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

Interested committees:

Title: Draft BS EN IEC 60947-1:2022 Low-voltage switchgear and
controlgear Part 1: General rules

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Introduction

This draft standard is based on international discussions in which the UK has taken an active part. Your comments on this draft are welcome and will assist in the preparation of the consequent standard. There is a high probability that this text could be adopted by CENELEC as a reference document for harmonization or as a European Standard. Recipients of this draft are requested to comment on the text bearing in mind this possibility.

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



121A/540/CD

COMMITTEE DRAFT (CD)

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121A/534/RR

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

SECRETARIAT:

France

SECRETARY:

Mr Michaël LAHEURTE

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 18, SC 23E, SC 121B

PROPOSED HORIZONTAL STANDARD:



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

FUNCTIONS CONCERNED:

☒ EMC

☒ ENVIRONMENT

☒ QUALITY ASSURANCE

☒ SAFETY

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

TITLE:

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

NOTE FROM TC/SC OFFICERS:

Officers of SC121A supports circulation of CD1 for project IEC 60947-1 ED7.

Secretary note 1: as far as possible, changes implemented in this new edition are visible in tracking mode for reader's convenience.

Secretary note 2: NCs are kindly requested to refer their comments to line numbers.

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CONTENTS

1		
2		
3	FOREWORD.....	14
4	INTRODUCTION.....	17
5	1 Scope.....	18
6	2 Normative references.....	18
7	3 Terms, definitions, symbols and reference clauses	22
8	3.1 General.....	22
9	3.2 Alphabetical index of definitions	23
10	3.3 General terms and definitions	28
11	3.4 Switching devices	31
12	3.5 Parts of switching devices	34
13	3.6 Operation of switching devices	40
14	3.7 Characteristic quantities	45
15	3.8 Tests	55
16	3.9 Ports.....	55
17	3.10 Terms and definitions concerning safety aspects	56
18	3.11 Symbols and references clauses for characteristics described in this	
19	document.....	58
20	4 Classification.....	60
21	5 Characteristics	60
22	5.1 Summary of the characteristics.....	60
23	5.2 Type of equipment	60
24	5.3 Rated and limiting values for the main circuit	60
25	5.3.1 Rated voltages.....	60
26	5.3.2 Currents	62
27	5.3.3 Rated frequency.....	63
28	5.3.4 Rated duties	63
29	5.3.5 Characteristics under normal load and overload conditions (see 8.2.4)	64
30	5.3.6 Short-circuit characteristics	65
31	5.3.7 Pole impedance of the switching device (Z)	66
32	5.3.8 Power consumption of the control circuit.....	66
33	5.4 Utilization category.....	66
34	5.5 Control circuits.....	67
35	5.5.1 Electrically or electronically controlled circuits	67
36	5.5.2 Air-supply control circuits (pneumatic or electro-pneumatic)	67
37	5.6 Auxiliary circuits.....	67
38	5.7 Relays and releases.....	68
39	5.8 Co-ordination with short-circuit protective devices (SCPD)	68
40	6 Product information	68
41	6.1 Nature of information.....	68
42	6.2 Marking.....	69
43	6.3 Instructions for installation, operation and maintenance, decommissioning	
44	and dismantling.....	70
45	6.4 Environmental information	71
46	7 Normal service, mounting and transport conditions	71
47	7.1 Normal service conditions	71
48	7.1.1 Ambient air temperature	71

49	7.1.2	Altitude	72
50	7.1.3	Atmospheric conditions	72
51	7.1.4	Shock and vibration	73
52	7.1.5	Other environmental categories	73
53	7.2	Conditions during transport and storage	73
54	7.3	Mounting	73
55	8	Constructional and performance requirements	73
56	8.1	Constructional requirements	73
57	8.1.1	General	73
58	8.1.2	Materials	74
59	8.1.3	Current-carrying parts and their connections	76
60	8.1.4	Clearances and creepage distances	77
61	8.1.5	Actuator	78
62	8.1.6	Indication of the contact position	78
63	8.1.7	Additional requirements for equipment suitable for isolation	79
64	8.1.8	Terminals	80
65	8.1.9	Additional requirements for equipment provided with a neutral pole	82
66	8.1.10	Provisions for protective earthing	82
67	8.1.11	Dedicated enclosures for equipment	83
68	8.1.12	Degrees of protection of enclosed equipment	84
69	8.1.13	Conduit pull-out, torque and bending with metallic conduits	84
70	8.1.14	Limited energy source	84
71	8.1.15	Stored charge energy circuit	85
72	8.1.16	Fault and abnormal conditions	85
73	8.1.17	Short-circuit and overload protection of ports	86
74	8.1.18	Use of voltage transient limiting device	86
75	8.2	Performance requirements	86
76	8.2.1	Operating conditions	86
77	8.2.2	Temperature-rise	88
78	8.2.3	Dielectric properties	89
79	8.2.4	Ability to make, carry and break currents under no-load, normal load	
80		and overload conditions	93
81	8.2.5	Ability to make, carry and break short-circuit currents	94
82	8.2.6	Pole impedance	94
83	8.2.7	Control circuit power consumption	94
84	8.2.8	Leakage currents of equipment suitable for isolation	95
85	8.3	Electromagnetic compatibility (EMC)	95
86	8.3.1	General	95
87	8.3.2	Immunity	95
88	8.3.3	Emission	95
89	8.4	Embedded software	96
90	8.5	Security	96
91	9	Tests	96
92	9.1	Kinds of test	96
93	9.1.1	General	96
94	9.1.2	Type tests	97
95	9.1.3	Routine tests	97
96	9.1.4	Sampling tests	97
97	9.1.5	Special tests	98
98	9.1.6	Verification of product capable to be reused, repaired and upgraded	98

99	9.2	Compliance with constructional requirements	98
100	9.2.1	General	98
101	9.2.2	Test of materials to abnormal heat and fire	98
102	9.2.3	Equipment marking	99
103	9.2.4	Enclosures for equipment	99
104	9.2.5	Mechanical and electrical properties of terminals	99
105	9.2.6	Verification of the effectiveness of indication of the main contact position of equipment suitable for isolation	102
107	9.2.7	Limited energy source test	104
108	9.2.8	Stored charge energy test	105
109	9.2.9	Conduit pull-out test, torque test and bending test with metallic conduits	105
110	9.2.10	Test of earth continuity for protective earth	106
111	9.2.11	Breakdown of components	106
112	9.2.12	Short-circuit and overload protection of ports	107
113	9.2.13	Void	108
114	9.2.14	Wire flexing test	108
115	9.2.15	Artificial optical radiation test	108
116	9.3	Performance	108
117	9.3.1	Test sequences	108
118	9.3.2	General test conditions	108
119	9.3.3	Performance under no-load, normal load and overload conditions	110
120	9.3.4	Performance under short-circuit conditions	124
121	9.4	Tests for EMC	130
122	9.4.1	General	130
123	9.4.2	Immunity	130
124	9.4.3	Emission	131
125	9.5	Embedded software	131
126	Annex A (informative)	Harmonisation of utilization categories for low-voltage switchgear and controlgear	168
127			
128	Annex B (normative)	Additional requirements for LV switchgear and controlgear intended for connection of aluminium conductors	171
129			
130	B.1	General	171
131	B.2	Terms, definitions, symbols and reference clauses	171
132	B.2.1	171	
133	B.2.2	171	
134	B.2.3	171	
135	B.3	Classification	172
136	B.4	Characteristics	172
137	B.5	Product information	172
138	B.5.1	Nature of information	172
139	B.5.2	Marking	172
140	B.5.3	Instructions for installation, operation and maintenance, decommissioning and dismantling	172
141			
142	B.6	Normal service, mounting and transport conditions	172
143	B.7	Constructional and performance requirements	173
144	B.8	Tests	173
145	B.8.1	General	173
146	B.8.2	Current cycling test	174
147	B.8.3	Climatic test	179
148	B.8.4	Mechanical properties of terminals	180

