AS/NZS 60947.1:2021

Australian/New Zealand Standard™

Low-voltage switchgear and controlgear

Part 1: General rules (IEC 60947-1:2020 (ED. 6.0) MOD)

Documents
Document Sharing Hub

Full document details: AS NZS 60947.1-2021

AS/NZS 60947.1:2021

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee EL-006, Industrial Switchgear And Controlgear. It was approved on behalf of the Council of Standards Australia on 24 September 2021 and by the New Zealand Standards Approval Board on 6 October 2021.

This Standard was published on 22 October 2021.

The following are represented on Committee EL-006:

Association of Accredited Certification Bodies
Australian Industry Group
Bureau of Steel Manufacturers of Australia
Engineers Australia
Joint Accreditation System of Australia & New Zealand
Master Electricians Australia
Master Electricians NZ
National Electrical Communications Association
National Electrical Switchboard Manufacturers Association
Rail Industry Safety and Standards Board

This Standard was issued in draft form for comment as DR AS/NZS 60947.1:2021.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

www.standards.govt.nz

ISBN 978 1 76113 547 7

Documents
Document Sharing Hub

Full document details: AS NZS 60947.1-2021

Australian/New Zealand Standard™

Low-voltage switchgear and controlgear

Part 1: General rules (IEC 60947-1:2020 (ED. 6.0) MOD)

Originated as AS 3650—1988.
Revised and redesignated as AS/NZS IEC 60947.1:2015.
Revised and redesignated as AS/NZS 60947.1:2021.

© IEC Geneva Switzerland 2021 — All rights reserved
© Standards Australia Limited/the Crown in right of New Zealand, administered by the New Zealand Standards Executive 2021

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of either the IEC or the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth) or the Copyright Act 1994 (New Zealand). If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please see the contact details on the back cover or the contact us page of the website for further information.

Documents
Document Sharing Hub

Full document details: AS NZS 60947.1-2021

Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-006, Industrial Switchgear And Controlgear, to supersede AS/NZS IEC 60947.1:2015, *Low-voltage switchgear and controlgear, Part 1: General rules.*

The objective of this document is to specify requirements, 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 —

(a) definitions;

(b) characteristics;

(c) information supplied with the equipment;

(d) normal service, mounting and transport conditions, decommissioning and dismantling;

(e) constructional and performance requirements;

(f) verification of characteristics and performance;

(g) energy efficiency aspects (see Annex V); and

(h) environmental aspects.

This document does not apply to —

(i) low-voltage switchgear and controlgear assemblies which are dealt with in AS/NZS IEC 61439 series, as applicable;

(ii) terminals for connection of aluminium conductors;

(iii) use within explosive atmospheres (refer to AS/NZS 60079 series);

(iv) software and firmware requirements for functional safety application (refer to AS 61508.3); and

(v) cyber security aspects (refer to IEC 62443 series).

This document is an adoption with national modifications, and has been reproduced from, IEC 60947-1:2020, *Low-voltage switchgear and controlgear — Part 1: General rules.*

The modifications are additional requirements and are set out in Appendix ZZ, which has been added at the end of the source text.

Appendix ZZ lists the variations to IEC 60947-1:2020 for the application of this document in Australia and New Zealand.

As this document has been reproduced from an International Standard, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms "normative" and "informative" are used in Standards to define the application of the appendices or annexes to which they apply. A "normative" appendix or annex is an integral part of a Standard, whereas an "informative" appendix or annex is only for information and guidance.

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

NOTES

Documents
Document Sharing Hub

CONTENTS

FOREWORD 13
INTRODUCTION 16
1 Scope 17
2 Normative references 17
3 Terms, definitions, symbols and reference clauses 21
3.1 General 21
3.2 Alphabetical index of definitions 21
3.3 General terms and definitions 26
3.4 Switching devices 30
3.5 Parts of switching devices 33
3.6 Operation of switching devices 39
3.7 Characteristic quantities 44
3.8 Tests 54
3.9 Ports 54
3.10 Symbols and references clauses for characteristics described in this document 54
4 Classification 55
5 Characteristics 55
5.1 Summary of the characteristics 55
5.2 Type of equipment 56
5.3 Rated and limiting values for the main circuit 56
5.3.1 Rated voltages 56
5.3.2 Currents 57
5.3.3 Rated frequency 58
5.3.4 Rated duties 58
5.3.5 Characteristics under normal load and overload conditions (see 8.2.4) 60
5.3.6 Short-circuit characteristics 61
5.3.7 Pole impedance of the switching device (Z) 62
5.4 Utilization category 62
5.5 Control circuits 62
5.5.1 Electrically or electronically controlled circuits 62
5.5.2 Air-supply control circuits (pneumatic or electro-pneumatic) 63
5.6 Auxiliary circuits 63
5.7 Relays and releases 63
5.8 Co-ordination with short-circuit protective devices (SCPD) 63
6 Product information 63
6.1 Nature of information 63
6.2 Marking 64
6.3 Instructions for installation, operation and maintenance, decommissioning and dismantling 65
6.4 Environmental information 66
7 Normal service, mounting and transport conditions 66
7.1 Normal service conditions 66
7.1.1 Ambient air temperature 66
7.1.2 Altitude 67
7.1.3 Atmospheric conditions 67

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

7.1.4 Shock and vibration 68
7.2 Conditions during transport and storage 68
7.3 Mounting 68
8 Constructional and performance requirements 68
8.1 Constructional requirements 68
8.1.1 General 68
8.1.2 Materials 69
8.1.3 Current-carrying parts and their connections 70
8.1.4 Clearances and creepage distances 70
8.1.5 Actuator 70
8.1.6 Indication of the contact position 71
8.1.7 Additional requirements for equipment suitable for isolation 71
8.1.8 Terminals 73
8.1.9 Additional requirements for equipment provided with a neutral pole 74
8.1.10 Provisions for protective earthing 74
8.1.11 Dedicated enclosures for equipment 76
8.1.12 Degrees of protection of enclosed equipment 76
8.1.13 Conduit pull-out, torque and bending with metallic conduits 76
8.2 Performance requirements 77
8.2.1 Operating conditions 77
8.2.2 Temperature-rise 78
8.2.3 Dielectric properties 79
8.2.4 Ability to make, carry and break currents under no-load, normal load and overload conditions 82
8.2.5 Ability to make, carry and break short-circuit currents 83
8.2.6 Pole impedance 83
8.2.7 Leakage currents of equipment suitable for isolation 84
8.3 Electromagnetic compatibility (EMC) 84
8.3.1 General 84
8.3.2 Immunity 84
8.3.3 Emission 85
9 Tests 85
9.1 Kinds of test 85
9.1.1 General 85
9.1.2 Type tests 85
9.1.3 Routine tests 86
9.1.4 Sampling tests 86
9.1.5 Special tests 86
9.2 Compliance with constructional requirements 87
9.2.1 General 87
9.2.2 Test of materials to abnormal heat and fire 87
9.2.3 Equipment 87
9.2.4 Enclosures for equipment 87
9.2.5 Mechanical and electrical properties of terminals 88
9.2.6 Verification of the effectiveness of indication of the main contact position of equipment suitable for isolation 90
9.2.7 Vacant 93
9.2.8 Conduit pull-out test, torque test and bending test with metallic conduits 93
9.2.9 Test of earth continuity for protective earth 94

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

9.3 Performance 94
9.3.1 Test sequences 94
9.3.2 General test conditions 94
9.3.3 Performance under no-load, normal load and overload conditions 96
9.3.4 Performance under short-circuit conditions 109
9.4 Tests for EMC 114
9.4.1 General 114
9.4.2 Immunity 114
9.4.3 Emission 115
Annex A (informative) Harmonisation of utilization categories for low-voltage switchgear and controlgear 146
Annex B (Vacant) 149
Annex C (normative) Degrees of protection of enclosed equipment 150
C.1 General 150
C.2 Object 150
C.3 Definitions 150
C.4 Designation 150
C.5 Degrees of protection against access to hazardous parts and against ingress of solid foreign objects indicated by the first characteristic numeral 150
C.6 Degrees of protection against ingress of water indicated by the second characteristic numeral 150
C.7 Degrees of protection against access to hazardous parts indicated by the additional letter 151
C.8 Supplementary letters 151
C.9 Examples of designations with IP Code 151
C.10 Marking 151
C.11 General requirements for tests 151
C.12 Tests for protection against access to hazardous parts indicated by the first characteristic numeral 152
C.13 Tests for protection against ingress of solid foreign objects indicated by the first characteristic numeral 152
C.14 Tests for protection against water indicated by second characteristic numeral 153
C.14.1 Test means 153
C.14.2 Test conditions 153
C.14.3 Acceptance conditions 153
C.15 Tests for protection against access to hazardous parts indicated by additional letter 153
C.16 Summary of responsibilities of relevant technical committees 153
Annex D (informative) Examples of clamping units and relationship between clamping unit and connecting device 157
D.1 Clamping unit in a connecting device 157
D.2 Examples of clamping units 158
Annex E (informative) Description of a method for adjusting the load circuit 165
Annex F (informative) Determination of short-circuit power-factor or time-constant 167
F.1 Determination of short-circuit power-factor 167
F.1.1 Method I – Determination from DC component 167
F.1.2 Method II – Determination with pilot generator 167
F.2 Determination of short-circuit time-constant (oscillographic method) 168
Annex G (informative) Measurement of creepage distances and clearances 169

