



DPC: 21/30448743 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 10 December 2021

Origin: International

Latest date for receipt of comments: 25 January 2022

Project No. 2019/03239

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

Interested committees:

Title: Draft BS EN IEC 60947-5-1 Low-voltage switchgear and controlgear. Part 5-1: Control circuit devices and switching elements
- Electromechanical control circuit devices.

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 25 January 2022

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

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



121A/427/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:
IEC 60947-5-1 ED5

DATE OF CIRCULATION:
2021-06-04

CLOSING DATE FOR COMMENTS:
2021-08-27

SUPERSEDES DOCUMENTS:
121A/330/CD, 121A/345A/CC

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR	
SECRETARIAT: France	SECRETARY: Mr Michaël LAHEURTE
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 44, TC 94	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	

This document is still under study and subject to change. It should not be used for reference purposes.

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 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices

NOTE FROM TC/SC OFFICERS:

SC121A Officers support circulation of CD2 for project IEC 60947-5-1 ED5.

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

Copyright © 2021 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

1	CONTENTS	2
2	FOREWORD	10
3	1 Scope	12
4	2 Normative references	13
5	3 Terms, definitions, symbols and abbreviated terms	15
6	3.1 Terms and definitions	15
7	3.1.1 General	15
8	3.1.2 Basic terms and definitions	15
9	3.1.3 Terms and definitions concerning automatic control switches	16
10	3.1.4 Terms and definitions concerning manually operated control switches	17
11	3.1.5 Terms and definitions concerning parts of control switches	19
12	3.1.6 Terms and definitions concerning operation of contactor relays	21
13	3.1.7 Terms and definitions concerning operation of pilot switches	21
14	3.1.8 Terms and definitions concerning operation of rotary switches	22
15	3.1.9 Terms and definitions concerning operation of mechanically operated control switches	22
16	3.1.10 Alphabetical index of definitions	24
17	3.2 Symbols and abbreviated terms	26
18	4 Classification	27
19	4.1 Contact elements	27
20	4.2 Control switches	27
21	4.3 Control circuit devices	28
22	4.4 Time delay switching elements	28
23	4.5 Control switch mounting	28
24	5 Characteristics	28
25	5.1 Summary of characteristics	28
26	5.1.1 General	28
27	5.1.2 Operation of a control switch	28
28	5.2 Type of control circuit device or switching element	28
29	5.2.1 Kind of control circuit device	28
30	5.2.2 Kind of switching elements	29
31	5.2.3 Number of poles	29
32	5.2.4 Kind of current	29
33	5.2.5 Interrupting medium	29
34	5.2.6 Operating conditions	29
35	5.3 Rated and limiting values for switching elements	30
36	5.3.1 General	30
37	5.3.2 Rated voltages (of a switching element)	30
38	5.3.3 Currents	30
39	5.3.4 Rated frequency	30
40	5.3.5 Vacant	31
41	5.3.6 Characteristics under normal and abnormal load conditions	31
42	5.3.7 Short-circuit characteristics	31
43	5.4 Utilization categories for switching elements	31
44	5.5 Control circuits	31

47	5.6	Vacant	32
48	5.7	Vacant	32
49	5.8	Vacant	32
50	5.9	Vacant	32
51	5.10	Electrically separated contact elements	32
52	5.11	Actuating quantities for pilot switches	32
53	5.12	Pilot switches having two or more contact elements	32
54	6	Product information	32
55	6.1	Nature of information	32
56	6.2	Marking	34
57	6.2.1	General	34
58	6.2.2	Terminal identification and marking	34
59	6.2.3	Functional markings	34
60	6.2.4	Emergency stop	34
61	6.2.5	Operating diagram	34
62	6.2.6	Time delay markings	35
63	6.3	Instructions for installation, operation and maintenance, decommissioning and dismantling	35
65	6.4	Environmental information	36
66	6.4.1	Environmentally conscious design process (ECD process)	36
67	6.4.2	Procedure to establish material declaration	36
68	6.5	Additional information	36
69	7	Normal service, mounting and transport conditions	36
70	7.1	Normal service conditions	36
71	7.1.1	Ambient air temperature	36
72	7.1.2	Altitude	36
73	7.1.3	Atmospheric conditions	36
74	7.1.4	Shock and vibration	36
75	7.2	Conditions during transport and storage	37
76	7.3	Mounting	37
77	7.3.1	General	37
78	7.3.2	Mounting of single hole mounted devices	37
79	8	Constructional and performance requirements	38
80	8.1	Constructional requirements	38
81	8.1.1	General	38
82	8.1.2	Materials	38
83	8.1.3	Current-carrying parts and their connections	39
84	8.1.4	Clearances and creepage distances	39
85	8.1.5	Actuator	39
86	8.1.6	Indication of the contact position	39
87	8.1.7	Conditions for control switches suitable for isolation	40
88	8.1.8	Terminals	40
89	8.1.9	Vacant	40
90	8.1.10	Provisions for protective earthing	40
91	8.1.11	Enclosures for equipment	40
92	8.1.12	Degrees of protection of enclosed equipment	40
93	8.1.13	Conduit pull-out, torque and bending with metallic conduits	40
94	8.1.14	Requirements for control circuit devices with artificial optical radiation	40

95	8.1.15	Biological and chemical effects.....	40
96	8.1.16	Hygienic design	41
97	8.1.17	Security aspects	41
98	8.1.18	Limited energy source	41
99	8.1.19	Fault and abnormal conditions.....	42
100	8.1.20	Stored charge energy circuit.....	42
101	8.1.21	Embedded software	42
102	8.2	Performance requirements	42
103	8.2.1	Operating conditions	42
104	8.2.2	Temperature-rise	42
105	8.2.3	Dielectric properties	43
106	8.2.4	Ability to make and break under normal and abnormal load conditions	43
107	8.2.5	Conditional short-circuit current.....	43
108	8.2.6	Vacant.....	43
109	8.2.7	Additional requirements for control switches suitable for isolation.....	43
110	8.3	Electromagnetic compatibility (EMC).....	43
111	8.3.1	General	43
112	8.3.2	Immunity.....	44
113	8.3.3	Emission.....	44
114	8.4	Special requirements.....	44
115	8.4.1	Class II control circuit devices	44
116	8.4.2	Additional requirements for control circuit devices with integrally	
117		connected cables	44
118	8.4.3	Additional requirements for semiconductor switching elements for	
119		control circuit devices.....	44
120	8.4.4	Special requirements for indicator lights, indicating towers and their	
121		optional audible functions.....	44
122	8.4.5	Special requirements for control switches with direct opening action	44
123	8.4.6	Special requirements for mechanically linked contact elements	45
124	8.4.7	Additional requirements for control circuit devices incorporating a built-	
125		in communication interface (SDCI)	45
126	9	Tests	51
127	9.1	Kinds of test.....	51
128	9.1.1	General	51
129	9.1.2	Type tests.....	51
130	9.1.3	Routine tests	51
131	9.1.4	Sampling tests	52
132	9.1.5	Special tests	52
133	9.2	Compliance with constructional requirements.....	53
134	9.2.1	General	53
135	9.2.2	Test of materials to abnormal heat and fire	53
136	9.2.3	Equipment	53
137	9.2.4	Degrees of protection.....	53
138	9.2.5	Mechanical and electrical properties of terminals	53
139	9.2.6	Verification of actuating force (or torque).....	55
140	9.2.7	Verification of limitation of rotation (of a rotary switch)	55
141	9.2.8	Conduit pull-out test, torque test and bending test with metallic conduits.....	55
142	9.2.9	Test of earth continuity for protective earth.....	55
143	9.2.10	Limited energy source test	55