149	B.8.5	Test for insertability of unprepared round aluminium conductors having	
150		the maximum cross-section	181
151	Annex C (normative)	Degrees of protection	183
152	C.1	General.....	183
153	C.2	Object.....	183
154	C.3	Definitions.....	183
155	C.4	Designation.....	183
156	C.5	Degrees of protection against access to hazardous parts and against ingress	
157		of solid foreign objects indicated by the first characteristic numeral	183
158	C.6	Degrees of protection against ingress of water indicated by the second	
159		characteristic numeral	183
160	C.7	Degrees of protection against access to hazardous parts indicated by the	
161		additional letter	184
162	C.8	Supplementary letters	184
163	C.9	Examples of designations with IP Code	184
164	C.10	Marking.....	184
165	C.11	General requirements for tests	184
166	C.12	Tests for protection against access to hazardous parts indicated by the first	
167		characteristic numeral	185
168	C.13	Tests for protection against ingress of solid foreign objects indicated by the	
169		first characteristic numeral	185
170	C.13.4	Dust test for first characteristic numerals 5 and 6	185
171	C.13.5.2	Acceptance conditions for first characteristic numeral 5.....	185
172	C.14	Tests for protection against water indicated by second characteristic	
173		numeral	186
174	C.14.1	Test means.....	186
175	C.14.2	Test conditions	186
176	C.14.3	Acceptance conditions	186
177	C.15	Tests for protection against access to hazardous parts indicated by	
178		additional letter	186
179	C.16	Summary of responsibilities of relevant technical committees	186
180	Annex D (informative)	Examples of clamping units and relationship between clamping	
181		unit and connecting device.....	190
182	D.1	Clamping unit in a connecting device	190
183	D.2	Structure of a PCB terminal block	190
184	D.3	Examples of clamping units	191
185	Annex E (informative)	Description of a method for adjusting the load circuit	199
186	Annex F (informative)	Determination of short-circuit power-factor or time-constant	201
187	F.1	Determination of short-circuit power-factor.....	201
188	F.1.1	Method I – Determination from DC component.....	201
189	F.1.2	Method II – Determination with pilot generator	201
190	F.2	Determination of short-circuit time-constant (oscillographic method).....	202
191	Annex G (informative)	Measurement of creepage distances and clearances	203
192	G.1	Basic principles.....	203
193	G.2	Use of ribs	203
194	G.3	Connection of parts of solid insulation (cemented joints)	203
195	Annex H (informative)	Correlation between the nominal voltage of the supply system	
196		and the rated impulse withstand voltage of equipment	211
197	Annex I (vacant)		213
198	Annex J (informative)	Items subject to agreement between manufacturer and user.....	214

199	Annex K (normative) Procedure to determine reliability data for electromechanical	
200	devices used in functional safety applications.....	215
201	K.1 General.....	215
202	K.1.1 Object.....	215
203	K.1.2 General requirements.....	215
204	K.2 Terms, definitions and symbols.....	216
205	K.2.1 Terms and definitions.....	216
206	K.2.2 Symbols.....	217
207	K.3 Method based on durability test results.....	217
208	K.3.1 General method.....	217
209	K.3.2 Test requirements.....	217
210	K.3.3 Number of samples.....	217
211	K.3.4 Characterization of a failure mode.....	217
212	K.3.5 Weibull modelling.....	218
213	K.3.6 Useful life and upper limit of failure rate.....	219
214	K.3.7 Reliability data.....	220
215	K.4 Data information.....	221
216	K.5 Example.....	221
217	K.5.1 Test results.....	221
218	K.5.2 Weibull distribution and median rank regression.....	222
219	K.5.3 Useful life and failure rate.....	223
220	Annex L (normative) Terminal marking and distinctive number.....	224
221	L.1 General.....	224
222	L.2 Terminal marking of impedances (alphanumeric).....	224
223	L.2.1 Coils.....	224
224	L.2.2 Electromagnetic releases.....	225
225	L.2.3 Interlocking electromagnets.....	225
226	L.2.4 Indicating light devices.....	226
227	L.3 Terminal marking of contact elements for switching devices with two	
228	positions (numerical).....	226
229	L.3.1 Contact elements for main circuits (main contact elements).....	226
230	L.3.2 Contact elements for auxiliary circuit (auxiliary contact elements).....	226
231	L.4 Terminal marking of overload protection devices.....	228
232	L.5 Distinctive number.....	229
233	L.6 Marking of terminals for external associated electronic circuit components,	
234	contacts and complete devices.....	229
235	L.6.1 Marking of terminals for external associated electronic circuit	
236	components and contacts.....	229
237	L.6.2 Marking of terminals for external complete devices.....	232
238	Annex M (normative) Flammability test.....	235
239	M.1 Hot wire ignition test (HWI).....	235
240	M.1.1 Test sample.....	235
241	M.1.2 Description of test apparatus.....	235
242	M.1.3 Conditioning.....	236
243	M.1.4 Test procedure.....	236
244	M.2 Arc ignition test (AI).....	236
245	M.2.1 Test sample.....	236
246	M.2.2 Description of test apparatus.....	236
247	M.2.3 Conditioning.....	237
248	M.2.4 Test procedure.....	237

249	M.3	HWI and AI requirements	238
250	Annex N (normative)	Requirements and tests for equipment with protective separation	240
251	N.1	General.....	240
252	N.2	Terms and definitions	240
253	N.3	Requirements.....	242
254	N.3.1	General	242
255	N.3.2	Dielectric requirements	242
256	N.3.3	Construction requirements	242
257	N.4	Tests	243
258	N.4.1	General	243
259	N.4.2	Dielectric tests	243
260	N.4.3	Test method for implementing protective impedance	244
261	N.4.4	Touch current measurement	245
262	N.4.5	Examples of constructional measures	246
263	Annex O (vacant)		248
264	Annex P (informative)	Terminal lugs for low voltage switchgear and controlgear	
265		connected to copper conductors.....	249
266	Annex Q (normative)	Tests for environmental categories	250
267	Q.1	General.....	250
268	Q.2	Classification of equipment.....	250
269	Q.3	Tests	251
270	Q.3.1	General test conditions	251
271	Q.3.2	Test sequences.....	251
272	Annex R (normative)	Application of the metal foil for dielectric testing on accessible	
273		parts during operation or adjustment	256
274	R.1	General.....	256
275	R.2	Object.....	256
276	R.3	Definition of zones	257
277	R.3.1	General	257
278	R.3.2	Application of metal foil on accessible parts during normal operation or	
279		adjustment.....	257
280	Annex S (normative)	Digital inputs and outputs.....	265
281	S.1	General.....	265
282	S.2	Terms and definitions	265
283	S.3	Functional requirements	265
284	S.3.1	Rated values and operating ranges	265
285	S.3.2	Digital I/Os.....	266
286	S.4	Verification of input/output requirements	274
287	S.4.1	General	274
288	S.4.2	Verification of digital inputs	275
289	S.4.3	Verification of digital outputs	275
290	S.4.4	Behaviour of the equipment.....	276
291	S.5	General information to be provided in the product documentation	277
292	S.5.1	Information on digital inputs (current sinking).....	277
293	S.5.2	Information on digital outputs for alternating currents (current sourcing)	277
294	S.5.3	Information on digital outputs for direct current (current sourcing)	278
295	S.6	Digital input standard operating range equations	278
296	Annex T (normative)	Extended functions within electronic overload relays	280
297	T.1	Object.....	280
298	T.1.1	General	280

299	T.1.2	Ground/earth fault detection function	280
300	T.2	Terms and definitions	280
301	T.3	Classification of electronic overload relays	281
302	T.4	Types of relays with ground/earth fault detection function	281
303	T.5	Performance requirements	281
304	T.5.1	Limits of operation of ground/earth fault electronic overload relays	281
305	T.5.2	Limits of operation of ground/earth fault current sensing electronic relays Type CII(-A and -B)	282
307	T.5.3	Limits of operation of voltage asymmetry relays	282
308	T.5.4	Limits of operation of phase reversal relays	282
309	T.5.5	Limits of operation of current imbalance relays	282
310	T.5.6	Limits of operation of over-voltage relays and releases	282
311	T.6	Tests	283
312	T.6.1	Limits of operation of ground/earth fault current sensing electronic relays Types CI and CII (-A and -B)	283
314	T.6.2	Verification of inhibit function of ground/earth fault current sensing electronic relays Type CII (-A and -B)	283
316	T.6.3	Current asymmetry relays	283
317	T.6.4	Voltage asymmetry relays	283
318	T.6.5	Phase reversal relays	284
319	T.6.6	Over-voltage relays	284
320	T.7	Routine and sampling tests	284
321	Annex U (informative)	Examples of control circuit configurations	285
322	U.1	External control device	285
323	U.1.1	Definition	285
324	U.1.2	Diagrammatic representation of an external control device	285
325	U.1.3	Parameters of an external control device	285
326	U.2	Control circuit configurations	286
327	U.2.1	Equipment with external control supply	286
328	U.2.2	Equipment with several external control supplies	286
329	U.2.3	Equipment with bus interface (may be combined with other circuit configurations)	287
331	Annex V (vacant)		288
332	Annex W (normative)	Determination of critical DC load current in DC devices	289
333	W.1	General	289
334	W.2	Determination of critical DC load current	289
335	Annex X (normative)	Co-ordination between circuit-breaker, MPSD or CPS and another short-circuit protective device associated in the same circuit	291
337	X.1	General	291
338	X.2	Object	291
339	X.3	General requirements for the co-ordination of a circuit-breaker, MPSD or CPS with another SCPD	292
341	X.3.1	General considerations	292
342	X.3.2	Take-over current (I_B)	292
343	X.3.3	Behaviour of C_1 in association with another SCPD	292
344	X.4	Type and characteristics of the associated SCPD	292
345	X.5	Verification of selectivity	293
346	X.5.1	General	293
347	X.5.2	Consideration of selectivity by desk study	293
348	X.5.3	Selectivity determined by test	294