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

G.1 Basic principles ... 169
G.2 Use of ribs ... 169
Annex H (informative) Correlation between the nominal voltage of the supply system and the rated impulse withstand voltage of equipment ... 176
Annex J (informative) Items subject to agreement between manufacturer and user ... 178
Annex K (normative) Procedure to determine reliability data for electromechanical devices used in functional safety applications ... 179
K.1 General ... 179
K.1.1 Overview ... 179
K.1.2 Object ... 179
K.1.3 General requirements ... 179
K.2 Terms, definitions and symbols ... 180
K.2.1 Terms and definitions ... 180
K.2.2 Symbols ... 181
K.3 Method based on durability test results ... 181
K.3.1 General method ... 181
K.3.2 Test requirements ... 181
K.3.3 Number of samples ... 181
K.3.4 Characterization of a failure mode ... 181
K.3.5 Weibull modelling ... 182
K.3.6 Useful life and upper limit of failure rate ... 184
K.3.7 Reliability data ... 185
K.4 Data information ... 185
K.5 Example ... 186
K.5.1 Test results ... 186
K.5.2 Weibull distribution and median rank regression ... 186
K.5.3 Useful life and failure rate ... 187
Annex L (normative) Terminal marking and distinctive number ... 189
L.1 General ... 189
L.2 Terminal marking of impedances (alphanumerical) ... 189
L.2.1 Coils ... 189
L.2.2 Electromagnetic releases ... 190
L.2.3 Interlocking electromagnets ... 190
L.2.4 Indicating light devices ... 191
L.3 Terminal marking of contact elements for switching devices with two positions (numerical) ... 191
L.3.1 Contact elements for main circuits (main contact elements) ... 191
L.3.2 Contact elements for auxiliary circuit (auxiliary contact elements) ... 191
L.4 Terminal marking of overload protection devices ... 193
L.5 Distinctive number ... 194
L.6 Marking of terminals for external associated electronic circuit components, contacts and complete devices ... 194
L.6.1 Marking of terminals for external associated electronic circuit components and contacts ... 194
L.6.2 Marking of terminals for external complete devices ... 197
Annex M (normative) Flammability test ... 200
M.1 Hot wire ignition test (HWI) ... 200
M.1.1 Test sample ... 200
M.1.2 Description of test apparatus ... 200

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

M.1.3 Conditioning 201
M.1.4 Test procedure 201
M.2 Arc ignition test (AI) 201
M.2.1 Test sample 201
M.2.2 Description of test apparatus 201
M.2.3 Conditioning 202
M.2.4 Test procedure 202
M.3 HWI and AI requirements 203
Annex N (normative) Requirements and tests for equipment with protective separation 204
N.1 General 204
N.2 Terms and definitions 204
N.3 Requirements 206
N.3.1 General 206
N.3.2 Dielectric requirements 206
N.3.3 Construction requirements 206
N.4 Tests 207
N.4.1 General 207
N.4.2 Dielectric tests 207
N.4.3 Examples of constructional measures 207
Annex O (informative) Environmentally conscious design 209
O.1 General 209
O.2 Object 209
O.3 Terms and definitions 210
O.4 General considerations 212
O.5 Fundamentals requirements of environmentally conscious design (ECD) 215
O.6 Environmentally conscious design process (ECD process) 216
O.6.1 General 216
O.6.2 Process steps of ECD 216
O.7 Tools for including ECD in product design and development 217
O.8 Relevant ISO technical committees 217
Annex P (informative) Terminal lugs for low voltage switchgear and controlgear connected to copper conductors 218
Annex Q (normative) Special tests – Tests for environmental categories 219
Q.1 General 219
Q.2 Classification of equipment 219
Q.3 Tests 220
Q.3.1 General test conditions 220
Q.3.2 Test sequences 220
Annex R (normative) Application of the metal foil for dielectric testing on accessible parts during operation or adjustment 225
R.1 General 225
R.2 Object 225
R.3 Definition of zones 226
R.3.1 General 226
R.3.2 Application of metal foil on accessible parts during normal operation or adjustment 226
Annex S (normative) Digital inputs and outputs 233
S.1 General 233
S.2 Terms and definitions 233

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

S.3 Functional requirements ... 233
S.3.1 Rated values and operating ranges ... 233
S.3.2 Digital I/Os ... 234
S.4 Verification of input/output requirements ... 242
S.4.1 General ... 242
S.4.2 Verification of digital inputs ... 243
S.4.3 Verification of digital outputs ... 243
S.4.4 Behaviour of the equipment ... 244
S.5 General information to be provided by the manufacturer ... 245
S.5.1 Information on digital inputs (current sinking) ... 245
S.5.2 Information on digital outputs for alternating currents (current sourcing) ... 245
S.5.3 Information on digital outputs for direct current (current sourcing) ... 246
S.6 Digital input standard operating range equations ... 246
Annex T (normative) Extended functions within electronic overload relays ... 248
T.1 Object ... 248
T.1.1 General ... 248
T.1.2 Ground/earth fault detection function ... 248
T.2 Terms and definitions ... 248
T.3 Classification of electronic overload relays ... 249
T.4 Types of relays with ground/earth fault detection function ... 249
T.5 Performance requirements ... 249
T.5.1 Limits of operation of ground/earth fault electronic overload relays ... 249
T.5.2 Limits of operation of ground/earth fault current sensing electronic relays Type CII(-A and -B) ... 250
T.5.3 Limits of operation of voltage asymmetry relays ... 250
T.5.4 Limits of operation of phase reversal relays ... 250
T.5.5 Limits of operation of current imbalance relays ... 250
T.5.6 Limits of operation of over-voltage relays and releases ... 250
T.6 Tests ... 251
T.6.1 Limits of operation of ground/earth fault current sensing electronic relays Types CI and CII (-A and -B) ... 251
T.6.2 Verification of inhibit function of ground/earth fault current sensing electronic relays Type CII (-A and -B) ... 251
T.6.3 Current asymmetry relays ... 251
T.6.4 Voltage asymmetry relays ... 251
T.6.5 Phase reversal relays ... 251
T.6.6 Over-voltage relays ... 252
T.7 Routine and sampling tests ... 252
Annex U (informative) Examples of control circuit configurations ... 253
U.1 External control device ... 253
U.1.1 Definition ... 253
U.1.2 Diagrammatic representation of an external control device ... 253
U.1.3 Parameters of an external control device ... 253
U.2 Control circuit configurations ... 254
U.2.1 Equipment with external control supply ... 254
U.2.2 Equipment with several external control supplies ... 254
U.2.3 Equipment with bus interface (may be combined with other circuit configurations) ... 255
Annex V (informative) Power management with switchgear and controlgear for electrical energy efficiency ... 256