144	9.2.11	Breakdown of components	56
145	9.2.12	Artificial optical radiation test	56
146	9.3	Performance	57
147	9.3.1	Test sequences	57
148	9.3.2	General test conditions	58
149	9.3.3	Performance under no-load, normal load and abnormal load conditions	58
150	9.3.4	Performance under conditional short-circuit current	61
151	9.4	Tests for EMC	62
152	9.4.1	General	62
153	9.4.2	Immunity	63
154	9.4.3	Emission	64
155	9.4.4	Measurement uncertainty	64
156	9.4.5	Test results and test report	64
157	Annex A (normative)	Electrical ratings based on utilization categories (see 4.1)	72
158	Annex B (informative)	Example of inductive test loads for DC contacts	74
159	B.1	General	74
160	B.2	Construction	74
161	Annex C (normative)	Special tests – Durability tests	76
162	C.1	General	76
163	C.1.1	Durability declaration	76
164	C.1.2	Test procedures	76
165	C.1.3	Failure criteria	76
166	C.2	Mechanical durability	77
167	C.2.1	General	77
168	C.2.2	Test procedures	77
169	C.3	Electrical durability	77
170	C.3.1	General	77
171	C.3.2	Test procedures	77
172	Annex D	Vacant	80
173	Annex E (informative)	Items subject to agreement between manufacturer and user	81
174	Annex F (normative)	Class II control circuit devices Requirements and tests	82
175	F.1	General	82
176	F.3	Terms and definitions	82
177	F.6	Product information	83
178	F.6.2	Marking	83
179	F.8	Constructional and functional requirements	83
180	F.8.1	Constructional requirements	83
181	F.8.2	Performance requirements	85
182	F.9	Tests	85
183	F.9.1	Kind of tests	85
184	Annex G (normative)	Additional requirements for control circuit devices with integrally connected cables	88
185	G.1	General	88
187	G.3	Terms and definitions	88
188	G.8	Constructional and performance requirements	88
189	G.8.1	Constructional requirements	88
190	G.8.2	Performance requirements	89
191	G.9	Tests	89

192	G.9.1	Kind of tests.....	89
193	Annex H (normative) Additional requirements for semiconductor switching elements		
194		for control circuit devices	93
195	H.1	General.....	93
196	H.3	Terms and definitions	93
197	H.4	Classification	93
198	H.4.1	Semiconductor switching elements	93
199	H.5	Characteristics	94
200	H.5.3	Rated and limiting values for semiconductor switching elements	94
201	H.5.4	Utilization categories.....	94
202	H.6	Product information	94
203	H.8	Constructional and performance requirements	95
204	H.8.2	Performance requirements	95
205	H.8.3	Electromagnetic compatibility (EMC)	95
206	H.9	Tests	96
207	H.9.3	Performance	96
208	H.9.4	Verification of electromagnetic compatibility.....	98
209	Annex J (normative) Special requirements for indicator lights, indicating towers and		
210		audible signalling devices	100
211	J.1	General.....	100
212	J.3	Terms and definitions	100
213	J.4	Classification	101
214	J.5	Characteristics	101
215	J.5.1	Rated operational voltage of an indicator light	101
216	J.5.2	Rated thermal power of an indicator light.....	101
217	J.5.3	Rated values of the lamp.....	101
218	J.5.4	rated voltage for the audible function	101
219	J.6	Product information	101
220	J.7	Normal service, mounting and transport conditions	102
221	J.8	Constructional and performance requirements	102
222	J.8.2.1.2	Limits of operation	103
223	J.8.2.5.1	Short-circuit durability of built-in transformer.....	103
224	J.9	Tests	103
225	J.9.3	Performance tests for indicator lights and indicating towers	103
226	J.9.4	Shock and vibration	105
227	J.9.5	Degree of protection for indicating towers.....	106
228	Annex K (normative) Special requirements for control switches with direct opening		
229		action	107
230	K.1	General.....	107
231	K.3	Terms and definitions	107
232	K.4	Classification	107
233	K.5	Characteristics	108
234	K.5.3.2.3	Rated insulation voltage	108
235	K.5.3.3.2	Conventional free air thermal current.....	108
236	K.5.4	Utilization categories for switching elements.....	108
237	K.6	Product information	108
238	K.6.2	Marking	108
239	K.6.5	Additional information	108
240	K.7	Normal service, mounting and transport conditions	109

241	K.8	Constructional and performance requirements	109
242	K.8.1	Constructional requirements	109
243	K.9	Tests	110
244	K.9.1	General	110
245	K.9.3	Performance	110
246	Annex L (normative)	Special requirements for mechanically linked contact elements	113
247	L.1	General	113
248	L.3	Terms and definitions	113
249	L.4	Classification	113
250	L.5	Characteristics	113
251	L.6	Product information	113
252	L.6.2.7	Mechanically linked contact elements identification and marking	114
253	L.7	Normal service, mounting and transport conditions	114
254	L.8	Constructional and performance requirements	114
255	L.9	Tests	115
256	L.9.1	General	115
257	L.9.5	Special test for mechanically linked contact elements	115
258	Annex M (normative)	Terminal marking, distinctive number and distinctive letter for	
259		control circuit devices	116
260	M.1	General	116
261	M.2	Terminal marking rule	116
262	M.2.1	General	116
263	M.2.2	Function digit	116
264	M.2.3	Sequence digit	116
265	M.2.4	Numbering method	116
266	M.3	Distinctive number and distinctive letter	117
267	M.3.1	General	117
268	M.3.2	Distinctive number	117
269	M.3.3	Distinctive letter	117
270	M.4	Terminal numbering sequence	117
271	M.5	Contactors designated by the distinctive letter E	118
272	M.6	Contactors designated by distinctive letters X, Y or Z	120
273	M.6.1	Contactors designated by the distinctive letter Z	120
274	M.6.2	Contactors designated by the distinctive letter X	120
275	M.6.3	Contactors designated by the distinctive letter Y	120
276	Annex N (normative)	Procedure to determine reliability data for electromechanical	
277		devices in control circuits used in functional safety applications	121
278	N.1	General	121
279	N.1.1	Overview	121
280	N.1.2	Object	121
281	N.1.3	General requirements	121
282	N.2	Terms, definitions and symbols	121
283	N.3	Method based on durability test results	121
284	N.3.1	General method	121
285	N.3.2	Test requirements	121
286	N.3.3	Number of samples	122
287	N.3.4	Characterization of a failure mode	122
288	N.3.5	Weibull modelling	122
289	N.3.6	Useful life and upper limit of failure rate	122