349	X.6	Verification of back-up protection.....	295
350	X.6.1	Determination of the take-over current.....	295
351	X.6.2	Verification of back-up protection	295
352	X.6.3	Tests for verification of back-up protection.....	296
353	X.6.4	Results to be obtained	297
354	Annex Y (normative)	Additional requirements for low-voltage switchgear a controlgear	
355		- equipment or devices incorporating a built-in communication interface complying	
356		with IEC 61131-9	302
357	Y.1	General.....	302
358	Y.2	Void	302
359	Y.3	Void	302
360	Y.4	Void	302
361	Y.5	Characteristics	302
362	Y.5.1	Rated and limiting values for SDCI	302
363	Y.6	Product information	303
364	Y.7	Void	303
365	Y.8	Constructional and performance requirements	303
366	Y.8.1	Constructional requirements.....	303
367	Y.8.2	Electromagnetic compatibility (EMC)	303
368	Y.9	Tests	303
369	Y.9.1	Kinds of tests	303
370	Annex Z (informative)	Power loss of the main poles of switchgear and controlgear	304
371	Z.1	General.....	304
372	Z.2	Determination method	304
373	Z.2.1	General	304
374	Z.2.2	AC devices without fuse links	304
375	Z.2.3	AC devices incorporating fuse links	305
376	Z.2.4	AC devices without fuse links and having a rated current not exceeding	
377		400 A.....	305
378	Z.2.5	AC devices with fuse links and having a rated current not exceeding	
379		400A.....	306
380	Z.2.6	DC devices	306
381	Z.3	Test conditions.....	306
382	Z.4	Test procedure.....	307
383	Z.4.1	General	307
384	Z.4.2	Voltage drop measurement.....	307
385	Z.4.3	Current measurement.....	307
386	Bibliography		312
387			
388	Figure 1 – Test equipment for flexion test (see 9.2.5.3 and Table 5).....		152
389	Figure 2 – Gauges of form A and form B (see 9.2.5.5.2 and Table 7Table).....		152
390	Figure 3 – Diagram of the test circuit for the verification of making and breaking		
391	capacities of a single-pole equipment on single-phase AC or on direct current (see		
392	9.3.3.5.2).....		153
393	Figure 4 – Diagram of the test circuit for the verification of making and breaking		
394	capacities of a two-pole equipment on single-phase AC or on direct current (see		
395	9.3.3.5.2).....		154
396	Figure 5 – Diagram of the test circuit for the verification of making and breaking		
397	capacities of a three-pole equipment (see 9.3.3.5.2)		155
398	Figure 6 – Diagram of the test circuit for the verification of making and breaking		
399	capacities of a four-pole equipment (see 9.3.3.5.2).....		156

400	Figure 7 – Schematic illustration of the recovery voltage across contacts of the first	
401	phase to clear under ideal conditions (see 9.3.3.5.2, item e))	157
402	Figure 8 – Diagram of a load circuit adjustment method	158
403	Figure 9 – Diagram of the test circuit for the verification of short-circuit making and	
404	breaking capacities of a single-pole equipment on single-phase AC or on direct current	
405	(see 9.3.4.1.2)	159
406	Figure 10 – Diagram of the test circuit for the verification of short-circuit making and	
407	breaking capacities of a two-pole equipment on single-phase AC or on direct current	
408	(see 9.3.4.1.2)	160
409	Figure 11 – Diagram of the test circuit for the verification of short-circuit making and	
410	breaking capacities of a three-pole equipment (see 9.3.4.1.2)	161
411	Figure 12 – Diagram of the test circuit for the verification of short-circuit making and	
412	breaking capacities of a four-pole equipment (see 9.3.4.1.2)	162
413	Figure 13 – Example of short-circuit making and breaking test record in the case of a	
414	single-pole equipment on single-phase AC (see 9.3.4.1.8)	163
415	Figure 14 – Verification of short-circuit making and breaking capacities on direct	
416	current (see 9.3.4.1.8)	164
417	Figure 15 – Determination of the prospective breaking current when the first calibration	
418	of the test circuit has been made at a current lower than the rated breaking capacity	
419	(see 9.3.4.1.8, item b))	165
420	Figure 16 – Actuator test force (see 9.2.6.2.1 and Table 17)	166
421	Figure 17 – Example of different parts	167
422	Figure B.1 – General test arrangement	175
423	Figure B.2 – Mounting of terminals for the current cycling test	175
424	For clarification of the definitions, see Figure D.1 – Clamping unit in a connecting	
425	device	190
426	Figure D.1 – Clamping unit in a connecting device	190
427	Figure D.2 – Structure of a PCB terminal block as a connection device	191
428	Figure D.3 – Screw clamping units	191
429	Figure D.4 – Pillar clamping units	192
430	Figure D.5 – Stud clamping units	193
431	Figure D.6 – Saddle clamping units	194
432	Figure D.7 – Lug clamping units	195
433	Figure D.8 – Mantle clamping units	196
434	Figure D.9 – Screwless-type clamping units (sketches)	197
435	Figure D.10 – PCB terminal block	198
436	The oscillatory frequency f of the transient recovery voltage and the value of the factor	
437	γ are essentially determined by the natural frequency and the damping of the load	
438	circuit. Since these values are independent of the voltage and frequency applied to the	
439	circuit, the adjustment can be made by energizing the load circuit from an AC power	
440	supply, the voltage and frequency of which may be different from those of the supply	
441	source utilized for the test of the equipment. The circuit is interrupted at a current zero	
442	by a diode, and the oscillations of the recovery voltage are observed on the screen of	
443	an oscilloscope, the sweep of which is synchronized with the frequency of the power	
444	supply (see Figure E.1 – Determination of the actual value of the factor γ)	199
445	The actual value of the factor γ is the ratio U_{11}/U_{12} ; U_{11} is read on the screen, U_{12} is	
446	read between the ordinate of point A and the ordinate of the trace when the load circuit	
447	is no longer energized by the generator (see Figure E.1 – Determination of the actual	
448	value of the factor γ)	199
449	Figure E.1 – Determination of the actual value of the factor γ	200
450	Figure G.1 – Measurement of ribs	205

451	Figure G.2 – Creepage distance across the fixed and moving insulation of contact carriers	205
453	Figure G.3 – Example 1	206
454	Figure G.4 – Example 2	206
455	Figure G.5 – Example 3	206
456	Figure G.6 – Example 4	207
457	Figure G.7 – Example 5	207
458	Figure G.8 – Example 6	207
459	Figure G.9 – Example 7	208
460	Figure G.10 – Example 8	208
461	Figure G.11 – Example 9	209
462	Figure G.12 – Example 10.....	209
463	Figure G.13 – Example 11.....	210
464	Figure G.14 – Example 12.....	210
465	Figure K.1 – Plot of Weibull median rank regression	223
466	Figure M.1 – Test fixture for hot wire ignition test	235
467	Figure M.2 – Circuit for arc ignition test	237
468	Figure N.1 – Protection by means of protective impedance	245
469	Figure N.2 – Measuring instrument.....	246
470	Figure N.3 – Example of application with component connected between separated circuits	247
472	Figure P.1 – Dimensions	249
473	Figure R.1 – Operating mechanism outside the enclosure	258
474	Figure R.2 – Application of the metallic foil to operating areas around switch actuator	259
475	Figure R.3 – Example of finger protected location for hazardous-live-parts in push-button vicinity	260
477	Figure R.4 – Example I of application of the foil	260
478	Figure R.5 – Example II of application of the foil	261
479	Figure R.6 – Example III of application of the foil	262
480	Figure R.7 – Application of metal foil on holes and grooves	263
481	Figure R.8 – Operating space for actuation by rotary means	264
482	Figure S.1 – I/O parameters	267
483	Figure S.2 – <i>U-I</i> operation regions of current-sinking inputs	268
484	Figure S.3 – Temporary overload waveform for digital AC outputs.....	271
485	Figure S.4 – Temporary overload waveform for digital DC outputs	274
486	Figure T.1 – Test circuit for the verification of the operating characteristic of a ground/earth fault current sensing electronic relay	284
488	Figure U.1 – Diagrammatic representation of an external control device.....	285
489	Figure U.2 – Single supply and control input.....	286
490	Figure U.3 – Separate supply and control inputs.....	286
491	Figure U.4 – Equipment with several external control supplies	286
492	Figure U.5 – Equipment with bus interface.....	287
493	Figure X.1 – Overcurrent co-ordination between a circuit-breaker, MPSD or CPS and a fuse or back-up protection by a fuse: operating characteristics	298
495	Figure X.2 – Total selectivity between two circuit-breakers or a circuit-breaker and a CPS or a circuit-breaker and a MPSD.....	298