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

V.1 General ... 256
V.2 Object ... 256
V.3 Terms and definitions ... 256
V.4 Electrical energy efficiency and safety ... 257
V.5 Principles on electrical energy efficiency (system approach) ... 257
V.5.1 General ... 257
V.5.2 Strategy of energy management ... 257
V.5.3 Power management with automation and control ... 257
V.6 Energy efficiency application ... 258
V.6.1 Saving of semiconductor losses ... 258
V.6.2 Power factor correction ... 258
V.6.3 Load shedding ... 258
V.6.4 Motor control for fixed speed applications ... 258
Annex W (normative) Procedure to establish material declaration ... 259
W.1 General ... 259
W.2 Object ... 259
W.3 Reference document ... 259
W.4 Terms and definitions ... 259
W.5 Material declaration requirements ... 260
W.5.1 General reporting requirements ... 260
W.5.2 Additional reporting requirements ... 261
W.6 Example of material declaration made according to W.5 ... 261
Annex X (normative) Co-ordination between circuit-breaker or CPS and another short-circuit protective device associated in the same circuit ... 267
X.1 General ... 267
X.2 Object ... 267
X.3 General requirements for the co-ordination of a circuit-breaker or CPS with another SCPD ... 268
X.3.1 General considerations ... 268
X.3.2 Take-over current (I_B) ... 268
X.3.3 Behaviour of C_1 in association with another SCPD ... 268
X.4 Type and characteristics of the associated SCPD ... 268
X.5 Verification of selectivity ... 269
X.5.1 General ... 269
X.5.2 Consideration of selectivity by desk study ... 269
X.5.3 Selectivity determined by test ... 270
X.6 Verification of back-up protection ... 271
X.6.1 Determination of the take-over current ... 271
X.6.2 Verification of back-up protection ... 271
X.6.3 Tests for verification of back-up protection ... 271
X.6.4 Results to be obtained ... 272
Bibliography ... 278

Figure 1 – Test equipment for flexion test (see 9.2.5.3 and Table 5) ... 131
Figure 2 – Gauges of form A and form B (see 9.2.5.5.2 and Table 7) ... 131
Figure 3 – Diagram of the test circuit for the verification of making and breaking capacities of a single-pole equipment on single-phase AC or on direct current (see 9.3.3.5.2) ... 132

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Figure 4 – Diagram of the test circuit for the verification of making and breaking capacities of a two-pole equipment on single-phase AC or on direct current (see 9.3.3.5.2) 133

Figure 5 – Diagram of the test circuit for the verification of making and breaking capacities of a three-pole equipment (see 9.3.3.5.2) 134

Figure 6 – Diagram of the test circuit for the verification of making and breaking capacities of a four-pole equipment (see 9.3.3.5.2) 135

Figure 7 – Schematic illustration of the recovery voltage across contacts of the first phase to clear under ideal conditions (see 9.3.3.5.2, item e)) 136

Figure 8 – Diagram of a load circuit adjustment method 137

Figure 9 – Diagram of the test circuit for the verification of short-circuit making and breaking capacities of a single-pole equipment on single-phase AC or on direct current (see 9.3.4.1.2) 138

Figure 10 – Diagram of the test circuit for the verification of short-circuit making and breaking capacities of a two-pole equipment on single-phase AC or on direct current (see 9.3.4.1.2) 139

Figure 11 – Diagram of the test circuit for the verification of short-circuit making and breaking capacities of a three-pole equipment (see 9.3.4.1.2) 140

Figure 12 – Diagram of the test circuit for the verification of short-circuit making and breaking capacities of a four-pole equipment (see 9.3.4.1.2) 141

Figure 13 – Example of short-circuit making and breaking test record in the case of a single-pole equipment on single-phase AC (see 9.3.4.1.8) 142

Figure 14 – Verification of short-circuit making and breaking capacities on direct current (see 9.3.4.1.8) 143

Figure 15 – Determination of the prospective breaking current when the first calibration of the test circuit has been made at a current lower than the rated breaking capacity (see 9.3.4.1.8, item b)) 144

Figure 16 – Actuator test force (see 9.2.6.2.1 and Table 17) 145

Figure D.1 – Clamping unit in a connecting device 157

Figure D.2 – Screw clamping units 158

Figure D.3 – Pillar clamping units 159

Figure D.4 – Stud clamping units 160

Figure D.5 – Saddle clamping units 161

Figure D.6 – Lug clamping units 162

Figure D.7 – Mantle clamping units 163

Figure D.8 – Screwless-type clamping units (sketches) 164

Figure E.1 – Determination of the actual value of the factor γ 166

Figure G.1 – Measurement of ribs 170

Figure G.2 – Creepage distance across the fixed and moving insulation of contact carriers 170

Figure G.3 – Example 1 171

Figure G.4 – Example 2 171

Figure G.5 – Example 3 171

Figure G.6 – Example 4 172

Figure G.7 – Example 5 172

Figure G.8 – Example 6 172

Figure G.9 – Example 7 173

Figure G.10 – Example 8 173

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Figure G.11 – Example 9 174
Figure G.12 – Example 10 174
Figure G.13 – Example 11 175
Figure K.1 – Plot of Weibull median rank regression 188
Figure M.1 – Test fixture for hot wire ignition test 200
Figure M.2 – Circuit for arc ignition test 202
Figure N.1 – Example of application with component connected between separated circuits 208
Figure O.1 – Conceptual relationship between provisions in product standards and the environmental impacts associated with the product during its life cycle 214
Figure O.2 – Overview of ECD process 215
Figure P.1 – Dimensions 218
Figure R.1 – Operating mechanism outside the enclosure 227
Figure R.2 – Application of the metallic foil to operating areas around switch actuator 228
Figure R.3 – Example of finger protected location for hazardous-live-parts in push-button vicinity 229
Figure R.4 – Example I of application of the foil 229
Figure R.5 – Example II of application of the foil 230
Figure R.6 – Example III of application of the foil 230
Figure R.7 – Application of metal foil on holes and grooves 231
Figure R.8 – Operating space for actuation by rotary means 232
Figure S.1 – I/O parameters 235
Figure S.2 – U-I operation regions of current-sinking inputs 236
Figure S.3 – Temporary overload waveform for digital AC outputs 239
Figure S.4 – Temporary overload waveform for digital DC outputs 242
Figure T.1 – Test circuit for the verification of the operating characteristic of a ground/earth fault current sensing electronic relay 252
Figure U.1 – Diagrammatic representation of an external control device 253
Figure U.2 – Single supply and control input 254
Figure U.3 – Separate supply and control inputs 254
Figure U.4 – Equipment with several external control supplies 254
Figure U.5 – Equipment with bus interface 255
Figure W.1 – Example of Main and Business information, graphical representation of the XML code 263
Figure W.2 – Example of product information, graphical representation of the XML code 264
Figure W.3 – Example of declarable substances information, graphical representation of the XML code 265
Figure W.4 – Example of material classes information, graphical representation of the XML code 266
Figure X.1 – Overcurrent co-ordination between a circuit-breaker or CPS and a fuse or back-up protection by a fuse: operating characteristics 273
Figure X.2 – Total selectivity between two circuit-breakers or a circuit-breaker and a CPS 274
Figure X.3 – Back-up protection by a circuit-breaker or CPS – Operating characteristics 275

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Figure X.4 – Example of test circuit for conditional short-circuit breaking capacity tests showing cable connections for a 3-pole circuit-breaker or CPS (C_1) 276

Figure X.5 – Example of test circuit for the verification of selectivity 277

Table 1 – Nominal cross-sections of round copper conductors and approximate relationship between mm^2 and AWG/kcmil sizes (see 8.1.8.2) 116

Table 2 – Temperature-rise limits of terminals (see 8.2.2.2 and 9.3.3.3.4) 117

Table 3 – Temperature-rise limits of accessible parts (see 8.2.2.3 and 9.3.3.3.4) 117

Table 4 – Tightening torques for the verification of the mechanical strength of screw-type terminals (see 9.2.5.2 and 9.3.2.1) 118

Table 5 – Test values for flexion and pull-out tests for round copper conductors (see 9.2.5.4.1) 119

Table 6 – Test values for pull-out test for flat copper conductors (see 9.2.5.4.2) 119

Table 7 – Maximum conductor cross-sections and corresponding gauges (see 9.2.5.5.1) 120

Table 8 – Relationship between conductor cross-section and diameter 121

Table 9 – Test copper conductors for test currents up to 400 A inclusive (see 9.3.3.3.4) 122

Table 10 – Test copper conductors for test currents above 400 A and up to 800 A inclusive (see 9.3.3.3.4) 123

Table 11 – Test copper bars for test currents above 400 A and up to 3 150 A inclusive (see 9.3.3.3.4) 123

Table 12 – Impulse withstand test voltages 124

Table 13 – Minimum clearances in air 124

Table 14 – Test voltages across the open contacts of equipment suitable for isolation 125

Table 15 – Minimum creepage distances 125

Table 16 – Values of power-factors and time-constants corresponding to test currents, and ratio n between peak and RMS values of current (see 9.3.4.3, item a)) 126