290	N.3.7	Reliability data	122
291	N.4	Data information.....	122
292	N.5	Example	122
293	Annex O (normative)	Additional requirements for control circuit devices incorporating	
294		a built-in communication interface complying with IEC 61131-9.....	123
295	O.1	General.....	123
296	O.2	Normative references	123
297	O.3	Terms and definitions	123
298	O.3.1	General	123
299	O.3.2	Terms and definitions concerning digital communication interface	123
300	O.3.3	Symbols and abbreviated terms.....	123
301	O.5	Characteristics	123
302	O.6	Product information	124
303	O.8	Constructional and performance requirements	124
304	O.8.1	Constructional requirements.....	124
305	O.8.3	Electromagnetic compatibility (EMC)	124
306	O.9	Tests	124
307	O.9.1	Kinds of tests	124
308	Bibliography		125
309			
310	Figure 1	– Examples of the recommended method for drawing an operating diagram of	
311		a rotary switch	66
312	Figure 2	– Operation of push-buttons	67
313	Figure 3	– Difference e between the over-travel of the actuator and that of the contact	
314		element	67
315	Figure 4	– Examples of contact elements (schematic sketches)	68
316	Figure 5	– Test circuits for multi-pole control switches – Contacts of same polarity, not	
317		electrically separated	69
318	Figure 6	– Test circuits for multi-pole control switches – Contacts of opposite polarity,	
319		and electrically separated	69
320	Figure 7	– Load L_d details for test conditions requiring different values of make and	
321		break current and/or power factor (time constant).....	70
322	Figure 8	– Test circuit, conditional short-circuit current (see 9.3.4.2).....	70
323	Figure 9	– Current/time limits for DC test loads (see 9.3.3.5)	71
324	Figure 10	– Voltage drop measurement at contact point of the clamping unit or terminal.....	71
325	Figure B.1	– Construction of load for DC contacts.....	75
326	Figure C.1	– Normal circuit (see C.3.2.2).....	79
327	Figure C.2	– Simplified circuit (see C.3.2.2).....	79
328	Figure F.1	– Device insulated by encapsulation	83
329	Figure F.2	– Device insulated by double and reinforced insulation	84
330	Figure F.3	– Test apparatus	86
331	Figure H.1	– Relationship between U_e and U_B	94
332	Figure H.2	– Example of test circuit for the verification of voltage drop, minimum	
333		operational current and OFF-state current	97
334	Figure H.3	– Short-circuit testing	98
335	Figure J.1	– Mounting dimensions for indicating tower socket	102

336	Figure J.2 – Mounting dimensions for temperature-rise tests.....	104
337	Figure K.1 – Verification of robustness of the actuating system.....	112
338	Figure L.1 – Example of representation of NO and NC contacts which are mechanically	
339	linked and NC non-linked contact	114
340	Figure L.2 – Symbol for device containing mechanically linked contacts	114
341		
342	Table 1 – Utilization categories for switching elements	31
343	Table 2 – Mounting hole diameter and dimensions of the key recess (if any)	37
344	Table 3 – Preferred minimum distances between centres of mounting holes.....	38
345	Table 4 – Verification of making and breaking capacities of switching elements under	
346	normal conditions corresponding to the utilization categories	46
347	Table 5 – Verification of making and breaking capacities of switching elements under	
348	abnormal conditions corresponding to the utilization categories	47
349	Table 6 – Test conditions for glow-wire test.....	47
350	Table 7 – Acceptance criteria	48
351	Table 8 – Immunity tests	49
352	Table 9 – Limits for limited energy sources without an overcurrent protective device	50
353	Table 10 – Limits for limited energy sources with an overcurrent protective device	50
354	Table 11 – Limits for limited energy source with limited current impedance	51
355	Table 12 – Test values for electrical performance and ageing test of screwless-type	
356	clamping units	65
357	Table A.1 – Examples of contact rating designation based on utilization categories.....	72
358	Table A.2 – Examples of semiconductors switching element ratings for 50 Hz and/or	
359	60 Hz ¹⁾	73
360	Table A.3 – Examples of semiconductors switching element ratings for direct current ¹⁾	73
361	Table B.1 – DC loads.....	75
362	Table C.1 – Making and breaking conditions for electrical durability	78
363	Table F.1 – Acceptance criteria for Annex F	85
364	Table G.1 – Material characteristics (informative)	90
365	Table G.2 – Examples of standard cable types (informative)	90
366	Table G.3 – Tensile forces	91
367	Table M.1 – Diagrams of control switches.....	118
368	Table M.2 – Diagrams of contactor relays designated by the distinctive letter E.....	119
369	Table M.3 – Diagrams of contactor relays designated by the distinctive letter Y.....	120
370	Table O.1 - Electrical characteristics of a Master port class B	124

371

372

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 5-1: Control circuit devices and switching elements –
Electromechanical control circuit devices**

FOREWORD

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

International Standard IEC 60947-5-1 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 fifth edition cancels and replaces the fourth edition published in 2016 and its Corrigendum 1:2016. This edition constitutes a technical revision.

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

- update of the scope structure and exclusions;
- requirements for control circuits;
- update of the normal service conditions (e.g. shock and vibration);
- update of information and marking requirements including environmental information requirements referencing Annexes O and W of IEC 60947-1:2020;

- update of the constructional requirements and the corresponding tests considering safety aspects (e.g. artificial optical radiation, safety related security, limited energy source, stored charge energy circuit);
- update of the EMC requirements according to the generic documents;
- requirements for Class II circuit devices achieved by double or reinforced insulation in Annex F;
- update of pull-out tests in Annex G;
- information requirements for audible signalling device in Annex J;
- insertion of new Annex O (Additional requirements for control circuit devices incorporating a built-in communication interface complying with IEC 61131-9).

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

FDIS	Report on voting
121A/XXX/FDIS	121A/XXX/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.

This International Standard should be used in conjunction with IEC 60947-1.

The provisions of the general rules, IEC 60947-1, are applicable to this standard, where specifically called for. General rules, clauses and subclauses thus applicable, as well as tables, figures and annexes are identified by a reference to IEC 60947-1, for example 1.2.3, Table 4 or Annex A of IEC 60947-1:2020.

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

- 8.2.4.1: Making and breaking capacities (United States of America and Canada)
- 9.3.3.5.2: Test circuits and connections (United States of America and Canada)

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.

Secretary note: for reader's convenience, essential updates regarding IEC 60947-5-1:2016+CORR1 2016 have been highlighted in blue colour.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices

1 Scope

This part of IEC 60947 applies to control circuit devices and switching elements intended for controlling, signalling, interlocking, etc., of switchgear and controlgear.

It applies to control circuit devices having a rated voltage not exceeding 1 000 V AC (at a frequency not exceeding 1 000 Hz) or 600 V DC.

This document applies to specific types of control circuit devices as contained in the following non exhaustive list:

- manually operated control switches;
- electromagnetically operated control switches, either time-delayed or instantaneous;
- contactor relays;
- pilot switches;
- pressure switches;
- temperature sensitive switches (thermostats);
- programmers;
- position switches;
- control switches operated by part of a machine or mechanism;
- associated control circuit equipment, for example indicator lights;
- control circuit devices incorporating semiconductor switching elements;
- control circuit devices incorporating a built-in single drop digital communication interface.

NOTE 1 Control circuit devices and switching elements are referred to as "equipment" or "device" equally in this document.

It also applies to specific types of control circuit switching elements associated with other devices (whose main circuits are covered by other standards) as contained in the following non exhaustive list:

- auxiliary contacts of a switching device (e.g. contactor, circuit breaker) which are not dedicated exclusively for use with the coil of that device;
- interlocking contacts of enclosure doors;
- control circuit contacts of rotary switches;
- control circuit contacts of overload relays.

This document does not apply to:

- relays covered in IEC 60255 or in IEC 61810 series;
- automatic electrical control devices for household and similar purposes;
- the use of control circuit devices and switching elements with additional measure within explosive atmospheres. These are given in IEC 60079 series;

Colour requirements and actuating forces are not addressed in this document.



NOTE 2 Colour requirements can be found in IEC 60073 and also in CIE S004/E-2001.