497	Figure X.3 – Back-up protection by a circuit-breaker or CPS – Operating	
498	characteristics	299
499	Figure X.4 – Example of test circuit for conditional short-circuit breaking capacity tests	
500	showing cable connections for a 3-pole circuit-breaker or CPS (C_1).....	300
501	Figure X.5 – Example of test circuit for the verification of selectivity	301
502	Figure Z.1 – Example of power loss measurement for AC devices without fuse links	308
503	Figure Z.2 – Example of power loss measurement for AC devices with fuse links	308
504	Figure Z.3 – Example of power loss measurement for devices without fuse links	309
505	Figure Z.4 – Example of power loss measurement for devices with fuse links	309
506	Figure Z.5 – Measurement points for devices with a single pole per phase	310
507	Figure Z.6 – Measurement points for devices with multiple poles per phase	311
508		
509	Table 1 – Nominal cross-sections of round copper conductors and approximate	
510	relationship between mm ² and AWG/kcmil sizes (see 8.1.8.2)	132
511	Table 2 – Temperature-rise limits of terminals (see 8.2.2.2 and 9.3.3.3.4)	133
512	Table 3 – Temperature-rise limits of accessible parts (see 8.2.2.3 and 9.3.3.3.4)	133
513	Table 4 – Tightening torques for the verification of the mechanical strength of screw-	
514	type terminals (see 9.2.5.2 and 9.3.2.1)	134
515	Table 5 – Test values for flexion and pull-out tests for round copper conductors (see	
516	9.2.5.4.1).....	136
517	Table 6 – Test values for pull-out test for flat copper conductors (see 9.2.5.4.2).....	136
518	Table 7 – Maximum conductor cross-sections and corresponding gauges (see	
519	9.2.5.5.1).....	137
520	Table 8 – Relationship between conductor cross-section and diameter	138
521	Table 9 – Test copper conductors for test currents up to 400 A inclusive (see 9.3.3.3.4).....	139
522	Table 10 – Test copper conductors for test currents above 400 A and up to 800 A	
523	inclusive (see 9.3.3.3.4)	140
524	Table 11 – Test copper bars for test currents above 400 A and up to 3 150 A inclusive	
525	(see 9.3.3.3.4)	140
526	Table 12 – Impulse withstand test voltages.....	141
527	Table 13 – Minimum clearances in air	141
528	Table 14 – Test voltages across the open contacts of equipment suitable for isolation.....	142
529	Table 15 – Minimum creepage distances	142
530	Table 16 – Values of power-factors and time-constants corresponding to test currents,	
531	and ratio n between peak and RMS values of current (see 9.3.4.3, item a))	143
532	Table 17 – Actuator test force (see 9.2.6.2.1)	144
533	Table 18 – Tolerances on test quantities (see 9.3.4.3, item a))	144
534	Table 19 – Dielectric test voltage corresponding to the rated insulation voltage	144
535	Table 20 – Test values for conduit pull-out test (see 9.2.9.2)	145
536	Table 21 – Test values for conduit bending test (see 9.2.9.3).....	145
537	Table 22 – Test values for conduit torque test (see 9.2.9.2 and 9.2.9.4)	145
538	Table 23 – Tests for EMC – Immunity (see 9.4.1)	145
539	Table 24 – Acceptance criteria when EM disturbances are present	149
540	Table 25 – Diameter of copper wire in case of supply with artificial neutral current	150
541	Table 26 – Cross-sectional area of a copper protective conductor	150
542	Table 27 – Limits for limited energy sources without an over-current protective device	150
543	Table 28 – Limits for limited energy sources with an over-current protective device	151

544	Table 29 – Limits for limited energy source with current limiting impedance.....	151
545	Table A.1 – Utilization categories used in the IEC 60947 series	168
546	Table B.1 – List of tests for terminal connections a with aluminium cables.....	173
547	Table B.2 – Conductor length for current cycling test as per conductor cross-section	176
548	Table B.3 – Equalizer dimensions	176
549	Table B.4 – Starting test current for the current cycling test	178
550	Table B.5 – Example of stability factor calculation	179
551	Table B.6 – Test values for flexion and pull-out test for cables	180
552	Table B.7 – Test aluminium cable for test currents up to 800 A ^{a, b}	181
553	Table B.8 – Test aluminium bars for test currents above 400 A and up to 3 150 A ^{a, f}	182
554	Table C.1 – IP Codes (1 of 3).....	187
555	Table G.1 – Minimum widths of grooves	203
556	Table H.1 – Correspondence between the nominal voltage of the supply system and	
557	the equipment rated impulse withstand voltage, in case of overvoltage protection by	
558	surge-arresters according to IEC 60099-1	212
559	Table K.1 – Failure modes of devices	218
560	Table K.2 – Example of 15 sorted ascending times to failure of contactors	222
561	Table K.3 – Example median rank calculation.....	222
562	Table M.1 – HWI and AI characteristics for materials necessary to retain current	
563	carrying parts in position	238
564	Table M.2 – HWI and AI characteristics for materials other than those covered by	
565	Table M.1	238
566	Table P.1 – Examples of terminal lugs for low voltage switchgear and controlgear	
567	connected to copper conductors.....	249
568	Table Q.1 – Test sequences (1 of 4)	252
569	Table S.1 – Rated values and operating ranges of incoming power supply	266
570	Table S.2 – Standard operating ranges for digital inputs (current sinking)	269
571	Table S.3 – Rated values and operating ranges for current sourcing digital AC outputs	270
572	Table S.4 – – Rated values and operating ranges (direct current) for current-sourcing	
573	digital DC outputs	273
574	Table S.5 – Overload and short-circuit tests for digital outputs	276
575	Table T.1 – Tripping time of ground/earth fault electronic overload relays	281
576	Table Y.1 – Electrical characteristics of a Master port class B	302
577		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: General rules

FOREWORD

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

This edition cancels and replaces the [sixth](#) edition published in 2020. This edition constitutes a technical revision.

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

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

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

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 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.

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

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

669

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.

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671

672

INTRODUCTION

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

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

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

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

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

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

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

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693

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: General rules

1 Scope

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

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

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

~~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*

- 733 IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*
- 734 IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance:*
735 *Shock*
- 736 IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic*
737 *(12 h + 12 h cycle)*
- 738 IEC 60068-2-52:2017, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic*
739 *(sodium chloride solution)⁴*
- 740 IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat,*
741 *steady state*
- 742 IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and*
743 *identification – Coding principles for indicators and actuators*
- 744 IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*
- 745 IEC 60092-504:2016, *Electrical installations in ships – Part 504: Automation, control and*
746 *instrumentation*
- 747 IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2:*
748 *Determination of thermal endurance properties of electrical insulating materials – Choice of*
749 *test criteria*
- 750 IEC 60228:2004, *Conductors of insulated cables*
- 751 IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*
752 IEC 60269-1:2006/AMD1:2009
753 IEC 60269-1:2006/AMD2:2014
- 754 IEC 60300-3-5:2001, *Dependability management – Part 3-5: Application guide – Reliability*
755 *test conditions and statistical test principles*
- 756 IEC TR 60344:2007, *Calculation of d.c. resistance of plain and coated copper conductors of*
757 *low-frequency cables and wires – Application guide*
- 758 IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)
759
- 760 IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and*
761 *identification – Identification of equipment terminals, conductor terminations and conductors*
- 762 IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and*
763 *identification – Actuating principles*
- 764 IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
765 IEC 60529:1989/AMD1:1999
766 IEC 60529:1989/AMD2:2013
- 767 IEC 60617, *Graphical symbols for diagrams* (available at <http://std.iec.ch/iec60617>)

⁴ ~~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).~~

- 768 IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1:*
769 *Principles, requirements and tests*
- 770 IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods –*
771 *Glow-wire apparatus and common test procedure*
- 772 IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods –*
773 *Glow-wire flammability test method for end-products (GWEPT)*
- 774 IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods –*
775 *Glow-wire flammability index (GWFI) test method for materials*
- 776 IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and*
777 *vertical flame test methods*
- 778 [IEC 60715:2017, Dimensions of low-voltage switchgear and controlgear – Standardized](#)
779 [mounting on rails for mechanical support of switchgear, controlgear and accessories](#)
- 780 [IEC 60721-3-1, Classification of environmental conditions – Part 3-1: Classification of groups](#)
781 [of environmental parameters and their severities – Storage](#)
- 782 [IEC 60721-3-2, Classification of environmental conditions – Part 3-2: Classification of groups](#)
783 [of environmental parameters and their severities – Transportation and Handling](#)
- 784 [IEC 60730-1, Automatic electrical controls – Part 1: General requirements](#)
- 785 IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*
786 IEC 60947-2:2016/AMD1:2019
- 787 IEC 60947-4-2, *Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-*
788 *starters – AC semiconductor motor controllers and starters*
- 789 IEC 60947-5 (all parts), *Low-voltage switchgear and controlgear – Part 5: Control circuit*
790 *devices and switching elements*
- 791 IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices*
792 *and switching elements – Electromechanical control circuit devices*
- 793 IEC 60947-8, *Low-voltage switchgear and controlgear – Part 8: Control units for built-in*
794 *thermal protection (PTC) for rotating electrical machines*
- 795 IEC 60981:2019, *Extra heavy-duty electrical rigid steel conduits*
- 796 IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements*
797 *for screw-type and screwless-type clamping units – Part 1: General requirements and*
798 *particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm²*
799 *(included)*
- 800 IEC 60999-2:2003, *Connecting devices – Electrical copper conductors – Safety requirements*
801 *for screw-type and screwless-type clamping units – Part 2: Particular requirements for*
802 *clamping units for conductors above 35 mm² up to 300 mm² (included)*
- 803 IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and*
804 *measurement techniques – Electrostatic discharge immunity test*
- 805 IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement*
806 *techniques – Radiated, radio-frequency, electromagnetic field immunity test*