Table 17 – Actuator test force (see 9.2.6.2.1) 127

Table 18 – Tolerances on test quantities (see 9.3.4.3, item a)) 127

Table 19 – Dielectric test voltage corresponding to the rated insulation voltage 127

Table 20 – Test values for conduit pull-out test (see 9.2.8.2) 128

Table 21 – Test values for conduit bending test (see 9.2.8.3) 128

Table 22 – Test values for conduit torque test (see 9.2.8.2 and 9.2.8.4) 128

Table 23 – Tests for EMC – Immunity (see 9.4.1) 129

Table 24 – Acceptance criteria when EM disturbances are present 130

Table 25 – Cross-sectional area of a copper protective conductor 130

Table A.1 – Utilization categories used in the IEC 60947 series 146

Table C.1 – IP Codes *(1 of 3)* 154

Table G.1 – Minimum widths of grooves 169

Table H.1 – Correspondence between the nominal voltage of the supply system and the equipment rated impulse withstand voltage, in case of overvoltage protection by surge-arresters according to IEC 60099-1 177

Table K.1 – Failure modes of devices 182

Table K.2 – Example of 15 sorted ascending times to failure of contactors 186

Table K.3 – Example median rank calculation 187

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Table M.1 – HWI and AI characteristics for materials necessary to retain current carrying parts in position 203

Table M.2 – HWI and AI characteristics for materials other than those covered by Table M.1 203

Table P.1 – Examples of terminal lugs for low voltage switchgear and controlgear connected to copper conductors 218

Table Q.1 – Test sequences *(1 of 4)* 221

Table S.1 – Rated values and operating ranges of incoming power supply 234

Table S.2 – Standard operating ranges for digital inputs (current sinking) 237

Table S.3 – Rated values and operating ranges for current sourcing digital AC outputs 238

Table S.4 – Rated values and operating ranges (direct current) for current-sourcing digital DC outputs 241

Table S.5 – Overload and short-circuit tests for digital outputs 244

Table T.1 – Tripping time of ground/earth fault electronic overload relays 249

Table W.1 – Example of main and business information in tabular form 262

Table W.2 – Example of product information in tabular form 263

Table W.3 – Example of declarable substances information in tabular form 264

Table W.4 – Example of material classes information in tabular form 266

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: General rules

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 sixth edition cancels and replaces the fifth edition published in 2007, Amendment 1:2010 and Amendment 2:2014. This edition constitutes a technical revision.

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

– DC values testing improvement;
– update of EMC tests;
– Annex B deletion;
– update of requirements for environmental tests (Table Q.1);
– improvement of Annex R (new examples);

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

– deletion of digital input Type 2, and introduction of Type 3 in Annex S;
– example for materials declaration (Annex W);
– new Annex X (co-ordination between short-circuit protective devices associated in the same circuit) created.

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

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

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

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

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

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

5.3.6.4 Rated conditional short-circuit current (I_q, alternatively I_{cc}) (North America)

6.2 Marking (USA and Canada)

8.1.3 Current-carrying parts and their connections (USA)

8.1.7.1 Additional constructional requirements (USA)

8.1.10.1 (North America)

9.2.6.2.2 Dependent power operation (USA)

9.2.6.2.3 Independent power operation (Canada and USA)

Figure 4 (USA and Canada)

Figure 5 (USA and Canada)

Figure 10 (USA and Canada)

Figure 11 (USA and Canada)

Figure X.4 (USA and Canada)

Figure X.5 (USA and Canada)

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

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

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.

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

INTRODUCTION

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

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

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

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

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

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

NOTE All references to “product standards” in this document means “product standards of IEC 60947 series”.

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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;
– verification of characteristics and performance;
– energy efficiency aspects (see Annex V);
– environmental aspects.

This document does not apply to:

– low-voltage switchgear and controlgear assemblies which are dealt with in IEC 61439 series, as applicable;
– terminals for connection of aluminium conductors;

NOTE Terminals for aluminium conductors are under consideration for the next revision.

– use within explosive atmospheres (see IEC 60079 series);
– software and firmware requirements for functional safety application (see IEC 61508-3);
– cyber security aspects (see IEC 62443 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)*

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

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

IEC 60068-2-52:1996, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*[1]

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60092-504:2016, *Electrical installations in ships – Part 504: Automation, control and instrumentation*

IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*

IEC 60228:2004, *Conductors of insulated cables*

IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*
IEC 60269-1:2006/AMD1:2009
IEC 60269-1:2006/AMD2:2014

IEC 60300-3-5:2001, *Dependability management – Part 3-5: Application guide – Reliability test conditions and statistical test principles*

IEC TR 60344:2007, *Calculation of d.c. resistance of plain and coated copper conductors of low-frequency cables and wires – Application guide*

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

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60617, *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

---

[1] Second edition (1996). This 2nd edition was replaced in 2017 by a 3rd Edition IEC 60068-2-52:2017, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*.

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

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

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

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers* IEC 60947-2:2016/AMD1:2019

IEC 60947-4-2, *Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters*

IEC 60947-5 (all parts), *Low-voltage switchgear and controlgear – Part 5: Control circuit devices and switching elements*

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

IEC 60947-8, *Low-voltage switchgear and controlgear – Part 8: Control units for built-in thermal protection (PTC) for rotating electrical machines*

IEC 60981:2019, *Extra heavy-duty electrical rigid steel conduits*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm^2 up to 35 mm^2 (included)*

IEC 60999-2:2003, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm^2 up to 300 mm^2 (included)*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

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

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

IEC 61000-4-34, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for equipment used in power station and substation environment*

IEC 61131-2:2017, *Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests*

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

IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance*

IEC 61649:2008, *Weibull analysis*

IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
IEC 62061:2005/AMD1:2012
IEC 62061:2005/AMD2:2015

IEC 62474:2018, *Material declaration for products of and for the electrotechnical industry*

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 32, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

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

ISO 13849-1:2015, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3 Terms, definitions, symbols and reference clauses

3.1 General

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:

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

3.2 Alphabetical index of definitions

References

A

"a" contact 3.5.12
Actuating force 3.6.17
Actuating system (of a mechanical switching device) 3.5.16
Actuator 3.5.17
Ambient air temperature 3.3.9
Anti-pumping device. 3.5.20
Applied voltage (for a switching device) 3.7.32
Arcing contact 3.5.8
Arcing time (of a multipole switching device) 3.7.41
Arcing time (of a pole or a fuse) 3.7.40
Automatic control 3.6.5
Auxiliary circuit (of a switching device) 3.5.4
Auxiliary contact 3.5.10
Auxiliary switch (of a mechanical switching device) 3.5.11

B

"b" contact 3.5.13
Back-up protection 3.7.24
Basic insulation N.2.2
Break contact 3.5.13
Breaking capacity (of a switching device or a fuse) 3.7.12
Breaking current (of a switching device or a fuse) 3.7.11
Break time 3.7.42

C

Censoring K.2.1.5
Circuit-breaker 3.4.11
Clamping unit 3.5.26
Clearance 3.7.46
Clearance between open contacts 3.7.49
Clearance between poles 3.7.47
Clearance to earth. 3.7.48
Closed position (of a mechanical switching device) 3.6.20
Closing operation (of a mechanical switching device) 3.6.8
Closing time 3.7.44
Comparative tracking index 3.7.64
Conditional short-circuit current (of a circuit or a switching device) 3.7.29
Conductive part 3.3.10
Connecting device 3.5.22
Constant failure rate period K.2.1.3
Contact (of a mechanical switching device) 3.5.5
Contact (piece) 3.5.6
Contactor relay 3.4.14
Control circuit (of a switching device) 3.5.3
Control circuit device 3.4.16

Documents
Document Sharing Hub

Full document details: AS NZS 60947.1-2021

Control contact 3.5.9
Controlgear 3.3.3
Control and protective switching device 3.4.24
Control switch (for control and auxiliary circuits) 3.4.17
Conventional non-tripping current (of an overcurrent relay or release) 3.7.30
Conventional tripping current (of an overcurrent relay or release 3.7.31
Co-ordination of insulation. 3.7.60
Creepage distance 3.7.51
Critical load current 3.7.16
Critical short-circuit current 3.7.17
Current-carrying part 3.5.37
Current setting (of an overcurrent or overload relay or release) 3.6.38
Current setting range (of an overcurrent or overload relay or release) 3.6.39
Current sinking S.2.3
Current sourcing S.2.4
Cut-off current 3.7.19
Cut-off (current) characteristic. 3.7.21