The object of this document is to state:

- definitions;
- classification;
- characteristics;
- product information;
- normal service, mounting and transport conditions;
- constructional, product safety and performance requirements;
- tests to verify the requirements and the rated characteristics.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

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

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

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

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

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*
IEC 60695-2-12:2010/AMD1:2014

IEC 60730-1, *Automatic electrical controls - Part 1: General requirements*

IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 60947-5-5:1997, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function*

IEC 60947-5-5:1997/AMD1:2005

IEC 60947-5-5:1997/AMD2:2016

- 541 IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements*
542 *for screw-type and screwless-type clamping units – Part 1: General requirements and particular*
543 *requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*
- 544 IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measure-*
545 *ment techniques – Electrostatic discharge immunity test*
- 546 IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and*
547 *measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
548 IEC 61000-4-3:2006/AMD1:2007
549 IEC 61000-4-3:2006/AMD2:2010
- 550 IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and*
551 *measurement techniques – Electrical fast transient/burst immunity test*
- 552 IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement*
553 *techniques – Surge immunity test*
554 IEC 61000-4-5:2014/AMD1:2017
- 555 IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement*
556 *techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
- 557 IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measure-*
558 *ment techniques – Power frequency magnetic field immunity test*
- 559 IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and*
560 *measurement techniques – Voltage dips, short interruptions and voltage variations immunity*
561 *tests*
562 IEC 61000-4-11:2004/AMD1:2017
- 563 IEC 61140:2016, *Protection against electric shock – Common aspects for installation and*
564 *equipment*
- 565 IEC 62443 (series), *Industrial communication networks - Network and system security*
- 566 IEC 62471 (all parts), *Photobiological safety of lamps and lamp systems*
- 567 IEC TR 62471-2:2009, *Photobiological safety of lamps and lamp systems - Part 2: Guidance on*
568 *manufacturing requirements relating to non-laser optical radiation safety*
- 569 IEC TS 63058, *Environmental aspects for Low-Voltage Switchgear and Controlgear and their*
570 *assemblies.*
- 571 IEC TS 63208, *Low-voltage switchgear and controlgear – Security aspects*
- 572 CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance*
573 *characteristics – Limits and methods of measurement*
574 CISPR 11:2015/AMD1:2016
575 CISPR 11:2015/AMD2:2019
- 576 ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: sampling schemes*
577 *indexed by acceptance quality limit AQL) for lot-by-lot inspection*
- 578 ISO 14159, *Safety of machinery — Hygiene requirements for the design of machinery*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

3.1.1 General

For the purposes of document, the terms and definitions given in Clause 3 of IEC 60947-1:2020, as well as the following terms, definitions, symbols and abbreviations 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>

3.1.2 Basic terms and definitions

3.1.2.1

control circuit device

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

Note 1 to entry: A control circuit device includes (a) control switch(es) and associated devices such as (an) indicator light(s).

Note 2 to entry: Control circuit devices can also include associated devices dealt with in other standards, such as instruments, potentiometers, relays, in so far as associated devices are used for the purposes specified above.

3.1.2.2

control switch (for control and auxiliary circuits)

a mechanical switching device which serves the purpose of controlling the operation of switchgear or controlgear, including signalling, electrical interlocking, etc.

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

Note 2 to entry: A control switch may include semiconductor elements or contact elements (see 3.1.5.2 and 3.1.5.3).

[SOURCE: IEC 60050-441:1984, 441-14-46, modified – Addition of a new Note 2 to entry.]

3.1.2.3

control switch suitable for isolation

a control switch which, in the open position, complies with the requirements specified for the isolating function (see 3.3.19 and 8.1.7 of IEC 60947-1:2020)

Note 1 to entry: Such control switches are intended to provide a higher degree of safety to personnel when working on the equipment controlled. For this reason, they have to be manually actuated relying on the intelligence of instructed persons to react in case they would fail to operate, e.g. in case of insufficiently opened contacts.

3.1.2.4

control station

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

Note 1 to entry: A control station panel or enclosure may also contain related equipment, e.g. potentiometers, signal lamps, instruments, etc.

[SOURCE: IEC 60050-441:1984, 441-12-08]

3.1.2.5**limited energy source**

source that is designed and protected such that, under both normal operating conditions and single fault conditions, the current that can be delivered is not hazardous with respect to fire hazard

[SOURCE: IEC 60947-4-1:2018]

3.1.2.6**single fault condition**

condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or a device

Note 1 to entry: If a single fault condition results in one or more other fault conditions, all are considered as one single fault condition.

[SOURCE: IEC Guide 104, 3.8]

3.1.2.7**recovery time**

time period between disruption and the point in time when the specified function is performed again

3.1.3 Terms and definitions concerning automatic control switches

NOTE: Automatic control switches are operated by automatic control (see 3.6.5 of IEC 60947-1:2020). They are also designated as *pilot switches* (see 3.4.18 of IEC 60947-1:2020).

3.1.3.1**instantaneous contactor relay**

a contactor relay operating without any intentional time delay

Note 1 to entry: Unless otherwise stated, a contactor relay is an instantaneous contactor relay.

[SOURCE: IEC 60050-441:1984, 441-14-36]

3.1.3.2**time-delay contactor relay**

a contactor relay with specified time-delay characteristics

Note 1 to entry: The time-delay may be associated with energization (*e*-delay) or with de-energization (*d*-delay) or both.

Note 2 to entry: A time-delay contactor relay may also incorporate instantaneous contact elements.

[SOURCE: IEC 60050-441:1984, 441-14-37, modified – addition of a new Note 2 to entry.]

3.1.3.3**position switch**

a pilot switch the actuating system of which is operated by a moving part of the machine, when this part reaches a predetermined position

[SOURCE: IEC 60050-441:1984, 441-14-49]

3.1.3.4**programmer**

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

3.1.4 Terms and definitions concerning manually operated control switches

Note 1 to entry: Manually operated control switches are operated by manual control (see 3.6.4 of IEC 60947-1:2020).

3.1.4.1 push-button

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

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

3.1.4.2 pull-button

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

3.1.4.3 push-pull button

a control switch having an actuator intended to be operated by manual push and returned to its initial position by manual pull, or vice versa

Note 1 to entry: There are also «push-push» or «push-turn» or other combinations of buttons.

3.1.4.4 rotary button

a combination of push-button type switching elements having an actuator operated by a manual rotation (see also 3.1.4.15 to 3.1.4.18 inclusive)

EXAMPLE A selector switch.

Note 1 to entry: A rotary push-button may have more than two positions; it may or may not have a spring return.

3.1.4.5 latched push-button

a push-button with spring return, but which remains in the actuated position until a latch is released by a separate action

Note 1 to entry: The latching may be released by subsequent actuation (such as pushing, turning, etc.) of the same or of an adjacent push-button or by the action of an electromagnet, etc.

3.1.4.6 locked push-button

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

Note 1 to entry: The locking may be obtained by turning the button, by turning a key, by operating a lever, etc.

3.1.4.7 key-operated push-button

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

Note 1 to entry: Key withdrawal may be provided at any position.

3.1.4.8 time-delay push-button

a push-button the contacts of which return to the initial position only after a pre-determined interval of time following the release of the actuating force

3.1.4.9**delayed action push-button**

a push-button in which the switching operation does not occur until after the force on the button has been maintained for a pre-determined interval of time

3.1.4.10**illuminated push-button**

a push-button incorporating a signalling lamp in the button

3.1.4.11**covered push-button**

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

3.1.4.12**shrouded push-button**

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

3.1.4.13**free push-button**

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

3.1.4.14**guided push-button**

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

Note 1 to entry: Examples of guided push-buttons: the actuators of which are keyed, square or rectangular, etc.

3.1.4.15**rotary control switch****rotary switch**

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

3.1.4.16**key-operated rotary switch**

a rotary switch where a key is used as the actuator

Note 1 to entry: Key withdrawal may be provided at any position.

