-13]

1808 **3.6.13**

1809 **dependent power operation**

1810 <of a mechanical switching device> operation by means of energy other than manual, where
1811 the completion of the operation is dependent upon the continuity of the power supply (to
1812 solenoids, electric or pneumatic motors, etc.)

1813 [SOURCE: IEC 60050-441:1984, 441-16-14]

1814 **3.6.14**

1815 **stored energy operation**

1816 <of a mechanical switching device> operation by means of energy stored in the mechanism
1817 itself prior to the completion of the operation and sufficient to complete it under predetermined
1818 conditions

1819 Note 1 to entry: This kind of operation can be subdivided according to:

- 1820 1) the manner of storing the energy (spring, weight, etc.);
1821 2) the origin of the energy (manual, electric, etc.);
1822 3) the manner of releasing the energy (manual, electric, etc.).

1823 [SOURCE: IEC 60050-441:1984, 441-16-15, modified – In Note 1 to entry, “may” changed to
1824 “can”.]

1825 **3.6.15**

1826 **independent manual operation**

1827 <of a mechanical switching device> stored energy operation where the energy originates from
1828 manual power, stored and released in one continuous operation, such that the speed and
1829 force of the operation are independent of the action of the operator

1830 [SOURCE: IEC 60050-441:1984, 441-16-16]

1831 **3.6.16**

1832 **independent power operation**

1833 <of a mechanical switching device> stored energy operation where the stored energy
1834 originates from an external power source and is released in one continuous operation, such
1835 that the speed and force of the operation are independent of the action of the operator

1836 **3.6.17**

1837 **actuating force**

1838 force applied to an actuator necessary to complete the intended operation

1839 [SOURCE: IEC 60050-441:1984, 441-16-17]

1840 **3.6.18**
1841 **restoring force**
1842 force provided to restore an actuator or a contact element to its initial position

1843 [SOURCE: IEC 60050-441:1984, 441-16-19]

1844 **3.6.19**
1845 **travel**
1846 <of a mechanical switching device or a part thereof> displacement (translation or rotation) of
1847 a point on a moving element

1848 Note 1 to entry: Distinction can be made between pre-travel, over-travel, etc.

1849 [SOURCE: IEC 60050-441:1984, 441-16-21, modified – In Note 1 to entry, “may” changed to
1850 “can”.]

1851 **3.6.20**
1852 **closed position**
1853 <of a mechanical switching device> position in which the predetermined continuity of the main
1854 circuit of the device is secured

1855 [SOURCE: IEC 60050-441:1984, 441-16-22]

1856 **3.6.21**
1857 **open position**
1858 <of a mechanical switching device> position in which the predetermined dielectric withstand
1859 voltage requirements are satisfied between open contacts in the main circuit of the device

1860 [SOURCE: IEC 60050-441:1984, 441-16-23, modified – “clearance between open contacts in
1861 the main circuit of the device is secured” has been replaced by “dielectric withstand voltage
1862 requirements are satisfied between open contacts in the main circuit of the device”.]

1863 **3.6.22**
1864 **tripped position**
1865 position of the switching device following a tripping operation

1866 **3.6.23**
1867 **tripping (operation)**
1868 opening operation of a mechanical switching device initiated by a relay or release

1869 **3.6.24**
1870 **trip-free mechanical switching device**
1871 mechanical switching device, the moving contacts of which return to and remain in the open
1872 position when the opening (i.e. tripping) operation is initiated after the initiation of the closing
1873 operation, even if the closing command is maintained

1874 Note 1 to entry: To ensure proper breaking of the current which can have been established, it may be necessary
1875 that the contacts momentarily reach the closed position.

1876 [SOURCE: IEC 60050-441:1984, 441-16-31, modified – Addition of “(i.e. tripping)” since the
1877 opening operation of a trip-free mechanical switching device is automatically controlled, in
1878 Note 1 to entry, “may” changed to “can”.]