D

DC steady-state recovery voltage 3.7.36
DC withstand voltage 3.7.67
Declarable substance W.4.1
Declarable substance group W.4.2
Definite time-delay overcurrent relay or release 3.6.27
Dependent manual operation (of a mechanical switching device) 3.6.12
Dependent power operation (of a mechanical switching device) 3.6.13
Design and development O.3.1
Digital input S.2.1
Digital output S.2.2
Direct overcurrent relay or release 3.6.29
Disconnector 3.4.8
Double insulation N.2.4

E

Electric shock 3.3.20
Electrical energy efficiency V.3.3
(Electrical) relay 3.5.14
(Electrically) protective separation 3.3.25
Electronically controlled electromagnet 3.5.36
Electronic overload relay with current or voltage asymmetry function T.2.2
Electronic overload relay with ground/earth fault detection function T.2.1
Electronic overload relay with phase reversal function T.2.3
Electronic overload relay with over voltage function T.2.4
Electronic overload relay with under power function T.2.6
Enclosure 3.3.16
End of life (EOL) O.3.19
Energy efficiency V.3.4
Energy management V.3.1
Energy management system (EnMS) V.3.2
Energy recovery O.3.20
Environment O.3.2
Environmental aspect O.3.3
Environmental impact O.3.4
Environmental parameter O.3.5
Environmentally conscious design (ECD) O.3.6
Environmentally conscious design tool O.3.7
Exposed conductive part 3.3.11
External controle device U.1.1.1
Extra-low voltage (ELV) N.2.6
Extraneous-conductive-part 3.3.12

F

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Flexible conductor 3.5.32
Functional insulation N.2.1
Fuse 3.4.4
Fuse-combination unit 3.4.7
Fuse-element 3.4.6
Fuse-link 3.4.5

H

Homogeneous field 3.7.62
Homogeneous material W.4.3

I

I^2t 3.7.18
Impulse withstand voltage 3.7.55
Independent manual operation (of a mechanical switching device) 3.6.15
Independent power operation (of a mechanical switching device) 3.6.16
Indicator light 3.5.19
Indirect overcurrent relay or release 3.6.30
Individual enclosure 3.4.23
Inhibit current T.2.5
Inhomogeneous field 3.7.63
Instantaneous relay or release 3.6.25
Integral enclosure 3.3.17
Insulation coordination barrier 3.3.23
Interlocking device 3.5.21
Inverse time-delay overcurrent relay or release 3.6.28
Isolating distance (of a pole of a mechanical switching device) 3.3.24
Isolation 3.3.19

J

Joule integral 3.7.18

L

Leakage current 3.7.50
Let-through current 3.7.19
Let-through (current) characteristic 3.7.21
Let-through energy 3.7.18
Life cycle O.3.8
Life cycle assessment (LCA) O.3.9
Life cycle stage O.3.10
Life cycle thinking (LCT) O.3.11
Limiting value 3.7.2
Line conductor 3.3.26
Live part 3.3.13
Load V.3.5
Load shedding V.3.7
Local control 3.6.6

M

Magnetic overload relay or release 3.6.33
Main circuit (of a switching device) 3.5.2
Main contact 3.5.7
Maintenance 3.3.31
Make-break time 3.7.45
Make contact 3.5.12
Make time 3.7.43
Making capacity (of a switching device) 3.7.13
Manual control 3.6.4
Manufacturer 3.3.21
Material class W.4.4
Material declaration W.4.5
Maximum cross-section 3.5.35

Documents
Document Sharing Hub

Full document details: AS NZS 60947.1-2021

Maximum prospective peak current (of an AC circuit) 3.7.8
(Mechanical) contactor 3.4.12
(Mechanical) switch 3.4.9
Mechanical switching device 3.4.2
Micro-environment (of a clearance or creepage distance) 3.7.58
Mid-point conductor 3.3.27
Minimum cross-section 3.5.34
Multiple tip contact system 3.5.33

N

Neutral conductor 3.3.15
Nominal value 3.7.1
No-make-break-current utilization K.2.1.7
Non-universal clamping unit 3.5.26.2
Non-universal terminal 3.5.25.2

O

Open position (of a mechanical switching device) 3.6.21
Opening operation (of a mechanical switching device) 3.6.9
Opening time (of a mechanical switching device) 3.7.39
Operating current (of an overcurrent relay or release) 3.6.37
Operating cycle (of a mechanical switching device) 3.6.2
Operating sequence (of a mechanical switching device) 3.6.3
Operation (of a mechanical switching device) 3.6.1
Organization O.3.12
Overall lifetime K.2.1.4
Overcurrent 3.3.4
Overcurrent partial selectivity 3.7.23.3
Overcurrent selectivity 3.7.23.1
Overcurrent protective co-ordination of overcurrent protective devices 3.7.22
Overcurrent relay or release 3.6.26
Overcurrent total selectivity 3.7.23.2
Overload 3.3.7
Overload current 3.3.8
Overload relay or release 3.6.31
Overvoltage category (of a circuit or within an electrical system) 3.7.59

P

Peak arc voltage (of a mechanical switching device) 3.7.38
Peak shaving V.3.6
Peak withstand current 3.7.28
PEL conductor 3.3.30
PELV circuit N.2.8
PEM conductor 3.3.28
PEN conductor 3.3.29
Pilot switch 3.4.18
Pole of a switching device 3.5.1
Pollution 3.7.56
Pollution degree (of environmental conditions) 3.7.57
Port 3.9.1
Position indicating device 3.5.18
Positively driven operation 3.6.11
Positive opening operation (of a mechanical switching device) 3.6.10
Power-frequency recovery voltage 3.7.35
Power-frequency withstand voltage 3.7.56
Power port (control supply port) 3.9.3
Prepared conductor 3.5.28
Process O.3.13
Product O.3.14
Product category O.3.15
Prospective breaking current (for a pole of a switching device or a fuse) 3.7.10
Prospective current (of a circuit and with respect to a switching device or a fuse) 3.7.5

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Prospective making current (for a pole of a switching device) 3.7.9
Prospective peak current 3.7.6
Prospective symmetrical current (of an AC circuit) 3.7.7
Prospective transient recovery voltage (of a circuit) 3.7.37
Protection by limitation of steady-state current and electric charge N.2.9
Protective conductor 3.3.14
Protective impedance device N.2.10
Push-button 3.4.19
Push-wire terminal 3.5.25.3

R

Rated value 3.7.3
Rated control circuit supply voltage (U_s) 3.7.66
Rated control circuit voltage (U_c) 3.7.65
Rating 3.7.4
Recovery voltage 3.7.33
Recyclability O.3.18
Recycling O.3.17
Reinforced insulation N.2.5
Release (of a mechanical switching device) 3.5.15
Reliability (performance) K.2.1.1
Remote control 3.6.7
Restoring force 3.6.18
Reverse current relay or release (direct current only) 3.6.36
Rigid conductor 3.5.31
Routine test 3.8.2

S

Sampling test 3.8.3
Screw-type terminal 3.5.24
Screwless-type terminal 3.5.25
Selectivity 3.7.21
Selectivity limit current (I_s) 3.7.68
SELV circuit N.2.7
Semiconductor contactor (solid-state contactor) 3.4.13
Semiconductor switching device 3.4.3
Short-circuit 3.3.5
Short-circuit breaking capacity 3.7.14
Short-circuit current 3.3.6
Short-circuit making capacity 3.7.15
Short-circuit protective device (SCPD) 3.4.21
Short-time delay 3.7.26
Short-time withstand current 3.7.27
Shunt release 3.6.34
Signal port 3.9.2
Solid conductor 3.5.29
Solid insulation 3.3.22
Special test 3.8.4
Stakeholder O.3.16
Starter 3.4.15
Stranded conductor 3.5.30
Stored energy operation (of a mechanical switching device) 3.6.14
Supplementary insulation N.2.3
Surge arrester 3.4.22
Suspended item K.2.1.6
Switch-disconnector 3.4.10
Switchgear 3.3.2
Switchgear and controlgear 3.3.1
Switching device 3.4.1

T

Take-over current 3.7.25

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

Temporary overvoltage 3.7.53
Terminal 3.5.23
Terminal block 3.4.20
Thermal overload relay or release 3.6.32
Time-current characteristic. 3.7.20
Time to failure K.2.1.8
Tracking 3.7.63
Transient recovery voltage 3.7.34
Travel (of a mechanical switching device or a part thereof) 3.6.19
Trip-free mechanical switching device 3.6.24
Tripped position 3.6.22
Tripping (operation) 3.6.23
Type test 3.8.1

