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2006-11

Low-voltage fuses –

Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F

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CONTENTS

FOREWORD.....	25
INTRODUCTION.....	29
1 General scope.....	31
1.2 Normative references.....	31
Fuse system A – D type fuse system	
1 General.....	33
1.1 Scope.....	33
2 Terms and definitions.....	33
3 Conditions for operation in service.....	33
4 Classification.....	33
5 Characteristics of fuses.....	33
5.2 Rated voltage.....	33
5.3.1 Rated current of the fuse-link.....	35
5.3.2 Rated current of the fuse-holder.....	35
5.3.3 Rated current of the gauge-piece.....	35
5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder.....	35
5.6 Limits of time-current characteristics.....	35
5.6.1 Time-current characteristics, time-current zones and overload curves.....	35
5.6.2 Conventional times and currents.....	37
5.6.3 Gates.....	37
5.7 Breaking range and breaking capacity.....	37
5.7.2 Rated breaking capacity.....	37
6 Markings.....	37
6.4 Marking of the gauge-pieces.....	39
7 Standard conditions for construction.....	39
7.1 Mechanical design.....	39
7.1.2 Connections including terminals.....	39
7.1.3 Fuse-contacts.....	39
7.1.4 Construction of a gauge-piece.....	41
7.1.6 Construction of a fuse-carrier.....	41
7.1.7 Construction of a fuse-link.....	41
7.1.8 Non-interchangeability.....	43
7.1.9 Construction of a fuse-base.....	43
7.2 Insulating properties.....	43
7.3 Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder.....	45
7.7 I^2t characteristics.....	47
7.7.1 Pre-arcing I^2t values.....	47
7.7.2 Operating I^2t values.....	47
7.8 Overcurrent discrimination of "gG" fuse-links.....	47
7.9 Protection against electric shock.....	49

8	Tests	49
	8.1.4 Arrangement of the fuse and dimensions	49
8.2	Verification of insulating properties.....	51
	8.2.1 Arrangement of the fuse-holder	51
	8.2.4 Test method	51
	8.2.6 Creepage distances, clearances and distances through sealing compound.....	51
8.3	Verification of temperature rise and power dissipation	53
	8.3.1 Arrangement of the fuse	53
	8.3.3 Measurement of the power dissipation of the fuse-link.....	53
	8.3.5 Acceptability of test results	53
	8.5.2 Characteristics of the test circuit.....	55
	8.5.5 Test method	55
	8.5.8 Acceptability of test results	55
	8.7.4 Verification of overcurrent discrimination	57
8.9	Verification of resistance to heat	59
	8.9.1 Fuse-base	59
	8.9.2 Fuse-carrier.....	61
8.10	Verification of non-deterioration of contacts.....	61
	8.10.1 Arrangement of the fuse	61
	8.10.2 Test method	61
	8.10.3 Acceptability of test results	63
8.11	Mechanical and miscellaneous tests	65
	8.11.1 Mechanical strength	65
Annex A (informative)	Special test for cable overload protection (for fuse system A).....	133
Fuse system B – Cylindrical fuses (NF cylindrical fuse system)		
1	General	135
	1.1 Scope.....	135
2	Terms and definitions	135
3	Conditions for operation in service.....	137
4	Classification.....	137
5	Characteristics of fuses	137
	5.2 Rated voltage	137
	5.3.1 Rated current of the fuse-link.....	137
	5.3.2 Rated current of the fuse-holder	137
	5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	137
	5.6.2 Conventional times and currents.....	139
	5.6.3 Gates	139
	5.7.2 Rated breaking capacity	139
6	Markings	139