3.1.4.17**limited movement rotary switch**

a rotary switch with a restricted angular movement of its actuator

3.1.4.18**unidirectional movement rotary switch**

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

3.1.4.19**joy stick**

a control switch having an actuator consisting of a pin or stick projecting essentially at a right angle from the panel or enclosure when in one of its positions and intended to be operated by angular displacement

Note 1 to entry: A joy stick may have more than two positions associated with different directions of the displacement of the stick and operating the contact elements differently: such a joy stick is referred to as a joy stick selector.

Note 2 to entry: The pin or stick may or may not have a spring return.

3.1.4.20**wobble stick**

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

3.1.4.21**foot switch****pedal**

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

[SOURCE: IEC 60050-441:1984, 441-14-52, modified – insertion of "force exerted by".]

3.1.5 Terms and definitions concerning parts of control switches**3.1.5.1****switching element**

a switching element may be a semiconductor element (see 3.1.5.2) or a contact element (see 3.1.5.3)

3.1.5.2**semiconductor element**

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

3.1.5.3**contact element**

<control switch> the parts, fixed and movable, conducting and insulating, of a control switch necessary to close and open one single conducting path of a circuit

Note 1 to entry: The contact element and the actuating system may form an indivisible unit, but frequently one or more contact elements may be combined with one or more actuating system or systems. The actuating systems may be different.

Note 2 to entry: Terms and definitions relating to various kinds of single contact elements of a control switch are given in 3.1.5.4 to 3.1.5.13 inclusive.

Note 3 to entry: This definition does not include control coils and magnet systems.

3.1.5.4**single gap contact element**

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

Note 1 to entry: See Figure 4 a) and Figure 4 c).

3.1.5.5**double gap contact element**

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

Note 1 to entry: See Figure 4 b), Figure 4 d) and Figure 4 e).

3.1.5.6**make-contact element****normally open**

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

3.1.5.7**break-contact element****normally closed**

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

3.1.5.8**change-over contact elements**

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

Note 1 to entry: See Figure 4 c), Figure 4 d) and Figure 4 e).

3.1.5.9**pulse contact element****fleeting contact element**

a contact element which opens or closes a circuit for a part of the travel during the transition of the actuator from one position to another

3.1.5.10**electrically separated contact elements**

contact elements belonging to the same control switch, but adequately insulated from each other so that they can be connected into electrically separated circuits, which can be either same polarity or opposite polarity

[SOURCE: IEC 60050-441:1984, 441-15-24, modified – supplemented by polarity statement]

3.1.5.11**independent action contact element****snap action contact element**

a contact element of a manual or automatic control device in which the velocity of contact motion is substantially independent of the velocity of motion of the actuator

3.1.5.12**dependent action contact element**

a contact element of a manual or automatic control device in which the velocity of contact motion depends on the velocity of motion of the actuator

3.1.5.13**contact unit**

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

3.1.5.14**button**

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

3.1.5.15**flush-button**

a button which is substantially level with the adjacent fixed surrounding surface when in its initial position and is below this surface when it is operated

3.1.5.16**recessed button**

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

3.1.5.17**extended button**

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

3.1.5.18**mushroom button**

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

3.1.5.19**locating mechanism**

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

Note 1 to entry: Other devices (e.g. a push-button with two positions, or an emergency stop) can also have such a function.

3.1.5.20**end stop**

a device that limits the travel of a moving part

Note 1 to entry: An end stop may relate either to the actuator or to the contact element.

3.1.6 Terms and definitions concerning operation of contactor relays**3.1.6.1****e-delay**

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

EXAMPLE Delay to close make-contacts (ON delay).

Note 1 to entry: The terms 'e-delay' and 'd-delay' may be applied to any kind of contact elements (see 3.1.5.3).

3.1.6.2**d-delay**

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

EXAMPLE Delay to open make-contacts (OFF delay)

Note 1 to entry: The terms 'e-delay' and 'd-delay' may be applied to any kind of contact elements (see 3.1.5.3).

3.1.6.3**fixed delay**

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

3.1.6.4**adjustable delay**

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

3.1.7 Terms and definitions concerning operation of pilot switches**3.1.7.1****actuating quantity**

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

3.1.7.2**operating value**

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

3.1.7.3**return value**

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

3.1.7.4**differential value**

the difference between the operating value and the return value

3.1.8 Terms and definitions concerning operation of rotary switches**3.1.8.1****definite position** (of a rotary switch)

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

3.1.8.2**position of rest**

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

3.1.8.3**transit position**

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

3.1.8.4**biased position**

a (definite) position of a rotary switch in which the actuator is pulled against a stop from which it will return to a position of rest by means of stored energy (for example, by means of a spring)

Note 1 to entry: During the transfer from a biased position to the adjacent position of rest, the rotary switch may pass through one or more transit positions.

3.1.8.5**latched position**

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

Note 1 to entry: The latching arrangement may be released manually or otherwise.

3.1.8.6**locked position**

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

Note 1 to entry: The locking may be obtained by turning a key, operating a lever, etc.

3.1.8.7**operating diagram**

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

3.1.9 Terms and definitions concerning operation of mechanically operated control switches**3.1.9.1****pre-travel of the actuator**

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

Note 1 to entry: See Dimension *a* on Figure 2.

3.1.9.2**over-travel of the actuator**

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

3.1.9.3**direct drive**

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

3.1.9.4**positive drive**

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

3.1.9.5**limited drive**

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

3.1.9.6**actuating torque**

the torque applied to an actuator necessary to complete the intended operation

[SOURCE: IEC 60050-441:1984, 441-16-18]

3.1.9.7**restoring torque**

the torque provided to restore an actuator or a contact element to its initial position

[SOURCE: IEC 60050-441:1984, 441-16-20]

3.1.9.8**minimum starting force**

the smallest value of force initiating the pre-travel of the actuator

3.1.9.9**minimum starting torque**

the smallest value of torque initiating the pre-travel of the actuator

3.1.9.10**minimum actuating force**

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

3.1.9.11**minimum actuating torque**

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

3.1.9.12**pre-travel of the contact element**

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

Note 1 to entry: See Dimension *b* on Figure 2.

3.1.9.13**over-travel of the contact element**

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

Note 1 to entry: See Dimension *d* on Figure 2.

3.1.9.14**bounce time**

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

[SOURCE: IEC 60050-444:2002, 444-05-04, modified – Figure 1 deleted]