- 807 IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement*
808 *techniques – Electrical fast transient/burst immunity test*
- 809 IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement*
810 *techniques – Surge immunity test*
- 811 IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement*
812 *techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
- 813 IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement*
814 *techniques – Power frequency magnetic field immunity test*
- 815 IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement*
816 *techniques – Voltage dips, short interruptions and voltage variations immunity tests*
- 817 IEC 61000-4-34, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement*
818 *techniques – Voltage dips, short interruptions and voltage variations immunity tests for*
819 *equipment with input current more than 16 A per phase*
- 820 IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards –*
821 *Immunity standard for industrial environments*
- 822 IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards –*
823 *Immunity for equipment used in power station and substation environment*
- 824 [IEC 61051-2:1991, Varistors for use in electronic equipment – Part 2: Sectional specification](#)
825 [for surge suppression varistors](#)
- 826 IEC 61131-2:2017, *Industrial-process measurement and control – Programmable controllers –*
827 *Part 2: Equipment requirements and tests*
- 828 [IEC 61131-9:2022, Programmable controllers - Part 9: Single-drop digital communication](#)
829 [interface for small sensors and actuators \(SDCI\)](#)
- 830 IEC 61140:2016, *Protection against electric shock – Common aspects for installation and*
831 *equipment*
- 832 IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test*
833 *and procedure requirements, test equipment*
- 834 [IEC 61238-1, Compression and mechanical connectors for power cables for rated voltages up](#)
835 [to 30 kV \(\$U_m = 36\$ kV\) – Part 1: Test methods and requirements](#)
- 836 [IEC 61238-1-1, Compression and mechanical connectors for power cables – Part 1-1: Test](#)
837 [methods and requirements for compression and mechanical connectors for power cables for](#)
838 [rated voltages up to 1 kV \(\$U_m = 1,2\$ kV\) tested on non-insulated conductors](#)
- 839 IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*
- 840 IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic*
841 *safety-related systems*
- 842 [IEC 61545, Connecting devices – Devices for the connection of aluminium conductors in](#)
843 [clamping units of any material and copper conductors in aluminium bodied clamping units](#)

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 62208:2011, Empty enclosures for low-voltage switchgear and controlgear assemblies – General requirements

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

IEC 62683DB, Low-voltage switchgear and controlgear – Product data and properties for information exchange – IEC CDD database

IEC TS 63058, Environmental aspects for low-voltage switchgear and controlgear and their assemblies

IEC TR 63201:2019, Low-voltage switchgear and controlgear – Guidance for the development of embedded software

IEC TS 63208, Low-voltage switchgear and controlgear – Security aspects

IEC 63404, Switchgear and controlgear and their assemblies for low voltage – Integration method of radiocommunication device into an equipment

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 7010, Graphical symbols – safety colours and safety signs – registered safety signs

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

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
<u>Abnormal operating condition</u>	<u>3.10.1</u>
<u>Accessible part</u>	<u>3.10.13</u>
Actuating force	3.6.17
Actuating system (of a mechanical switching device)	3.5.16
Actuator	3.5.17
<u>Adjacent surface</u>	<u>3.10.2</u>
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	3.10.3
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
Contact relay	3.4.14
Control circuit (of a switching device)	3.5.3
Control circuit device	3.4.17
Control contact	3.5.9
Controlgear	3.3.3
Control and protective switching device	3.4.25
Control switch (for control and auxiliary circuits)	3.4.18
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	

943	Current setting (of an overcurrent or overload relay or release).....	3.6.38
944	Current setting range (of an overcurrent or overload relay or release)	3.6.39
945	Current sinking	S.2.3
946	Current sourcing	S.2.4
947	Cut-off current	3.7.19
948	Cut-off (current) characteristic.....	3.7.21
949		
950	D	
951	DC steady-state recovery voltage	3.7.36
952	DC withstand voltage	3.7.67
953	<u>Dedicated wiring accessory</u>	3.6.40
954	Definite time-delay overcurrent relay or release	3.6.27
955	Dependent manual operation (of a mechanical switching device)	3.6.12
956	Dependent power operation (of a mechanical switching device)	3.6.13
957	Digital input	S.2.1
958	Digital output	S.2.2
959	Direct overcurrent relay or release	3.6.29
960	Disconnecter	3.4.8
961	Double insulation	N.2.4
962		
963	E	
964	Electric shock	3.10.12
965	<u>Electrical energy efficiency</u>	
966	(Electrical) relay	3.5.14
967	Electronically controlled electromagnet.....	3.5.36
968	Electronic overload relay with current or voltage asymmetry function	T.2.2
969	Electronic overload relay with ground/earth fault detection function	T.2.1
970	Electronic overload relay with phase reversal function	T.2.3
971	Electronic overload relay with over voltage function	T.2.4
972	Electronic overload relay with under power function	T.2.6
973	Enclosure	3.10.9
974	<u>Enclosure port</u>	3.9.4
975	<u>Energy efficiency</u>	V.3.4
976	<u>Energy management</u>	V.3.1
977	<u>Energy management system (EnMS)</u>	V.3.2
978	<u>Equalizer</u>	3.8.6
979	Exposed conductive part	3.10.4
980	External controle device	U.1.1.1
981	Extra-low voltage (ELV)	N.2.6
982	Extraneous-conductive-part	3.10.5
983		
984	F	
985	Flexible conductor	3.5.32
986	Functional insulation	N.2.1
987	Fuse	3.4.4
988	Fuse-combination unit.....	3.4.7
989	Fuse-element.	3.4.6
990	Fuse-link	3.4.5
991		
992	G	
993	<u>Galvanic separation</u>	3.3.11
994	H	
995	<u>Hazardous-live-part</u>	3.10.14
996	Homogeneous field	3.7.62
997	<u>Hot functional surface</u>	3.10.19
998		
999	I	
1000	I^2t	3.7.18
1001	Impulse withstand voltage	3.7.54
1002	Independent manual operation (of a mechanical switching device)	3.6.15
1003	Independent power operation (of a mechanical switching device)	3.6.16
1004	Indicator light.....	3.5.19
1005	Indirect overcurrent relay or release	3.6.30

1006	Individual enclosure	3.4.23
1007	Inhibit current	T.2.5
1008	Inhomogeneous field	3.7.62
1009	Instantaneous relay or release	3.6.25
1010	Integral enclosure	3.10.10
1011	Insulation coordination barrier	3.3.14
1012	Interlocking device	3.5.21
1013	Inverse time-delay overcurrent relay or release	3.6.28
1014	Isolating distance (of a pole of a mechanical switching device)	3.3.15
1015	Isolation	3.10.11
1016		
1017	J	
1018	Joule integral	3.7.18
1019		
1020	L	
1021	Leakage current	3.7.50
1022	Let-through current	3.7.19
1023	Let-through (current) characteristic	3.7.21
1024	Let-through energy	3.7.18
1025	<u>Limited energy source</u>	3.10.15
1026	Limiting value	3.7.2
1027	Line conductor	3.3.17
1028	Live part	3.10.6
1029	<u>Load</u>	V.3.5
1030	<u>Load shedding</u>	V.3.7
1031	Local control	3.6.6
1032		
1033	M	
1034	Magnetic overload relay or release	3.6.33
1035	Main circuit (of a switching device)	3.5.2
1036	Main contact	3.5.7
1037	Maintenance	3.3.22
1038	Make-break time	3.7.45
1039	Make contact	3.5.12
1040	Make time	3.7.43
1041	Making capacity (of a switching device)	3.7.13
1042	Manual control	3.6.4
1043	Manufacturer	3.3.12
1044	Maximum cross-section	3.5.35
1045	Maximum prospective peak current (of an AC circuit)	3.7.8
1046	(Mechanical) contactor	3.4.12
1047	(Mechanical) switch	3.4.9
1048	Mechanical switching device	3.4.2
1049	Micro-environment (of a clearance or creepage distance)	3.7.58
1050	Mid-point conductor	3.3.18
1051	Minimum cross-section	3.5.34
1052	<u>Motor protective switching device</u>	3.4.16
1053	Multiple tip contact system	3.5.33
1054		
1055	N	
1056	Neutral conductor	3.10.8
1057	Nominal value	3.7.1
1058	No-make-break-current utilization	K.2.1.7
1059	Non-universal clamping unit	3.5.26.2
1060	Non-universal terminal	3.5.25.2
1061		
1062	O	
1063	Open position (of a mechanical switching device)	3.6.21
1064	Opening operation (of a mechanical switching device)	3.6.9
1065	Opening time (of a mechanical switching device)	3.7.39
1066	Operating current (of an overcurrent relay or release)	3.6.37
1067	Operating cycle (of a mechanical switching device)	3.6.2
1068	Operating sequence (of a mechanical switching device)	3.6.3