U

Under-voltage relay or release 3.6.35
Universal clamping unit 3.5.26.1
Universal terminal 3.5.25.1
Unprepared conductor 3.5.27
Useful life K.2.1.2
Utilization category (for a switching device or a fuse) 3.3.18

W

Working voltage 3.7.52

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 60050-441:2000, 441-11-01]

3.3.2
switchgear
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, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy

[SOURCE: IEC 60050-441:2000, 441-11-02]

3.3.3
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, intended in principle for the control of electric energy consuming equipment

[SOURCE: IEC 60050-441:2000, 441-11-03]

3.3.4
overcurrent
current exceeding the rated current

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

[SOURCE: IEC 60050-441:2000, 441-11-06]

3.3.5
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

[SOURCE: IEC 60050-195:1998, 195-04-11]

3.3.6
short-circuit current
overcurrent resulting from a short-circuit due to a fault or an incorrect connection in an electric circuit

[SOURCE: IEC 60050-441:2000, 441-11-07]

3.3.7
overload
operating conditions in an electrically undamaged circuit, which cause an overcurrent

[SOURCE: IEC 60050-441:2000, 441-11-08]

3.3.8
overload current
overcurrent occurring in an electrically undamaged circuit

3.3.9
ambient air temperature
temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse

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

[SOURCE: IEC 60050-441:2000, 441-11-13, modified – “the” has been deleted.]

3.3.10
conductive part
part which is capable of conducting current although it may not necessarily be used for carrying service current

[SOURCE: IEC 60050-441:2000, 441-11-09, modified – “a” has been deleted.]

3.3.11
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 1 to entry: Typical exposed conductive parts are walls of enclosures, operating handles, etc.

[SOURCE: IEC 60050-441:2000, 441-11-10, modified – “a” has been deleted.]

3.3.12
extraneous-conductive-part
conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the electric potential of a local earth

[SOURCE: IEC 60050-195:1998, 195-06-11]

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3.3.13
live part
conductive part intended to be energized in normal conditions, including a neutral conductor or mid-point conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-195:1998, 195-02-19, modified – “conductor or” deleted, “normal conditions, including a neutral conductor or mid-point conductor” replaces “normal operation, including a neutral conductor.]

3.3.14
protective conductor
PE (identification)
conductor provided for purposes of safety, for example protection against electric shock

[SOURCE: IEC 60050-195:1998, 195-02-09]

3.3.15
neutral conductor
N (identification)
conductor electrically connected to the neutral point and capable of contributing to the distribution of electrical energy

[SOURCE: IEC 60050-195:1998, 195-02-06, modified – alternative term “N (identification)” has been added.]

3.3.16
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 hazardous live parts and hazardous mechanical parts

[SOURCE: IEC 60050-441:2000, 441-13-01, modified – references to “of an assembly” deleted from term and definition, “hazardous live parts and hazardous mechanical parts” replaces “live parts and against contact with moving parts”.]

3.3.17
integral enclosure
enclosure which forms an integral part of the equipment

3.3.18
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 1 to entry: The specified requirements can 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.

[SOURCE: IEC 60050-441:2000, 441-17-19, modified – In Note 1 to entry, “may” changed to “can”.]

3.3.19
isolation

disconnection of an installation or its discrete section from any source of the electric energy for purposes of electrical safety

AVA Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3.3.20
electric shock
physiological effect resulting from an electric current passing through a human or animal body

[SOURCE: IEC 60050-195:1998, 195-01-04]

3.3.21
manufacturer
for the purposes of this document, any person, company or organisation with ultimate responsibility as follows:

– to verify compliance with the appropriate standard or standards;

– to provide the product information according to Clause 6

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

3.3.22
solid insulation
solid insulating material interposed between two conductive parts

3.3.23
insulation coordination barrier
solid insulating material that is not an integral part, provided for the purpose of increasing either creepage distances or clearance distances or both

3.3.24
isolating distance
<of a pole of a mechanical switching device> clearance between open contacts meeting the safety requirements specified for disconnectors

[SOURCE: IEC 60050-441:2000, 441-17-35, modified – "the" has been deleted.]

3.3.25
protective separation
electrically protective separation
separation of one electric circuit from another by means of:

– double insulation, or

– basic insulation and electrically protective screen, or

– reinforced insulation

[SOURCE: IEC 60050-195:1998, 195-06-19, modified – "screen" replaces "screening".]

3.3.26
line conductor
phase conductor (in AC systems) (deprecated)
pole conductor (in DC systems) (deprecated)
conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a neutral or mid-point conductor

[SOURCE: IEC 60050-195:1998, 195-02-08]

3.3.27
mid-point conductor
conductor electrically connected to the mid-point and capable of contributing to the distribution of electric energy

[SOURCE: IEC 60050-195:1998, 195-02-07]

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3.3.28
PEM conductor
conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[SOURCE: IEC 60050-195:1998, 195-02-13]

3.3.29
PEN conductor
conductor combining the functions of both a protective earthing conductor and a neutral conductor

[SOURCE: IEC 60050-195:1998, 195-02-12]

3.3.30
PEL conductor
conductor combining the functions of both a protective earthing conductor and a line conductor

[SOURCE: IEC 60050-195:1998, 195-02-14]

3.3.31
maintenance
combination of all technical actions intended to retain an item in, or restore it to, a state in which it can perform as required

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

3.4 Switching devices

3.4.1
switching device
device designed to make or break the current in one or more electric circuits

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

[SOURCE: IEC 60050-441:2000, 441-14-01, modified – Note 1 to entry has been added.]

3.4.2
mechanical switching device
switching device designed to close and open one or more electric circuits by means of separable contacts

Note 1 to entry: Any mechanical switching device can be designated according to the medium in which its contacts open and close, e.g.: air, SF_6, oil.

[SOURCE: IEC 60050-441:2000, 441-14-02, modified – In Note 1 to entry, “may” changed to “can”.]

3.4.3
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

[SOURCE: IEC 60050-441:2000, 441-14-03, modified – Addition of “and/or break”.]

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3.4.4
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

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

[SOURCE: IEC 60050-441:2000, 441-18-01]

3.4.5
fuse-link
part of a fuse (including the fuse-element(s)) intended to be replaced after the fuse has operated

[SOURCE: IEC 60050-441:2000, 441-18-09]

3.4.6
fuse-element
part of the fuse-link designed to melt under the action of current exceeding some definite value for a definite period of time

[SOURCE: IEC 60050-441:2000, 441-18-08]

3.4.7
fuse-combination unit
combination of a mechanical switching device and one or more fuses in a composite unit, assembled by the manufacturer or in accordance with their instructions

[SOURCE: IEC 60050-441:2000, 441-14-04, modified – “his instructions” has been replaced by “their instructions” and Note 1 to entry has been deleted.]

3.4.8
disconnector
mechanical switching device which, in the open position, complies with the requirements specified for isolation

3.4.9
switch
mechanical switch
mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions which may include specified operating overload conditions and also carrying for a specified time currents under specified abnormal circuit conditions such as those of short-circuit

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

[SOURCE: IEC 60050-441:2000, 441-14-10, modified – In Note 1 to entry, “may” changed to “can”.]

3.4.10
switch-disconnector
switch which, in the open position, satisfies the isolating requirements specified for a disconnector

[SOURCE: IEC 60050-441:2000, 441-14-12]

Documents
Document Sharing Hub
© Standards Australia Limited/Standards New Zealand 2021
Full document details: AS NZS 60947.1-2021

3.4.11
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

[SOURCE: IEC 60050-441:2000, 441-14-20, modified – "time" replaced "duration".]

3.4.12
contactor
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

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

[SOURCE: IEC 60050-441:2000, 441-14-33, modified – In term, “mechanical” in parenthesis, and in Note 1 to entry, “Mechanical” has been deleted and “may” changed to “can”.]

3.4.13
semiconductor contactor
solid-state contactor
device which performs the function of a contactor by utilizing a semiconductor switching device

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

3.4.14
contactor relay
contactor used as a control switch

[SOURCE: IEC 60050-441:2000, 441-14-35]

3.4.15
starter
combination of all the switching means necessary to start and stop a motor, in combination with suitable overload protection

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

[SOURCE: IEC 60050-441:2000, 441-14-38, modified – In Note 1 to entry, “may” changed to “can”.]