3.1.10 Alphabetical index of definitions

Alphabetical index of definitions References

A

Actuating quantity 3.1.7.1

Actuating torque 3.1.9.6

Adjustable delay (of a contact element) 3.1.6.4

B

Biased position 3.1.8.4

Bounce time 3.1.9.14

Break-contact element (normally closed) 3.1.5.7

Button 3.1.5.14

C

Change-over contact elements 3.1.5.8

Contact element 3.1.5.3

Contact unit 3.1.5.13

Control circuit device 3.1.2.1

Control station 3.1.2.4

Control switch 3.1.2.2

Control switch suitable for isolation 3.1.2.3

Covered push-button 3.1.4.11

D

d-delay (of a contact element) 3.1.6.2

Definite position (abbreviation: position) (of a rotary switch) 3.1.8.1

Delayed action push-button 3.1.4.9

Dependent action contact element 3.1.5.12

Differential value 3.1.7.4

Direct drive 3.1.9.3

Double gap contact element 3.1.5.5

E

998	e-delay (of a contact element)	3.1.6.1
999	Electrically separated contact elements	3.1.5.10
1000	End stop	3.1.5.20
1001	Extended button	3.1.5.17
1002	F	
1003	Fixed delay (of a contact element)	3.1.6.3
1004	Flush-button	3.1.5.15
1005	Foot-switch (pedal)	3.1.4.21
1006	Free push-button	3.1.4.13
1007	G	
1008	Guided push-button	3.1.4.14
1009	I	
1010	Illuminated push-button	3.1.4.10
1011	Independent (snap) action contact element	3.1.5.11
1012	Instantaneous contactor relay	3.1.3.1
1013	J	
1014	Joy stick	3.1.4.19
1015	K	
1016	Key-operated push-button	3.1.4.7
1017	Key-operated rotary switch.....	3.1.4.16
1018	L	
1019	Latched position	3.1.8.5
1020	Latched push-button	3.1.4.5
1021	Limited drive	3.1.9.5
1022	Limited energy source	3.1.2.5
1023	Limited movement rotary switch	3.1.4.17
1024	Locating mechanism (of a rotary switch)	3.1.5.19
1025	Locked position	3.1.8.6
1026	Locked push-button	3.1.4.6
1027	M	
1028	Make-contact element (normally open)	3.1.5.6
1029	Minimum actuating force	3.1.9.10
1030	Minimum actuating torque	3.1.9.11
1031	Minimum starting force	3.1.9.8
1032	Minimum starting torque	3.1.9.9
1033	Mushroom button	3.1.5.18
1034	O	
1035	Operating diagram	3.1.8.7

1036	Operating value	3.1.7.2
1037	Over-travel of the actuator	3.1.9.2
1038	Over-travel of the contact element	3.1.9.13
1039	P	
1040	Position of rest	3.1.8.2
1041	Position switch	3.1.3.3
1042	Positive drive	3.1.9.4
1043	Pre-travel of the actuator	3.1.9.1
1044	Pre-travel of the contact element	3.1.9.12
1045	Programmer	3.1.3.4
1046	Pull-button	3.1.4.2
1047	Pulse (fleeting) contact element	3.1.5.9
1048	Push-button	3.1.4.1
1049	Push-pull button	3.1.4.3
1050	R	
1051	Recessed button	3.1.5.16
1052	Recovery time	3.1.2.7
1053	Restoring torque	3.1.9.7
1054	Return value	3.1.7.3
1055	Rotary control switch	3.1.4.15
1056	Rotary button	3.1.4.4
1057	S	
1058	Semiconductor element	3.1.5.2
1059	Shrouded push-button	3.1.4.12
1060	Single fault condition	3.1.2.6
1061	Single gap contact element	3.1.5.4
1062	Switching element	3.1.5.1
1063	T	
1064	Time-delay contactor relay	3.1.3.2
1065	Time-delay push-button	3.1.4.8
1066	Transit position	3.1.8.3
1067	U	
1068	Unidirectional movement rotary switch	3.1.4.18
1069	W	
1070	Wobble stick	3.1.4.20
1071		

1072 3.2 Symbols and abbreviated terms

1073 EMC Electromagnetic compatibility

1074	I_e	Rated operational current
1075	I_{th}	Conventional free air thermal current
1076	I_{the}	Conventional enclosed thermal current
1077	SCPD	short-circuit protective device
1078	$T_{0,95}$	Time to reach 95 % of the steady-state current
1079	U_c	Rated control circuit voltage
1080	U_e	Rated operational voltage
1081	U_i	Rated insulation voltage
1082	U_{imp}	Rated impulse withstand voltage
1083	U_s	Rated control circuit supply voltage

1084 **4 Classification**

1085 **4.1 Contact elements**

1086 Contact elements may be classified as follows:

- 1087 a) Utilization categories (see 5.4).
1088 b) Electrical ratings based on utilization categories (see Annex A).
1089 c) One of the following form letters (see Figure 4):
1090 Form A – Single gap make-contact element;
1091 Form B – Single gap break-contact element;
1092 Form C – Single gap make-break three terminal change-over contact element;
1093 Form X – Double gap make-contact element;
1094 Form Y – Double gap break-contact element;
1095 Form Z – Double gap make-break four terminal change-over contact element.
1096 d) Other types not included in c).

1097 NOTE 1 Regarding Figure 4 e) the two moving contact elements are electrically separated (see 3.1.5.10).

1098 NOTE 2 Distinction is made between make before break (overlap) change-over contact elements where the two
1099 circuits are both closed for a part of the travel of the moving contacts from one position to the other, and break before
1100 make (non-overlap) change-over contact elements where the two circuits are both open for a part of the travel of the
1101 moving contacts from one position to the other. Unless otherwise stated, change-over contact elements are break
1102 before make.

1103 **4.2 Control switches**

1104 Control switches may be classified according to the contact element and the nature of the
1105 actuating system, e.g. push-buttons, form X.

4.3 Control circuit devices

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

4.4 Time delay switching elements

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

4.5 Control switch mounting

The control switch mounting may be classified by the mounting hole size, e.g. D12, D16, D22, D30 (see 7.3.2).

5 Characteristics

5.1 Summary of characteristics

5.1.1 General

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

- type of equipment (see 5.2);
- rated and limiting values for switching elements (see 5.3);
- utilization categories of switching elements (see 5.4);
- normal and abnormal load characteristics (see 5.3.6).

NOTE For items subject to agreement between manufacturer and user see Annex E.

5.1.2 Operation of a control switch

5.1.2.1 Principal application of a control switch

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

Other applications, e.g. the switching of tungsten filament lamps, small motors, etc., are not dealt with in detail in this document, but are mentioned in 5.3.6.1.

5.1.2.2 Normal conditions of use

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

5.1.2.3 Abnormal conditions of use

Abnormal conditions may arise, for example, when the coil of a contactor is energized but the device fails to operate correctly. Refer to Table 5.

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

5.2 Type of control circuit device or switching element

5.2.1 Kind of control circuit device

The kind of control circuit device shall be stated:

- 1142 • manual control switches, e.g. push-buttons, rotary switches, foot switches, etc.;
- 1143 • electromagnetically operated control switches, either time delayed or instantaneous, e.g.
- 1144 contactor relays;
- 1145 • pilot switches, e.g. pressure switches, temperature sensitive switches (thermostats),
- 1146 programmers, etc.;
- 1147 • position switches;
- 1148 • associated control equipment, e.g. indicator lights, etc.

1149 **5.2.2 Kind of switching elements**

1150 The kind of switching elements shall be stated:

- 1151 • auxiliary contacts of a switching device (e.g. contactor, circuit breaker, etc.) which are not
- 1152 dedicated exclusively for use with the coil of that device;
- 1153 • interlocking contacts of enclosure doors;
- 1154 • control circuit contacts of rotary switches;
- 1155 • control circuit contacts of overload relays.

1156 **5.2.3 Number of poles**

1157 The number of poles shall be stated.

1158 **5.2.4 Kind of current**

1159 The kind of current shall be stated:

1160 Alternating current or direct current.

1161 **5.2.5 Interrupting medium**

1162 The interrupting medium shall be stated:

1163 Air, oil, gas, vacuum, etc.

1164 **5.2.6 Operating conditions**

1165 **5.2.6.1 Method of operation**

1166 The method of operation shall be stated:

1167 Manual, electromagnetic, pneumatic, electro-pneumatic.

1168 **5.2.6.2 Method of control**

1169 The method of control shall be stated:

- 1170 • automatic;
- 1171 • non-automatic;
- 1172 • semi-automatic.

5.3 Rated and limiting values for switching elements

5.3.1 General

The rated values established for the switching elements of a control circuit device shall be stated in accordance with 5.3.2 to 5.3.6 inclusive but it is not necessary to specify all the values listed.

5.3.2 Rated voltages (of a switching element)

5.3.2.1 General

A switching element is defined by the rated voltages described in 5.3.2.2 to 5.3.2.4.