1069	Operation (of a mechanical switching device)	3.6.1
1070		
1071	Overall lifetime	K.2.1.4
1072	Overcurrent	3.3.4
1073	Overcurrent partial selectivity	3.7.23.3
1074	Overcurrent selectivity	3.7.23.1
1075	Overcurrent protective co-ordination of overcurrent protective devices	3.7.22
1076	Overcurrent relay or release	3.6.26
1077	Overcurrent total selectivity	3.7.23.2
1078	Overload	3.3.7
1079	Overload current	3.3.8
1080	Overload relay or release	3.6.31
1081	Overvoltage category (of a circuit or within an electrical system)	3.7.59
1082		
1083	P	
1084	Peak arc voltage (of a mechanical switching device)	3.7.38
1085	<u>Peak shaving</u>	<u>V.3.6</u>
1086	Peak withstand current	3.7.28
1087	PEL conductor	3.3.21
1088	PELV circuit	N.2.8
1089	PEM conductor	3.3.19
1090	PEN conductor	3.3.20
1091	Pilot switch	3.4.19
1092	Pole of a switching device	3.5.1
1093	Pollution	3.7.56
1094	Pollution degree (of environmental conditions)	3.7.57
1095	Port	3.9.1
1096	Position indicating device	3.5.18
1097	Positively driven operation	3.6.11
1098	Positive opening operation (of a mechanical switching device)	3.6.10
1099	Power-frequency recovery voltage	3.7.35
1100	Power-frequency withstand voltage	3.7.55
1101	Power port (control supply port)	3.9.3
1102	Prepared conductor	3.5.28
1103	Prospective breaking current (for a pole of a switching device or a fuse)	3.7.10
1104	Prospective current (of a circuit and with respect to a switching device or a fuse)	3.7.5
1105	<u>Protective impedance</u>	<u>3.10.16</u>
1106	Prospective making current (for a pole of a switching device)	3.7.9
1107	Prospective peak current	3.7.6
1108	Prospective symmetrical current (of an AC circuit)	3.7.7
1109	Prospective transient recovery voltage (of a circuit)	3.7.37
1110	Protection by limitation of steady-state current and electric charge	N.2.9
1111	Protective conductor	3.10.7
1112	Protective impedance device	N.2.10
1113	Push-button	3.4.20
1114	Push-wire terminal	3.5.25.3
1115		
1116	R	
1117	Rated value	3.7.3
1118	Rated control circuit supply voltage (U_s)	3.7.66
1119	Rated control circuit voltage (U_c)	3.7.65
1120	Rating	3.7.4
1121	<u>Reasonably foreseeable misuse</u>	<u>3.10.17</u>
1122	Recovery voltage	3.7.33
1123	<u>Reference conductor</u>	<u>3.8.5</u>
1124	Reinforced insulation	N.2.5
1125	Release (of a mechanical switching device)	3.5.15
1126	Reliability (performance)	K.2.1.1
1127	Remote control	3.6.7
1128	Restoring force	3.6.18
1129	Reverse current relay or release (direct current only)	3.6.36
1130	Rigid conductor	3.5.24

1131	Routine test	3.8.2
1132		
1133	S	
1134	Sampling test	3.8.3
1135	Screw-type terminal	3.5.24
1136	Screwless-type terminal	3.5.25
1137	Selectivity limit current (I_s)	3.7.68
1138	SELV circuit	N.2.7
1139	Semiconductor contactor (solid-state contactor)	3.4.13
1140	Semiconductor switching device	3.4.3
1141	Short-circuit	3.3.5
1142	Short-circuit breaking capacity	3.7.14
1143	Short-circuit current	3.3.6
1144	Short-circuit making capacity	3.7.15
1145	Short-circuit protective device (SCPD)	3.4.21
1146	Short-time delay	3.7.26
1147	Short-time withstand current	3.7.27
1148	Shunt release	3.6.34
1149	Signal port	3.9.2
1150	<u>Single-drop digital communication interface (SDCI)</u>	<u>3.3.23</u>
1151	<u>Single fault condition</u>	<u>3.10.18</u>
1152	Solid conductor	3.5.29
1153	Special test.	3.8.4
1154	<u>Stability factor</u>	<u>3.8.7</u>
1155	Starter	3.4.15
1156	Stranded conductor	3.5.30
1157	Stored energy operation (of a mechanical switching device)	3.6.14
1158	Supplementary insulation	N.2.3
1159	Surge arrester	3.4.23
1160	Suspended item	K.2.1.6
1161	Switch-disconnector	3.4.10
1162	Switchgear	3.3.2
1163	Switchgear and controlgear	3.3.1
1164	Switching device	3.4.1
1165		
1166	T	
1167	Take-over current	3.7.25
1168	Temporary overvoltage	3.7.53
1169	Terminal	3.5.23
1170	Terminal block	3.4.21
1171	Thermal overload relay or release	3.6.32
1172	Time-current characteristic	3.7.20
1173	Time to failure	K.2.1.8
1174	Tracking	3.7.63
1175	Transient recovery voltage	3.7.34
1176	Travel (of a mechanical switching device or a part thereof)	3.6.19
1177	Trip-free mechanical switching device	3.6.24
1178	Tripped position	3.6.22
1179	Tripping (operation)	3.6.23
1180	Type test	3.8.1
1181		
1182	U	
1183	Under-voltage relay or release	3.6.35
1184	Universal clamping unit	3.5.26.1
1185	Universal terminal	3.5.25.1
1186	Unprepared conductor	3.5.27
1187	Useful life	K.2.1.2
1188	Utilization category (for a switching device or a fuse)	3.3.10
1189		
1190	W	
1191	Working voltage	3.7.52
1192		

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

[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**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”.]

3.3.11**galvanic separation**

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

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

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

~~3.3.11~~ 3.3.12**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.

~~3.3.12~~ 3.3.13**solid insulation**

solid insulating material interposed between two conductive parts

~~3.3.13~~ 3.3.14**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

~~3.3.14~~ 3.3.15**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.]

3.3.153.3.16**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”.]

3.3.163.3.17**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]

3.3.173.3.18**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]

3.3.183.3.19**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]

3.3.193.3.20**PEN conductor**

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

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

3.3.203.3.21**PEL conductor**

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

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

3.3.213.3.22**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.]

3.3.223.3.23**single-drop digital communication interface****SDCI**

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

EXAMPLE: IO-Link™

3.3.24**product documentation**

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

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

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

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, SF₆, 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”.]

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**disconnecter**

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]

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**motor protective switching device****MPSD**

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

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

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

Note 3 to entry: In North America, this device is called manual motor controller suitable for tap conductor protection.

3.4.17**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.

3.4.18**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.

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]

3.4.19**pilot switch**

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

1456 Note 1 to entry: The actuating quantity can be pressure, temperature, velocity, liquid level, elapsed time, etc.

1457 [SOURCE: IEC 60050-441:2000, 441-14-48, modified – In Note 1 to entry, “may” changed to
1458 “can”.]

1459 **3.4.20**

1460 **push-button**

1461 control switch having an actuator intended to be operated by force exerted by a part of the
1462 human body, usually the finger or palm of the hand, and having stored energy (spring) return

1463 [SOURCE: IEC 60050-441:2000, 441-14-53]

1464 **3.4.21**

1465 **terminal block**

1466 insulating part carrying one or more mutually insulated terminal assemblies and intended to
1467 be fixed to a support

1468 **3.4.22**

1469 **short-circuit protective device**

1470 **SCPD**

1471 device intended to protect a circuit or parts of a circuit against short-circuit currents by
1472 interrupting them

1473 **3.4.23**

1474 **surge arrester**

1475 device designed to protect the electrical apparatus from high transient overvoltages and to
1476 limit the duration and frequently the amplitude of the follow-on current

1477 **3.4.24**

1478 **individual enclosure**

1479 enclosure designed and dimensioned to contain one equipment only

1480 **3.4.25**

1481 **control and protective switching device**

1482 **CPS**

1483 mechanical switching device with a control function operated other than by hand capable of:

1484 – making, carrying and breaking currents under normal conditions;

1485 – making, carrying for a specified time in overload conditions;

1486 – breaking currents under specified abnormal conditions such as those of short-circuits;

1487 – continuity of service.

1488 with or without local manual operating means

1489 **3.5 Parts of switching devices**

1490 **3.5.1**

1491 **pole of a switching device**

1492 portion of a switching device associated exclusively with one electrically separated conducting
1493 path of its main circuit and excluding those portions which provide a means for mounting and
1494 operating all poles together

1495 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
1496 be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to
1497 operate together.

1498 [SOURCE: IEC 60050-441:2000, 441-15-01, modified – In Note 1 to entry, “may” changed to
1499 “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

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”.]