3.4.16
control circuit device
electrical device, intended for the controlling, signalling, interlocking, etc. of switchgear and controlgear

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

3.4.17
control switch
<for control and auxiliary circuits> mechanical switching device which serves the purpose of controlling the operation of switchgear or controlgear, including signalling, electrical interlocking, etc.

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

[SOURCE: IEC 60050-441:2000, 441-14-46]

3.4.18
pilot switch
non-manual control switch actuated in response to specified conditions of an actuating quantity

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

[SOURCE: IEC 60050-441:2000, 441-14-48, modified – In Note 1 to entry, “may” changed to “can”.]

3.4.19
push-button
control switch having an actuator intended to be operated by force exerted by a part of the human body, usually the finger or palm of the hand, and having stored energy (spring) return

[SOURCE: IEC 60050-441:2000, 441-14-53]

3.4.20
terminal block
insulating part carrying one or more mutually insulated terminal assemblies and intended to be fixed to a support

3.4.21
short-circuit protective device
SCPD
device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting them

3.4.22
surge arrester
device designed to protect the electrical apparatus from high transient overvoltages and to limit the duration and frequently the amplitude of the follow-on current

3.4.23
individual enclosure
enclosure designed and dimensioned to contain one equipment only

3.4.24
control and protective switching device
CPS
mechanical switching device operated other than by hand, but with or without local manual operating means, capable of:

– making, carrying and breaking currents under normal conditions, including specified operating overload conditions
– making, carrying for a specified time, and breaking currents under specified abnormal conditions such as those of short-circuits

3.5 Parts of switching devices

3.5.1
pole of a switching device
portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together

Documents
Document Sharing Hub
© Standards Australia Limited/Standards New Zealand 2021
Full document details: AS NZS 60947.1-2021

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 be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to operate together.

[SOURCE: IEC 60050-441:2000, 441-15-01, modified – In Note 1 to entry, “may” changed to “can”.]

3.5.2
main circuit
<of a switching device> all the conductive parts of a switching device included in the circuit which it is designed to close or open

[SOURCE: IEC 60050-441:2000, 441-15-02]

3.5.3
control circuit
<of a switching device> all the conductive parts (other than the main circuit) of a switching device which are included in a circuit used for the closing operation or opening operation, or both, of the device

[SOURCE: IEC 60050-441:2000, 441-15-03]

3.5.4
auxiliary circuit
<of a switching device> all the conductive parts of a switching device which are intended to be included in a circuit other than the main circuit and the control circuits of the device

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

[SOURCE: IEC 60050-441:2000, 441-15-04, modified – In Note 1 to entry, “may” changed to “can”.]

3.5.5
contact
<of a mechanical switching device> conductive parts designed to establish circuit continuity when they touch and which, due to their relative motion during an operation, open or close a circuit or, in the case of hinged or sliding contacts, maintain circuit continuity

[SOURCE: IEC 60050-441:2000, 441-15-05]

3.5.6
contact
contact piece
one of the conductive parts forming a contact

[SOURCE: IEC 60050-441:2000, 441-15-06]

3.5.7
main contact
contact included in the main circuit of a mechanical switching device, intended to carry, in the closed position, the current of the main circuit

[SOURCE: IEC 60050-441:2000, 441-15-07]

3.5.8
arcing contact
contact on which the arc is intended to be established

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

[SOURCE: IEC 60050-441:2000, 441-15-08, modified – “injury” has been replaced by “deterioration” and In Note 1 to entry, “may” changed to “can”.]

3.5.9
control contact
contact included in a control circuit of a mechanical switching device and mechanically operated by this device

[SOURCE: IEC 60050-441:2000, 441-15-09]

3.5.10
auxiliary contact
contact included in an auxiliary circuit and mechanically operated by the switching device

[SOURCE: IEC 60050-441:2000, 441-15-10]

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

[SOURCE: IEC 60050-441:2000, 441-15-11]

3.5.12
"a" contact
make contact
control or auxiliary contact which is closed when the main contacts of the mechanical switching device are closed and open when they are open

[SOURCE: IEC 60050-441:2000, 441-15-12]

3.5.13
"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

[SOURCE: IEC 60050-441:2000, 441-15-13]

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

[SOURCE: IEC 60050-151:2001, 151-13-31]

3.5.15
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

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

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

[SOURCE: IEC 60050-441:2000, 441-15-17, modified – Note 1 to entry has been added.]

3.5.16
actuating system
<of a mechanical switching device> whole of the operating means of a mechanical switching device which transmit the actuating force to the contact pieces

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

3.5.17
actuator
part of the actuating system to which an external actuating force is applied

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

[SOURCE: IEC 60050-441:2000, 441-15-22]

3.5.18
position indicating device
part of a mechanical switching device which indicates whether it is in the open, closed, or, where appropriate, earthed position

[SOURCE: IEC 60050-441:2000, 441-15-25]

3.5.19
indicator light
light signal giving information either by lighting or extinguishing

3.5.20
anti-pumping device
device which prevents reclosing after a close-open operation as long as the device initiating closing is maintained in the position for closing

[SOURCE: IEC 60050-441:2000, 441-16-48]

3.5.21
interlocking device
device which makes the operation of a switching device dependent upon the position of operation of one or more other pieces of equipment

[SOURCE: IEC 60050-441:2000, 441-16-49]

3.5.22
connecting device
device for the electrical connection of one (or more) conductor(s), comprising one (or more) terminal(s), either fixed to a base or forming an integral part of the equipment

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

3.5.23
terminal
conductive part of one pole of a device for electrical connection to external circuit, composed of one or more clamping unit(s) and insulation if necessary

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

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3.5.24
screw-type terminal
terminal intended for the connection and disconnection of conductors or for the inter-connection of two or more conductors, the connection being made, directly or indirectly, by means of screws or nuts of any kind

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

3.5.25
screwless-type terminal
terminal intended for the connection and disconnection of conductors or for the interconnection on two or more conductors, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc.

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

3.5.25.1
universal terminal
terminal for the connection and disconnection of all types of conductors (solid, stranded and flexible)

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

3.5.25.2
non-universal terminal
terminal for the connection and disconnection of a certain kind of conductor only (for example, solid conductors only or solid and stranded conductors only)

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

3.5.25.3
push-wire terminal
non-universal terminal in which the connection is made by pushing in solid or stranded conductors

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

3.5.26
clamping unit
part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure

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

3.5.26.1
universal clamping unit
clamping unit intended for all types of conductors

3.5.26.2
non-universal clamping unit
clamping unit intended for certain types of conductors only, for example:

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

Documents
Document Sharing Hub
© Standards Australia Limited/Standards New Zealand 2021
Full document details: AS NZS 60947.1-2021

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

3.5.27
unprepared conductor
conductor which has been cut and the insulation of which has been removed for insertion into a terminal

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

3.5.28
prepared conductor
conductor, the strands of which are soldered or the end of which is fitted with a cable lug, eyelet, etc.

3.5.29
solid conductor
conductor consisting of a single wire

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

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

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

3.5.30
stranded conductor
conductor consisting of a number of wires, all or some of which are wound in a helix

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

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

3.5.31
rigid conductor
solid or stranded conductor having wires of such diameters, or so assembled, that the conductor is not suitable for use in a flexible cable

3.5.32
flexible conductor
stranded conductor having wires of diameters small enough and so assembled that the conductor is suitable for use in a flexible cable

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

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

3.5.33
multiple tip contact system
contact system comprising more than one contact gap per pole, which can be switched, in series and/or in parallel

3.5.34
minimum cross-section
value of the smallest connectable conductor cross-section stated by the manufacturer as suitable for the terminal

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

3.5.35
maximum cross-section
value of the largest connectable conductor cross-section stated by the manufacturer as suitable for the terminal

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

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

3.5.36
electronically controlled electromagnet
electromagnet in which the coil is controlled by a circuit with active electronic elements

3.5.37
current-carrying part
conductive part which carries the electric current under normal conditions

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

3.6 Operation of switching devices

3.6.1
operation
<of a mechanical switching device> transfer of the moving contact(s) from one position to an adjacent position

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

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

[SOURCE: IEC 60050-441:2000, 441-16-01, modified – in Note 1 to entry, "for example" has been added and "may" changed to "can".]