5.3.2.2 Rated operational voltage (U_e)

Subclause 5.3.1.1 of IEC 60947-1:2020 applies with the following additions:

For three-phase circuits, U_e is stated as RMS voltage between phases.

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

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

5.3.2.3 Rated insulation voltage (U_i)

Subclause 5.3.1.2 of IEC 60947-1:2020 applies.

5.3.2.4 Rated impulse withstand voltage (U_{imp})

Subclause 5.3.1.3 of IEC 60947-1:2020 applies.

5.3.3 Currents

5.3.3.1 General

A switching element is characterized by the currents described in 5.3.3.2 to 5.3.3.4.

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

Subclause 5.3.2.1 of IEC 60947-1:2020 applies.

5.3.3.3 Conventional enclosed thermal current (I_{the})

Subclause 5.3.2.2 of IEC 60947-1:2020 applies.

5.3.3.4 Rated operational current (I_e)

The first paragraph of Subclause 5.3.2.3 of IEC 60947-1:2020 applies.

5.3.4 Rated frequency

Subclause 5.3.3 of IEC 60947-1:2020 applies.

5.3.5 Vacant**5.3.6 Characteristics under normal and abnormal load conditions****5.3.6.1 Rated making and breaking capacities and behaviour of switching elements under normal conditions**

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

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

A switching element designated for the switching of small motors and tungsten filament lamp loads shall be assigned a utilization category given in IEC 60947-4-1 and comply with the appropriate corresponding requirements in that publication.

EXAMPLE 1 A typical example for a small motor load is the motor-load for household or similar application (AC-7a, AC-7b), see Table 1 of IEC 60947-4-1:2018.

EXAMPLE 2 Typical examples for lamp loads are electric discharge lamp or incandescent lamp (AC-5a, AC-5b), see Table 1 of IEC 60947-4-1:2018.

5.3.6.2 Making and breaking capacities under abnormal conditions

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

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

5.3.7 Short-circuit characteristics**5.3.7.1 Rated conditional short-circuit current**

Subclause 5.3.6.4 of IEC 60947-1:2020 applies.

5.4 Utilization categories for switching elements

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

Table 1 – Utilization categories for switching elements

Kind of current	Category	Typical applications
Alternating current	AC-12	Control of resistive loads and solid state loads with isolation by optocouplers
	AC-13	Control of solid state loads with transformer isolation
	AC-14	Control of small electromagnetic loads (≤ 72 VA)
	AC-15	Control of electromagnetic loads (> 72 VA)
Direct current	DC-12	Control of resistive loads and solid state loads with isolation by optocouplers
	DC-13	Control of electromagnets
	DC-14	Control of electromagnetic loads having economy resistors in circuit

5.5 Control circuits

Subclause 5.5.1 of IEC 60947-1:2020 applies with the following additions.

The list of characteristics given in subclause 5.5.1 of IEC 60947-1:2020 shall be completed by

- 1237 – limited energy (if the source is in accordance with 8.1.18 of this document);
- 1238 – SELV (PELV) supply (in accordance with Annex N of IEC 60947-1:2020)
- 1239 – the power consumption of the electromagnet of a contactor relay, necessary for determining
- 1240 the characteristics of the power supply of the control circuit, which is given by:
- 1241 – holding power,
- 1242 – pick-up power
- 1243 in accordance to IEC 60947-4-1.

1244 NOTE In the USA and Canada, control circuits can be supplied by Class 2 sources as defined in NFPA 70, National
1245 Electrical Code and CSA C22.1, Canadian Electrical Code in lieu of or in addition to SELV (PELV) sources.

1246 **5.6 Vacant**

1247 **5.7 Vacant**

1248 **5.8 Vacant**

1249 **5.9 Vacant**

1250 **5.10 Electrically separated contact elements**

1251 The manufacturer shall state whether the contact elements of a control circuit device are
1252 electrically separated or not (see 3.1.5.10). Separated contact elements shall be assumed to
1253 be opposite polarity unless otherwise stated by the manufacturer.

1254 **5.11 Actuating quantities for pilot switches**

1255 The operating value and return value of the actuating quantity are to be determined on uniform
1256 rising values and normal falling values of the actuating quantity. Unless otherwise stated, the
1257 rate of change shall be regular and such that the operating (or return) value is reached in not
1258 less than 10 s.

1259 The operating value and the return value may both be fixed values, or one of them or both may
1260 be adjustable (or the differential value may be adjustable).

1261 Where appropriate, the manufacturer shall indicate a withstand value, either a maximum value
1262 higher than the highest setting of the operating value or a minimum value lower than the lowest
1263 setting of the return value. A withstand value implies no damage to the pilot switch or no change
1264 in its characteristics.

1265 **5.12 Pilot switches having two or more contact elements**

1266 Pilot switches having two or more contact elements which are not individually adjustable may
1267 have different operating and return values for each contact element.

1268 A pilot switch having two or more contact elements which are individually adjusted is considered
1269 as a combination of pilot switches.

1270 **6 Product information**

1271 **6.1 Nature of information**

1272 The following information shall be given by the manufacturer:

1273 *Identification*

- 1274 a) manufacturer's name or trade mark;

1275 b) type designation or serial number that makes it possible to get the relevant information
1276 concerning the switching element (or the entire control switch) from the manufacturer or
1277 from his catalogue or by selection from Annex A;

1278 c) IEC 60947-5-1 if the manufacturer claims compliance with this document;

1279 *Characteristics*

1280 d) rated operational voltages (see 5.3.2.2);

1281 e) utilization category and rated operational currents at the rated operational voltages of the
1282 control circuit device. If auxiliary contacts of a switching device (i.e. contactor or circuit
1283 breaker) are dedicated exclusively for use with that device or a series thereof (see Footnote
1284 e of Table 4) the intended controlled load (i.e. switching device coil) shall be identified.;

1285 f) value of the rated frequency/frequencies (see 5.3.4), where applicable, e.g.: 50 Hz,
1286 50 Hz/60 Hz, and/or the indication "DC" or the symbol **— — —** (IEC 60417-5031:2002-10);

1287 *Safety and installation*

1288 g) rated insulation voltage (see 5.3.2.3);

1289 h) rated impulse withstand voltage (see 5.3.2.4);

1290 i) rated control circuit voltage U_c (see 5.5), nature of current and rated frequency, where
1291 applicable;

1292 j) rated control circuit supply voltage U_s (see 5.5), nature of current and rated frequency where
1293 applicable;

1294 In the case of electronically controlled electromagnets, other information may also be
1295 necessary, for example control circuit configuration (see 5.5).

1296 k) IP code (see Annex C of IEC 60947-1:2020);

1297 l) pollution degree (see 7.1.3.2);

1298 m) type and maximum ratings of short-circuit protective device (see 9.3.4.3);

1299 n) conditional short-circuit current;

1300 o) suitability for isolation, where applicable, with the symbol S00288:2001-07 of IEC 60617;

1301 p) for each relevant circuit, suitability for use with SELV/PELV circuit with the corresponding
1302 maximum rated operational voltage (see IEC 61140 and Annex N of IEC 60947-1:2020);

1303 q) indication of contact elements of same polarity;

1304 r) length of insulation to be removed before insertion of the conductor into the terminal;

1305 s) for non-universal screwless terminals:

1306 – "s" or "sol" for terminals declared for solid conductors;

1307 – "r" for terminals declared for solid and stranded conductors;

1308 – "f" for terminals declared for flexible conductors.