1542 **3.5.9**
1543 **control contact**
1544 contact included in a control circuit of a mechanical switching device and mechanically
1545 operated by this device

1546 [SOURCE: IEC 60050-441:2000, 441-15-09]

1547 **3.5.10**
1548 **auxiliary contact**
1549 contact included in an auxiliary circuit and mechanically operated by the switching device

1550 [SOURCE: IEC 60050-441:2000, 441-15-10]

1551 **3.5.11**
1552 **auxiliary switch**
1553 <of a mechanical switching device> switch containing one or more control and/or auxiliary
1554 contacts mechanically operated by a switching device

1555 [SOURCE: IEC 60050-441:2000, 441-15-11]

1556 **3.5.12**
1557 **"a" contact**
1558 **make contact**
1559 control or auxiliary contact which is closed when the main contacts of the mechanical
1560 switching device are closed and open when they are open

1561 [SOURCE: IEC 60050-441:2000, 441-15-12]

1562 **3.5.13**
1563 **"b" contact**
1564 **break contact**
1565 control or auxiliary contact which is open when the main contacts of the mechanical switching
1566 device are closed and closed when they are open

1567 [SOURCE: IEC 60050-441:2000, 441-15-13]

1568 **3.5.14**
1569 **relay**
1570 **electrical relay**
1571 device designed to produce sudden, predetermined changes in one or more electric output
1572 circuits when certain conditions are fulfilled in the electric input circuits controlling the device

1573 [SOURCE: IEC 60050-151:2001, 151-13-31]

1574 **3.5.15**
1575 **release**
1576 <of a mechanical switching device> device, mechanically connected to a mechanical
1577 switching device, which releases the holding means and permits the opening or the closing of
1578 the switching device

1579 Note 1 to entry: A release can have instantaneous, time-delay, etc., operation. The various types of releases are
1580 defined in 3.6.24 to 3.6.35.

1581 [SOURCE: IEC 60050-441:2000, 441-15-17, modified – Note 1 to entry has been added.]

1582 **3.5.16**
1583 **actuating system**
1584 <of a mechanical switching device> whole of the operating means of a mechanical switching
1585 device which transmit the actuating force to the contact pieces

1586 Note 1 to entry: The operating means of an actuating system can be mechanical, electromagnetic, hydraulic,
1587 pneumatic, thermal, etc.

1588 **3.5.17**

1589 **actuator**

1590 part of the actuating system to which an external actuating force is applied

1591 Note 1 to entry: The actuator can take the form of a handle, knob, push-button, roller, plunger, etc.

1592 [SOURCE: IEC 60050-441:2000, 441-15-22]

1593 **3.5.18**

1594 **position indicating device**

1595 part of a mechanical switching device which indicates whether it is in the open, closed, or,
1596 where appropriate, earthed position

1597 [SOURCE: IEC 60050-441:2000, 441-15-25]

1598 **3.5.19**

1599 **indicator light**

1600 light signal giving information either by lighting or extinguishing

1601 **3.5.20**

1602 **anti-pumping device**

1603 device which prevents reclosing after a close-open operation as long as the device initiating
1604 closing is maintained in the position for closing

1605 [SOURCE: IEC 60050-441:2000, 441-16-48]

1606 **3.5.21**

1607 **interlocking device**

1608 device which makes the operation of a switching device dependent upon the position of
1609 operation of one or more other pieces of equipment

1610 [SOURCE: IEC 60050-441:2000, 441-16-49]

1611 **3.5.22**

1612 **connecting device**

1613 device for the electrical connection of one (or more) conductor(s), comprising one (or more)
1614 terminal(s), either fixed to a base or forming an integral part of the equipment

1615 [SOURCE: IEC 60999-1:1999, 3.3]

1616 **3.5.23**

1617 **terminal**

1618 conductive part of one pole of a device for electrical connection to external circuit, composed
1619 of one or more clamping unit(s) and insulation if necessary

1620 [SOURCE: IEC 60999-1:1999, 3.2, modified – “of a device for electrical connection to external
1621 circuit” has been added.]

1622 **3.5.24**

1623 **screw-type terminal**

1624 terminal intended for the connection and disconnection of conductors or for the inter-
1625 connection of two or more conductors, the connection being made, directly or indirectly, by
1626 means of screws or nuts of any kind

1627 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”.]

3.5.25.4**PCB terminal block**

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

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

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

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.

Note 1 to entry: Screw-type clamping units are not suitable for the connection of flexible or stranded tinned or soldered conductor ends.

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

1719 Note 1 to entry: The manufacturer can declare several minimum cross-sections depending on the type of
1720 conductor, for example solid, stranded, flexible, with or without ferrule.

1721 **3.5.35**

1722 **maximum cross-section**

1723 value of the largest connectable conductor cross-section stated by the manufacturer as
1724 suitable for the terminal

1725 Note 1 to entry: The manufacturer can declare several maximum cross-sections depending on the type of
1726 conductor, for example solid, stranded, flexible, with or without ferrule.

1727 Note 2 to entry: The term “rated cross-section” used in IEC 60947-7-1 and IEC 60999-2 and the term “rated
1728 connecting capacity” of a clamping unit used in IEC 60999-1 are considered equivalent when referring to certain
1729 thermal, mechanical and electrical requirements, as stated by the manufacturer and as specified in their relevant
1730 product standard.

1731 **3.5.36**

1732 **electronically controlled electromagnet**

1733 electromagnet in which the coil is controlled by a circuit with active electronic elements

1734 **3.5.37**

1735 **current-carrying part**

1736 conductive part which carries the electric current under normal conditions

1737 Note 1 to entry: The line conductor (L), the neutral conductor (N), the mid-point conductor (M), the PEN
1738 conductor, the PEM conductor and the PEL conductor are the current-carrying parts. The protective conductor (PE)
1739 is not a current-carrying part.

1740 **3.6 Operation of switching devices**

1741 **3.6.1**

1742 **operation**

1743 <of a mechanical switching device> transfer of the moving contact(s) from one position to an
1744 adjacent position

1745 Note 1 to entry: For example, for a circuit-breaker, this can be a closing operation or an opening operation.

1746 Note 2 to entry: If distinction is necessary, an operation in the electrical sense, e.g., make or break, is referred to
1747 as a switching operation, and an operation in the mechanical sense, e.g., close or open, is referred to as a
1748 mechanical operation.

1749 [SOURCE: IEC 60050-441:2000, 441-16-01, modified – in Note 1 to entry, “for example” has
1750 been added and “may” changed to “can”.]

1751 **3.6.2**

1752 **operating cycle**

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

1755 [SOURCE: IEC 60050-441:2000, 441-16-02]

1756 **3.6.3**

1757 **operating sequence**

1758 <of a mechanical switching device> succession of specified operations with specified time
1759 intervals

1760 [SOURCE: IEC 60050-441:2000, 441-16-03]

1761 **3.6.4**

1762 **manual control**

1763 control of an operation by human intervention

1764 [SOURCE: IEC 60050-441:2000, 441-16-04]

1765 **3.6.5**
1766 **automatic control**
1767 control of an operation without human intervention, in response to the occurrence of
1768 predetermined conditions

1769 [SOURCE: IEC 60050-441:2000, 441-16-05]

1770 **3.6.6**
1771 **local control**
1772 control of an operation at a point on or adjacent to the controlled switching device

1773 [SOURCE: IEC 60050-441:2000, 441-16-06]

1774 **3.6.7**
1775 **remote control**
1776 control of an operation at a point distant from the controlled switching device

1777 [SOURCE: IEC 60050-441:2000, 441-16-07]

1778 **3.6.8**
1779 **closing operation**
1780 <of a mechanical switching device> operation by which the device is brought from the open
1781 position to the closed position

1782 [SOURCE: IEC 60050-441:2000, 441-16-08]

1783 **3.6.9**
1784 **opening operation**
1785 <of a mechanical switching device> operation by which the device is brought from the closed
1786 position to the open position

1787 [SOURCE: IEC 60050-441:2000, 441-16-09]

1788 **3.6.10**
1789 **positive opening operation**
1790 <of a mechanical switching device> opening operation which, in accordance with specified
1791 requirements, ensures that all the main contacts are in the open position when the actuator is
1792 in the position corresponding to the open position of the device

1793 [SOURCE: IEC 60050-441:2000, 441-16-11]

1794 **3.6.11**
1795 **positively driven operation**
1796 operation which, in accordance with specified requirements, is designed to ensure that
1797 auxiliary contacts of a mechanical switching device are in the respective positions
1798 corresponding to the open or closed position of the main contacts

1799 [SOURCE: IEC 60050-441:2000, 441-16-12]

1800 **3.6.12**
1801 **dependent manual operation**
1802 <of a mechanical switching device> operation solely by means of directly applied manual
1803 energy such that the speed and force of the operation are dependent upon the action of the
1804 operator

1805 [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”.]

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.

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

1895 **3.6.30**
1896 **indirect overcurrent relay or release**
1897 overcurrent relay or release energized by the current in the main circuit of a switching device
1898 through a current transformer or a shunt

1899 **3.6.31**
1900 **overload relay or release**
1901 overcurrent relay or release intended for protection against overloads

1902 **3.6.32**
1903 **thermal overload relay or release**
1904 inverse time-delay overload relay or release depending for its operation (including its time-
1905 delay) on the thermal action of the current flowing in the relay or release

1906 **3.6.33**
1907 **magnetic overload relay or release**
1908 overload relay or release depending for its operation on the force exerted by the current in the
1909 main circuit exciting the coil of an electromagnet

1910 Note 1 to entry: Such a relay or release usually has an inverse time-delay/current characteristic.

1911 **3.6.34**
1912 **shunt release**
1913 release energized by a source of voltage

1914 Note 1 to entry: The source of voltage can be independent of the voltage of the main circuit.

1915 [SOURCE: IEC 60050-441:2000, 441-16-41, modified – In Note 1 to entry, “may” changed to
1916 “can”.]