1879 **3.6.25**
1880 **instantaneous relay or release**
1881 relay or release which operates without any intentional time-delay

1882 **3.6.26**
1883 **overcurrent relay or release**
1884 relay or release which causes a mechanical switching device to open with or without time-
1885 delay when the current in the relay or release exceeds a predetermined value

1886 Note 1 to entry: This value can in some cases depend upon the rate-of-rise of current.

1887 **3.6.27**
1888 **definite time-delay overcurrent relay or release**
1889 overcurrent relay or release which operates with a definite time-delay which may be
1890 adjustable, but is independent of the value of the overcurrent

1891 [SOURCE: IEC 60050-441:1984, 441-16-34, modified – Addition of "or release"]

1892 **3.6.28**
1893 **inverse time-delay overcurrent relay or release**
1894 overcurrent relay or release which operates after a time-delay inversely dependent upon the
1895 value of the overcurrent

1896 Note 1 to entry: Such a relay or release can be designed so that the time-delay approaches a definite minimum
1897 value for high values of overcurrent.

1898 [SOURCE: IEC 60050-441:1984, 441-16-35, modified – Addition of "or release"]

1899 **3.6.29**
1900 **direct overcurrent relay or release**
1901 overcurrent relay or release directly energized by the current in the main circuit of a switching
1902 device

1903 [SOURCE: IEC 60050-441:1984, 441-16-36, modified – Addition of "relay or" and
1904 "mechanical" has been deleted.]

1905 **3.6.30**
1906 **indirect overcurrent relay or release**
1907 overcurrent relay or release energized by the current in the main circuit of a switching device
1908 through a current transformer or a shunt

1909 [SOURCE: IEC 60050-441:1984, 441-16-37, modified – Addition of "relay or" and
1910 "mechanical" has been deleted.]

1911 **3.6.31**
1912 **overload relay or release**
1913 overcurrent relay or release intended for protection against overloads

1914 [SOURCE: IEC 60050-441:1984, 441-16-38, modified – Addition of "relay or".]

1915 **3.6.32**
1916 **thermal overload relay or release**
1917 inverse time-delay overload relay or release depending for its operation (including its time-
1918 delay) on the thermal action of the current flowing in the relay or release

1919 [SOURCE: IEC 60050-441:1984, 441-16-39, modified – Addition of "relay or".]

1920 **3.6.33**
1921 **magnetic overload relay or release**
1922 overload relay or release depending for its operation on the force exerted by the current in the
1923 main circuit exciting the coil of an electromagnet

1924 Note 1 to entry: Such a relay or release usually has an inverse time-delay/current characteristic.

1925 [SOURCE: IEC 60050-441:1984, 441-16-40, modified – Addition of "relay or".]

1926 **3.6.34**

1927 **shunt release**

1928 release energized by a source of voltage

1929 Note 1 to entry: The source of voltage can be independent of the voltage of the main circuit.

1930 [SOURCE: IEC 60050-441:1984, 441-16-41, modified – In Note 1 to entry, "may" changed to
1931 "can".]

1932 **3.6.35**

1933 **under-voltage relay or release**

1934 relay or release which permits a mechanical switching device to open or close, with or without
1935 time-delay, when the voltage across the terminals of the relay or release falls below a
1936 predetermined value

1937 [SOURCE: IEC 60050-441:1984, 441-16-42, modified – Addition of "relay or" and "a shunt
1938 release" has been replaced by "relay or release".]

1939 **3.6.36**

1940 **reverse current relay or release** (direct current only)

1941 relay or release which permits a mechanical switching device to open, with or without time-
1942 delay, when the current flows in the reverse direction and exceeds a predetermined value

1943 [SOURCE: IEC 60050-441:1984, 441-16-43, modified – "shunt release" replaced by "relay or
1944 release".]

1945 **3.6.37**

1946 **operating current**

1947 <of an overcurrent relay or release> value of current at and above which the relay or release
1948 will operate

1949 [SOURCE: IEC 60050-441:1984, 441-16-45, modified – Addition of "relay or", "the current
1950 value" has been replaced by "value of current" and "can" has been replaced by "will".]