1309 a) for light sources of the equipment, the labelling text required by Table 1 of IEC TR 62471-
1310 2:2009, if any;

1311 b) environment A or B for EMC (see 8.3.1 of IEC 60947-1:2020);

1312 c) recovery time, where applicable.

1313 The following optional information can be provided:

1314 d) material declaration according to Annex W of IEC 60947-1:2020 (see 6.4.2).

1315 **6.2 Marking**

1316 **6.2.1 General**

1317 Markings shall be indelible and easily legible and shall not be placed on screws and removable
1318 washers.

1319 Marking of data under a) and b) of 6.1 is mandatory on the nameplate of the control circuit
1320 device in order to permit the complete information to be obtained from the manufacturer.

1321 Marking of data under q) of 6.1 shall be included on the nameplate of the control circuit device
1322 in order to ensure proper wiring at installation.

1323 Whenever space permits, data under c) to p) and r) of 6.1 shall be included on the nameplate,
1324 or on the control circuit device or otherwise in the manufacturer's documentation.

1325 The indication "s", "sol", "r" or "f" for non-universal screwless terminals shall be marked on the
1326 device or, if the space available is not sufficient, on the smallest package unit or in technical
1327 information provided with the product.

1328 Marking of data under t) of 6.1 shall be provided as defined in IEC TR 62471-2:2009.

1329 Additional marking requirements are specified in the annexes of this document and shall be
1330 considered, where applicable.

1331 **6.2.2 Terminal identification and marking**

1332 Subclause 8.1.8.4 of IEC 60947-1:2020 applies, with the additional requirements stated in
1333 Annex M.

1334 **6.2.3 Functional markings**

1335 Actuators may be identified by indelible symbols. If a stop-button carries any symbol on the
1336 actuator, it shall be a circle or an oval (signifying the value zero). The symbols circle or oval
1337 shall be used for stop-buttons only.

1338 Letters or words may be used where the space available is sufficient to ensure a clear
1339 identification. In all other cases, identification markings shall be placed on permanent labels
1340 surrounding each actuator or closely adjacent to it.

1341 Symbols shall be in accordance with IEC 60417.

1342 **6.2.4 Emergency stop**

1343 Actuator shape and colour, background colour and direction of unlatching for emergency stop
1344 devices with mechanical latching function shall be in accordance with 4.2 of IEC 60947-5-
1345 5:1997/AMD2:2016.

1346 **6.2.5 Operating diagram**

1347 **6.2.5.1 General**

1348 As rotary switches may have a multiplicity of contact elements and a multiplicity of actuator
1349 positions, it is necessary that the manufacturer indicates the relationship between the
1350 actuator positions and the associated contact element positions.

1351 It is recommended that the relationship be given in the form of an operating diagram, examples
1352 of which are shown in Figure 1 together with explanatory notes.

6.2.5.2 Position indication and contact position

Subclause 8.1.6.1 of IEC 60947-1:2020 applies with the following addition:

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

6.2.5.3 Terminal markings for operating diagrams

Terminal markings shall be clearly identifiable with respect to the operating diagram. See also Annex M.

6.2.6 Time delay markings

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

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

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

The manufacturer shall indicate, for each time-delay contact element, the characteristics of the delay, according to 3.1.6.1 or 3.1.6.2.

6.3 Instructions for installation, operation and maintenance, decommissioning and dismantling

Subclause 6.3 of IEC 60947-1:2020 applies with the following additions:

Safety information and instructions shall be provided when relevant in order to achieve the safe use of the control circuit device. Such information shall be easily understood by the user, i.e. in form of commonly used symbols and/or drawings. Examples include ISO 7000, IEC 60417-DB, IEC 60825-1 and IEC TR 62471-2.

Products within the scope of this document are intended to be selected, installed, and maintained by skilled personnel only.

EXAMPLE Following symbols can be used for “skilled person”.



IEC 60417-6182
Installation, electrotechnical expertise



IEC 60417-6183 1142
Installation, mechanical expertise

6.4 Environmental information

6.4.1 Environmentally conscious design process (ECD process)

Assistance in the consideration of environmental aspects relating to products in scope of this document is given in Clause 4 and Clause 5 of IEC TS 63058:2020.

6.4.2 Procedure to establish material declaration

Providing the material declaration is at discretion of the manufacturer. When provided, Clause 7 of IEC TS 63058:2020 specifies content and form of the material declaration.

6.5 Additional information

Additional information necessary for certain types of control circuit devices shall appear according to the relevant rules given in the appropriate Annexes for:

- Class II control circuit devices, see F.6.2;
- semiconductor switching elements for control circuit devices, see H.6;
- indicator lights, indicating towers and audible signalling devices, see J.6;
- control switches with direct opening action, see K.6;
- mechanically linked contact elements, see L.6;
- reliability data, see N.4;
- interface specific information, see O.6.

7 Normal service, mounting and transport conditions

7.1 Normal service conditions

7.1.1 Ambient air temperature

Subclause 7.1.1 of IEC 60947-1:2020 applies.

7.1.2 Altitude

Subclause 7.1.2 of IEC 60947-1:2020 applies.

7.1.3 Atmospheric conditions

7.1.3.1 Humidity

Subclause 7.1.3.1 of IEC 60947-1:2020 applies.

7.1.3.2 Pollution degree

Subclause 7.1.3.2 of IEC 60947-1:2020 applies with the following condition:

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

7.1.4 Shock and vibration

Standard conditions of shock and vibration of Table Q.1 of IEC 60947-1:2020 apply unless otherwise stated in this document.

7.2 Conditions during transport and storage

Subclause 7.2 of IEC 60947-1:2020 applies.

7.3 Mounting

7.3.1 General

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

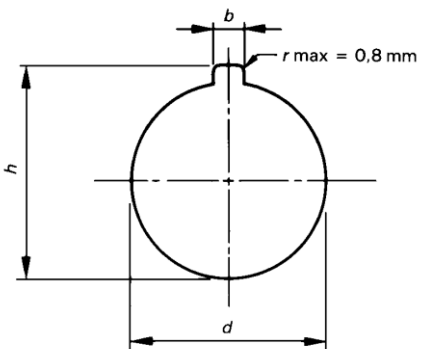
7.3.2 Mounting of single hole mounted devices

7.3.2.1 Dimensions

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

The dimensions are indicated in Table 2:

Table 2 – Mounting hole diameter and dimensions of the key recess (if any)

	Size	Mounting hole diameter, d mm	Key recess (if any)	
			Height, h mm	Width, b mm
	D30	$30,5^{+0,5}_0$	$33,0^{+0,5}_0$	$4,8^{+0,2}_0$
	D22	$22,3^{+0,4}_0$	$24,1^{+0,4}_0$	$3,2^{+0,2}_0$
	D16	$16,2^{+0,2}_0$	$17,9^{+0,2}_0$	$1,7^{+0,2}_0$
	D12	$12,1^{+0,2}_0$	$13,8^{+0,2}_0$	$1,7^{+0,2}_0$

7.3.2.2 Location of the key recess (if any)

The standardized position of the key is in the up position (12 o'clock) and associated with the b dimension in Table 3.

7.3.2.3 Range of panel thickness

The device, with or without the sealing gasket indicated by the manufacturer, shall be capable of being mounted on any thickness of panel between 1 mm and 6 mm, if necessary by the use of packing piece(s) supplied for the purpose.

NOTE The sealing gasket is not standardized.

7.3.2.4 Grouping of devices

When a number of devices of the sizes given in 7.3.2.1 are mounted in rows on a panel, the distances a between the mounting centres in the same row and b between the centre lines of the rows shall be not less than those given in Table 3, unless otherwise stated by the manufacturer.