1917 **3.6.35**
1918 **under-voltage relay or release**
1919 relay or release which permits a mechanical switching device to open or close, with or without
1920 time-delay, when the voltage across the terminals of the relay or release falls below a
1921 predetermined value

1922 **3.6.36**
1923 **reverse current relay or release** (direct current only)
1924 relay or release which permits a mechanical switching device to open, with or without time-
1925 delay, when the current flows in the reverse direction and exceeds a predetermined value

1926 [SOURCE: IEC 60050-441:2000, 441-16-43, modified – “shunt release” replaced by “relay or
1927 release”.]

1928 **3.6.37**
1929 **operating current**
1930 <of an overcurrent relay or release> value of current at and above which the relay or release
1931 will operate

1932 **3.6.38**
1933 **current-setting**
1934 <of an overcurrent or overload relay or release> value of current of the main circuit to which
1935 the operating characteristics of the relay or release are referred and for which the relay or
1936 release is set

1937 Note 1 to entry: A relay or release can have more than one current setting, provided by an adjustment dial,
1938 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

3.6.40**dedicated wiring accessory**

prefabricated connection wiring system specifically intended for identified switchgear or controlgear

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

Note 2 to entry: A typical dedicated wiring accessory is for example a connection link.

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”.]

1980	3.7.6
1981	prospective peak current
1982	peak value of a prospective current during the transient period following initiation
1983	Note 1 to entry: The definition assumes that the current is made by an ideal switching device, i.e. with
1984	instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different
1985	paths, e.g. polyphase circuits, it further assumes that the current is made simultaneously in all poles, even if only
1986	the current in one pole is considered.
1987	[SOURCE: IEC 60050-441:2000, 441-17-02]
1988	3.7.7
1989	prospective symmetrical current
1990	<of an AC circuit> prospective current when it is initiated at such an instant that no transient
1991	phenomenon follows the initiation
1992	Note 1 to entry: For polyphase circuits the condition of non-transient period can only be satisfied for the current in
1993	one pole at a time.
1994	Note 2 to entry: The prospective symmetrical current is expressed by its RMS value.
1995	[SOURCE: IEC 60050-441:2000, 441-17-03, modified – In the Note 2 to entry, “RMS value”
1996	instead of “RMS”.]
1997	3.7.8
1998	maximum prospective peak current
1999	<of an AC circuit> prospective peak current when initiation of the current takes place at the
2000	instant which leads to the highest possible value
2001	Note 1 to entry: For a multipole device in a polyphase circuit, the maximum prospective peak current refers to one
2002	pole only.
2003	[SOURCE: IEC 60050-441:2000, 441-17-04, modified – In the Note 1 to entry, “to a single
2004	pole only” replaced by “to one pole only”.]
2005	3.7.9
2006	prospective making current
2007	<for a pole of a switching device> prospective current when initiated under specified
2008	conditions
2009	Note 1 to entry: The specified conditions can relate to the method of initiation, e.g. by an ideal switching device,
2010	or to the instant of initiation, e.g., leading to the maximum prospective peak current in an AC circuit, or to the
2011	highest rate of rise. The specification of these conditions is given in the relevant product standard.
2012	[SOURCE: IEC 60050-441:2000, 441-17-05, modified – In the Note 1 to entry, “is found in the
2013	relevant publications” replaced by “is given in the relevant product standard and “may”
2014	changed to “can”.]
2015	3.7.10
2016	prospective breaking current
2017	<for a pole of a switching device or a fuse> prospective current evaluated at a time
2018	corresponding to the instant of the initiation of the breaking process
2019	Note 1 to entry: Specifications concerning the instant of the initiation of the breaking process are given in the
2020	relevant product standard. For mechanical switching devices or fuses, it is usually defined as the moment of
2021	initiation of the arc during the breaking process.
2022	[SOURCE: IEC 60050-441:2000, 441-17-06, modified – In the Note 1 to entry, “are to be
2023	found in the relevant publications” replaced by “are given in the relevant product standard”.]
2024	3.7.11
2025	breaking current
2026	<of a switching device or a fuse> current in a pole of a switching device or in a fuse at the
2027	instant of initiation of the arc during a breaking process

2028 Note 1 to entry: For alternating current, the current is expressed as the symmetrical RMS value of the AC
2029 component.

2030 [SOURCE: IEC 60050-441:2000, 441-17-07, modified – Note 1 to entry has been added.]

2031 **3.7.12**

2032 **breaking capacity**

2033 <of a switching device or a fuse> value of prospective breaking current that a switching
2034 device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use
2035 and behaviour

2036 Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant product
2037 standard.

2038 Note 2 to entry: For alternating current, the current is expressed as the symmetrical RMS value of the AC
2039 component.

2040 Note 3 to entry: For short-circuit breaking capacity, see 3.7.14.

2041 [SOURCE: IEC 60050-441:2000, 441-17-08, modified – In the Note 1 to entry, “the relevant
2042 publications” has been replaced by “the relevant product standard”, the Note 2 to entry has
2043 been modified and the Note 3 to entry has been added.]

2044 **3.7.13**

2045 **making capacity**

2046 <of a switching device> value of prospective making current that a switching device is capable
2047 of making at a stated voltage under prescribed conditions of use and behaviour

2048 Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant product
2049 standard.

2050 Note 2 to entry: For short-circuit making capacity, see 3.7.15.

2051 [SOURCE: IEC 60050-441:2000, 441-17-09, modified – In the title, reference to “a fuse”
2052 deleted, in the Note 1 to entry, “the relevant publications” has been replaced by “the relevant
2053 product standard” and addition of the Note 2 to entry.]

2054 **3.7.14**

2055 **short-circuit breaking capacity**

2056 breaking capacity for which prescribed conditions include a short-circuit at the terminals of the
2057 switching device

2058 [SOURCE: IEC 60050-441:2000, 441-17-11]

2059 **3.7.15**

2060 **short-circuit making capacity**

2061 making capacity for which prescribed conditions include a short-circuit at the terminals of the
2062 switching device

2063 [SOURCE: IEC 60050-441:2000, 441-17-10]

2064 **3.7.16**

2065 **critical load current**

2066 I_{crit}

2067 value of breaking current, within the range of service conditions, at which the arcing time is
2068 significantly extended

2069 Note 1 to entry: This phenomenon, crucial for direct currents (e.g. photovoltaic (PV) applications), is due to the
2070 low magnetic field coming from the arc current, creating a slow moving arc.

2071 **3.7.17**
2072 **critical short-circuit current**
2073 value of breaking current, less than the rated short-circuit breaking capacity, at which the arc
2074 energy is significantly higher than at the rated short-circuit breaking capacity

2075 **3.7.18**
2076 **I^2t**
2077 **let-through energy**
2078 **Joule integral**
2079 integral of the square of the current over a given time interval

2080
$$I^2t = \int_{t_0}^{t_1} i^2 dt$$

2081 [SOURCE: IEC 60050-441:2000, 441-18-23, modified – Notes to entry 1, 2 and 3 have been
2082 deleted, “let-through energy” added as second preferred term.]

2083 **3.7.19**
2084 **cut-off current**
2085 **let-through current**
2086 maximum instantaneous value of current attained during the breaking operation of a switching
2087 device or a fuse

2088 Note 1 to entry: This concept is of particular importance when the switching device or the fuse operates in such a
2089 manner that the prospective peak current of the circuit is not reached.

2090 [SOURCE: IEC 60050-441:2000, 441-17-12]

2091 **3.7.20**
2092 **time-current characteristic**
2093 curve giving the time, e.g. pre-arcing time or operating time, as a function of the prospective
2094 current, under stated conditions of operation

2095 [SOURCE: IEC 60050-441:2000, 441-17-13]

2096 **3.7.21**
2097 **cut-off (current) characteristic**
2098 **let-through (current) characteristic**
2099 curve giving the cut-off current as a function of the prospective current, under stated
2100 conditions of operation

2101 Note 1 to entry: In the case of alternating current, the values of the cut-off currents are the maximum values
2102 which can be reached whatever the degree of asymmetry. In the case of direct current, the values of the cut-off
2103 currents are the maximum values reached related to the time constant as specified.

2104 [SOURCE: IEC 60050-441:2000, 441-17-14]

2105 **3.7.22**
2106 **overcurrent protective co-ordination of overcurrent protective devices**
2107 co-ordination of two or more overcurrent protective devices in series to ensure overcurrent
2108 selectivity and/or back-up protection

2109 **3.7.23.1**
2110 **overcurrent selectivity**
2111 co-ordination of the operating characteristics of two or more overcurrent protective devices
2112 such that, on the incidence of overcurrents within stated limits, the device intended to operate
2113 within these limits does so, while the other(s) does (do) not

2114 Note 1 to entry: Distinction is made between series selectivity involving different overcurrent protective devices
2115 passing substantially the same overcurrent and network selectivity involving identical protective devices passing
2116 different proportions of the overcurrent.