1951 **3.6.38**

1952 **current-setting**

1953 <of an overcurrent or overload relay or release> value of current of the main circuit to which
1954 the operating characteristics of the relay or release are referred and for which the relay or
1955 release is set

1956 Note 1 to entry: A relay or release can have more than one current setting, provided by an adjustment dial,
1957 interchangeable heaters, etc.

1958 **3.6.39**

1959 **current setting range**

1960 <of an overcurrent or overload relay or release> range between the minimum and maximum
1961 values over which the current setting of the relay or release can be adjusted

1962 [SOURCE: IEC 60050-441:1984, 441-16-47, modified – "current setting" has been replaced by
1963 "current-setting", addition of "relay or" and "the range" has been replaced by "range".]

1964 **3.6.40**

1965 **dedicated wiring accessory**

1966 prefabricated connection wiring system specifically intended for identified switchgear or
1967 controlgear

1968 Note 1 to entry: A dedicated wiring accessory can be integrated in the switchgear or controlgear or delivered
1969 separately.

1970

1971 **3.7 Characteristic quantities**1972 **3.7.1**1973 **nominal value**

1974 value of a quantity used to designate and identify a component, device, equipment, or system

1975 Note 1 to entry: The nominal value is generally a rounded value.

1976 [SOURCE: IEC 60050-151:2001, 151-16-09]

1977 **3.7.2**1978 **limiting value**1979 in a specification of a component, device, equipment, or system, the greatest or smallest
1980 admissible value of a quantity

1981 [SOURCE: IEC 60050-151:2001, 151-16-10]

1982 **3.7.3**1983 **rated value**1984 value of a quantity used for specification purposes, established for a specified set of operating
1985 conditions of a component, device, equipment, or system

1986 [SOURCE: IEC 60050-151:2001, 151-16-08]

1987 **3.7.4**1988 **rating**

1989 set of rated values and operating conditions

1990 [SOURCE: IEC 60050-151:2001, 151-16-11]

1991 **3.7.5**1992 **prospective current**1993 <of a circuit and with respect to a switching device or a fuse> current that would flow in the
1994 circuit if each pole of the switching device or the fuse were replaced by a conductor of
1995 negligible impedance1996 Note 1 to entry: The method to be used to evaluate and to express the prospective current is to be specified in
1997 the relevant product standard.1998 [SOURCE: IEC 60050-441:1984, 441-17-01, modified – In the Note 1 to entry, “relevant
1999 publications” is replaced by “relevant product standard”.]2000 **3.7.6**2001 **prospective peak current**

2002 peak value of a prospective current during the transient period following initiation

2003 Note 1 to entry: The definition assumes that the current is made by an ideal switching device, i.e. with
2004 instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different
2005 paths, e.g. polyphase circuits, it further assumes that the current is made simultaneously in all poles, even if only
2006 the current in one pole is considered.

2007 [SOURCE: IEC 60050-441:1984, 441-17-02]

2008 **3.7.7**2009 **prospective symmetrical current**2010 <of an AC circuit> prospective current when it is initiated at such an instant that no transient
2011 phenomenon follows the initiation

2012 Note 1 to entry: For polyphase circuits the condition of non-transient period can only be satisfied for the current in
2013 one pole at a time.

2014 Note 2 to entry: The prospective symmetrical current is expressed by its RMS value.

2015 [SOURCE: IEC 60050-441:1984, 441-17-03, modified – In the Note 2 to entry, “RMS value”
2016 instead of “RMS”.]

2017 **3.7.8**

2018 **maximum prospective peak current**

2019 <of an AC circuit> prospective peak current when initiation of the current takes place at the
2020 instant which leads to the highest possible value

2021 Note 1 to entry: For a multipole device in a polyphase circuit, the maximum prospective peak current refers to one
2022 pole only.

2023 [SOURCE: IEC 60050-441:1984, 441-17-04, modified – In the Note 1 to entry, “to a single
2024 pole only” replaced by “to one pole only”.]