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

[SOURCE: IEC 60050-441:2000, 441-16-02]

3.6.3
operating sequence
<of a mechanical switching device> succession of specified operations with specified time intervals

[SOURCE: IEC 60050-441:2000, 441-16-03]

3.6.4
manual control
control of an operation by human intervention

Documents
Document Sharing Hub
© Standards Australia Limited/Standards New Zealand 2021
Full document details: AS NZS 60947.1-2021

[SOURCE: IEC 60050-441:2000, 441-16-04]

3.6.5
automatic control
control of an operation without human intervention, in response to the occurrence of predetermined conditions

[SOURCE: IEC 60050-441:2000, 441-16-05]

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

[SOURCE: IEC 60050-441:2000, 441-16-06]

3.6.7
remote control
control of an operation at a point distant from the controlled switching device

[SOURCE: IEC 60050-441:2000, 441-16-07]

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

[SOURCE: IEC 60050-441:2000, 441-16-08]

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

[SOURCE: IEC 60050-441:2000, 441-16-09]

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

[SOURCE: IEC 60050-441:2000, 441-16-11]

3.6.11
positively driven operation
operation which, in accordance with specified requirements, is designed to ensure that auxiliary contacts of a mechanical switching device are in the respective positions corresponding to the open or closed position of the main contacts

[SOURCE: IEC 60050-441:2000, 441-16-12]

3.6.12
dependent manual operation
<of a mechanical switching device> operation solely by means of directly applied manual energy such that the speed and force of the operation are dependent upon the action of the operator

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

[SOURCE: IEC 60050-441:2000, 441-16-13]

3.6.13
dependent power operation
<of a mechanical switching device> operation by means of energy other than manual, where the completion of the operation is dependent upon the continuity of the power supply (to solenoids, electric or pneumatic motors, etc.)

[SOURCE: IEC 60050-441:2000, 441-16-14]

3.6.14
stored energy operation
<of a mechanical switching device> operation by means of energy stored in the mechanism itself prior to the completion of the operation and sufficient to complete it under predetermined conditions

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

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

[SOURCE: IEC 60050-441:2000, 441-16-15, modified – In Note 1 to entry, “may” changed to “can”.]

3.6.15
independent manual operation
<of a mechanical switching device> stored energy operation where the energy originates from manual power, stored and released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator

[SOURCE: IEC 60050-441:2000, 441-16-16]

3.6.16
independent power operation
<of a mechanical switching device> stored energy operation where the stored energy originates from an external power source and is released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator

3.6.17
actuating force
force applied to an actuator necessary to complete the intended operation

[SOURCE: IEC 60050-441:2000, 441-16-17]

3.6.18
restoring force
force provided to restore an actuator or a contact element to its initial position

[SOURCE: IEC 60050-441:2000, 441-16-19]

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

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

[SOURCE: IEC 60050-441:2000, 441-16-21 – In Note 1 to entry, “may” changed to “can”.]

Documents
Document Sharing Hub

Full document details: AS NZS 60947.1-2021

3.6.20
closed position
<of a mechanical switching device> position in which the predetermined continuity of the main circuit of the device is secured

[SOURCE: IEC 60050-441:2000, 441-16-22]

3.6.21
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

3.6.22
tripped position
position of the switching device following a tripping operation

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

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

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

[SOURCE: IEC 60050-441:2000, 441-16-31, modified – Addition of "(i.e. tripping)" since the opening operation of a trip-free mechanical switching device is automatically controlled, in Note 1 to entry, “may” changed to “can”.]

3.6.25
instantaneous relay or release
relay or release which operates without any intentional time-delay

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

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

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

3.6.28
inverse time-delay overcurrent relay or release
overcurrent relay or release which operates after a time-delay inversely dependent upon the value of the overcurrent

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

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

3.6.29
direct overcurrent relay or release
overcurrent relay or release directly energized by the current in the main circuit of a switching device

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

3.6.31
overload relay or release
overcurrent relay or release intended for protection against overloads

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

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

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

3.6.34
shunt release
release energized by a source of voltage

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

[SOURCE:IEC 60050-441:2000, 441-16-41, modified – In Note 1 to entry, “may” changed to “can”.]

3.6.35
under-voltage relay or release
relay or release which permits a mechanical switching device to open or close, with or without time-delay, when the voltage across the terminals of the relay or release falls below a predetermined value

3.6.36
reverse current relay or release (direct current only)
relay or release which permits a mechanical switching device to open, with or without time-delay, when the current flows in the reverse direction and exceeds a predetermined value

[SOURCE: IEC 60050-441:2000, 441-16-43, modified – “shunt release” replaced by “relay or release”.]

3.6.37
operating current
<of an overcurrent relay or release> value of current at and above which the relay or release will operate

3.6.38
current-setting
<of an overcurrent or overload relay or release> value of current of the main circuit to which the operating characteristics of the relay or release are referred and for which the relay or release is set

Documents
Document Sharing Hub
© Standards Australia Limited/Standards New Zealand 2021
Full document details: AS NZS 60947.1-2021

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

3.6.39
current setting range
<of an overcurrent or overload relay or release> range between the minimum and maximum values over which the current setting of the relay or release can be adjusted

3.7 Characteristic quantities

3.7.1
nominal value
value of a quantity used to designate and identify a component, device, equipment, or system

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

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

3.7.2
limiting value
in a specification of a component, device, equipment, or system, the greatest or smallest admissible value of a quantity

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

3.7.3
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

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

3.7.4
rating
set of rated values and operating conditions

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

3.7.5
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 1 to entry: The method to be used to evaluate and to express the prospective current is to be specified in the relevant product standard.

[SOURCE:IEC 60050-441:2000, 441-17-01, modified – In the Note 1 to entry, “relevant publications” is replaced by “relevant product standard”.]

3.7.6
prospective peak current
peak value of a prospective current during the transient period following initiation

Note 1 to entry: 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.

[SOURCE:IEC 60050-441:2000, 441-17-02]

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021

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

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

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

[SOURCE: IEC 60050-441:2000, 441-17-03, modified – In the Note 2 to entry, “RMS value” instead of “RMS”.]

3.7.8
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 1 to entry: For a multipole device in a polyphase circuit, the maximum prospective peak current refers to one pole only.

[SOURCE: IEC 60050-441:2000, 441-17-04, modified – In the Note 1 to entry, “to a single pole only” replaced by “to one pole only”.]

3.7.9
prospective making current
<for a pole of a switching device> prospective current when initiated under specified conditions

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

[SOURCE: IEC 60050-441:2000, 441-17-05, modified – In the Note 1 to entry, “is found in the relevant publications” replaced by “is given in the relevant product standard and “may” changed to “can”.]

3.7.10
prospective breaking current
<for a pole of a switching device or a fuse> prospective current evaluated at a time corresponding to the instant of the initiation of the breaking process

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

[SOURCE: IEC 60050-441:2000, 441-17-06, modified – In the Note 1 to entry, “are to be found in the relevant publications” replaced by “are given in the relevant product standard”.]

3.7.11
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

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

[SOURCE: IEC 60050-441:2000, 441-17-07, modified – Note 1 to entry has been added.]

Documents
Document Sharing Hub
© Standards Australia Limited/Standards New Zealand 2021
Full document details: AS NZS 60947.1-2021

3.7.12
breaking capacity
<of a switching device or a fuse> value of prospective breaking current that a switching device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

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

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

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

[SOURCE: IEC 60050-441:2000, 441-17-08, modified – In the Note 1 to entry, "the relevant publications" has been replaced by "the relevant product standard", the Note 2 to entry has been modified and the Note 3 to entry has been added.]

3.7.13
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

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

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

[SOURCE: IEC 60050-441:2000, 441-17-09, modified – In the title, reference to "a fuse" deleted, in the Note 1 to entry, "the relevant publications" has been replaced by "the relevant product standard" and addition of the Note 2 to entry.]

3.7.14
short-circuit breaking capacity
breaking capacity for which prescribed conditions include a short-circuit at the terminals of the switching device

[SOURCE: IEC 60050-441:2000, 441-17-11]

3.7.15
short-circuit making capacity
making capacity for which prescribed conditions include a short-circuit at the terminals of the switching device

[SOURCE: IEC 60050-441:2000, 441-17-10]

3.7.16
critical load current
I_{crit}
value of breaking current, within the range of service conditions, at which the arcing time is significantly extended

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

3.7.17
critical short-circuit current
value of breaking current, less than the rated short-circuit breaking capacity, at which the arc energy is significantly higher than at the rated short-circuit breaking capacity

Documents
Document Sharing Hub

© Standards Australia Limited/Standards New Zealand 2021

Full document details: AS NZS 60947.1-2021