2025 **3.7.9**

2026 **prospective making current**

2027 <for a pole of a switching device> prospective current when initiated under specified
2028 conditions

2029 Note 1 to entry: The specified conditions can relate to the method of initiation, e.g. by an ideal switching device,
2030 or to the instant of initiation, e.g., leading to the maximum prospective peak current in an AC circuit, or to the
2031 highest rate of rise. The specification of these conditions is given in the relevant product standard.

2032 [SOURCE: IEC 60050-441:1984, 441-17-05, modified – In the Note 1 to entry, “is found in the
2033 relevant publications” replaced by “is given in the relevant product standard and “may”
2034 changed to “can”.]

2035 **3.7.10**

2036 **prospective breaking current**

2037 <for a pole of a switching device or a fuse> prospective current evaluated at a time
2038 corresponding to the instant of the initiation of the breaking process

2039 Note 1 to entry: Specifications concerning the instant of the initiation of the breaking process are given in the
2040 relevant product standard. For mechanical switching devices or fuses, it is usually defined as the moment of
2041 initiation of the arc during the breaking process.

2042 [SOURCE: IEC 60050-441:1984, 441-17-06, modified – In the Note 1 to entry, “are to be
2043 found in the relevant publications” replaced by “are given in the relevant product standard”.]

2044 **3.7.11**

2045 **breaking current**

2046 <of a switching device or a fuse> current in a pole of a switching device or in a fuse at the
2047 instant of initiation of the arc during a breaking process

2048 Note 1 to entry: For alternating current, the current is expressed as the symmetrical RMS value of the AC
2049 component.

2050 [SOURCE: IEC 60050-441:1984, 441-17-07, modified – Note 1 to entry has been added.]

2051 **3.7.12**

2052 **breaking capacity**

2053 <of a switching device or a fuse> value of prospective breaking current that a switching
2054 device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use
2055 and behaviour

2056 Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant product
2057 standard.

2058 Note 2 to entry: For alternating current, the current is expressed as the symmetrical RMS value of the AC
2059 component.

2060 Note 3 to entry: For short-circuit breaking capacity, see 3.7.14.

2061 [SOURCE: IEC 60050-441:1984, 441-17-08, modified – In the Note 1 to entry, “the relevant
2062 publications” has been replaced by “the relevant product standard”, the Note 2 to entry has
2063 been modified and the Note 3 to entry has been added.]

2064 **3.7.13**

2065 **making capacity**

2066 <of a switching device> value of prospective making current that a switching device is capable
2067 of making at a stated voltage under prescribed conditions of use and behaviour

2068 Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant product
2069 standard.

2070 Note 2 to entry: For short-circuit making capacity, see 3.7.15.

2071 [SOURCE: IEC 60050-441:1984, 441-17-09, modified – In the title, reference to “a fuse”
2072 deleted, in the Note 1 to entry, “the relevant publications” has been replaced by “the relevant
2073 product standard” and addition of the Note 2 to entry.]

2074 **3.7.14**

2075 **short-circuit breaking capacity**

2076 breaking capacity for which prescribed conditions include a short-circuit at the terminals of the
2077 switching device

2078 [SOURCE: IEC 60050-441:1984, 441-17-11]

2079 **3.7.15**

2080 **short-circuit making capacity**

2081 making capacity for which prescribed conditions include a short-circuit at the terminals of the
2082 switching device

2083 [SOURCE: IEC 60050-441:1984, 441-17-10]

2084 **3.7.16**

2085 **critical load current**

2086 I_{crit}

2087 value of breaking current, within the range of service conditions, at which the arcing time is
2088 significantly extended

2089 Note 1 to entry: This phenomenon, crucial for direct currents (e.g. photovoltaic (PV) applications), is due to the
2090 low magnetic field coming from the arc current, creating a slow moving arc.

2091 **3.7.17**

2092 **critical short-circuit current**

2093 value of breaking current, less than the rated short-circuit breaking capacity, at which the arc
2094 energy is significantly higher than at the rated short-circuit breaking capacity

2095 **3.7.18**

2096 I^2t

2097 **let-through energy**

2098 **Joule integral**

2099 integral of the square of the current over a given time interval

$$2100 \quad I^2t = \int_{t_0}^{t_1} i^2 dt$$