7	Standard conditions for construction.....	141
7.1	Mechanical design.....	141
7.1.2	Connections including terminals	141
7.1.6	Construction of a fuse-carrier	141
7.1.7	Construction of a fuse-link.....	141
7.1.8	Non-interchangeability.....	143
7.1.9	Construction of a fuse-base.....	143
7.2	Insulating properties.....	143
7.3	Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder.....	145
7.7	I^2t characteristics	147
7.7.1	Pre-arcing I^2t values.....	147
7.7.2	Operating I^2t values.....	147
7.8	Overcurrent discrimination of "gG" fuse-links.....	147
7.9	Protection against electric shock	147
8	Tests.....	149
8.1.6	Testing of fuse-holders	149
8.3.1	Arrangement of the fuse	149
8.3.3	Measurement of the power dissipation of the fuse-link.....	151
8.4	Verification of operation	153
8.4.1	Arrangement of the fuse	153
8.5	Verification of the breaking capacity.....	153
8.5.1	Arrangement of the fuse	153
8.5.5	Test method	155
8.5.8	Acceptability of test results.....	155
8.7.4	Verification of overcurrent discrimination	155
8.8	Verification of the degree of protection of enclosures	155
8.8.1	Verification of protection against electric shock	155
8.9	Verification of resistance to heat	155
8.10	Verification of non-deterioration of contacts.....	157
8.10.1	Arrangement of the fuse	157
8.10.2	Test method.....	157
8.10.3	Acceptability of test results.....	159
8.12	Verification of the reliability of terminals	165
Fuse system C – Cylindrical fuses (BS cylindrical fuse system)		
1	General.....	183
1.1	Scope.....	183
2	Terms and definitions	183
3	Conditions for operation in service.....	183
4	Classification.....	183
5	Characteristics of fuses	185
5.3	Rated current	185
5.3.1	Rated current of the fuse-link.....	185
5.3.2	Rated current of the fuse-holder	185
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	185

5.6	Limits of time-current characteristics	185
5.6.1	Time-current characteristics, time-current curves and overload curves	185
5.6.2	Conventional times and currents.....	185
5.7	Breaking range and breaking capacity	185
5.7.2	Rated breaking capacity	185
6	Markings	187
7	Standard conditions for construction.....	187
7.1	Mechanical design.....	187
7.1.2	Connections including terminals	187
7.1.6	Construction of a fuse-carrier	187
7.1.7	Construction of a fuse-link	187
7.1.8	Non-interchangeability.....	187
7.1.9	Construction of a fuse-base.....	187
7.3	Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder.....	189
7.9	Protection against electric shock	189
8	Tests	189
8.1	General	189
8.1.4	Arrangement of the fuse	189
8.3	Verification of temperature rise and power dissipation	189
8.3.1	Arrangement of the fuse	189
8.3.3	Measurement of the power dissipation of the fuse-link.....	189
8.4	Verification of operation	189
8.4.1	Arrangement of fuse	189
8.5	Verification of breaking capacity.....	191
8.5.1	Arrangement of the fuse	191
8.5.5	Test method	191
8.5.8	Acceptability of test results.....	191
8.10	Verification of non-deterioration of contacts.....	191
8.10.1	Arrangement of the fuse	191
8.10.2	Test method	191
8.10.3	Acceptability of test results.....	191

Fuse system D – Cylindrical fuses (Italian cylindrical fuse system)

1	General	211
1.1	Scope.....	211
2	Terms and definitions	211
3	Conditions for operation in service.....	211
4	Classification.....	211
5	Characteristics of fuses	211
5.3.1	Rated current of the fuse-link.....	213
5.3.2	Rated current of the fuse-holder	213
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	213
5.6	Limits of time-current characteristics	215
5.6.1	Time-current characteristics, time-current zones and overload curves	215

5.6.2	Conventional times and currents.....	215
5.6.3	Gates	215
5.7.2	Rated breaking capacity	217
6	Markings	217
7	Standard conditions for construction.....	217
7.1	Mechanical design.....	217
7.1.2	Connections including terminals	217
7.1.6	Construction of a fuse-carrier	219
7.1.7	Construction of a fuse-link.....	219
7.1.8	Non-interchangeability.....	219
7.1.9	Construction of a fuse-base.....	219
7.2	Insulating properties.....	219
7.3	Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder.....	221
7.7	I^2t characteristics	221
7.7.1	Minimum pre-arcing I^2t values at 0,01 s.....	221
7.7.2	Maximum operating I^2t values at 0,01 s.....	223
7.9	Protection against electric shock	223
8	Tests.....	223
8.1.6	Testing of the fuse-holder.....	223
8.3	Verification of temperature rise and power dissipation.....	225
8.3.1	Arrangement of the fuse.....	225
8.3.3	Measurement of the power dissipation of the fuse-link.....	225
8.4	Verification of operation	227
8.4.1	Arrangement of the fuse.....	227
8.5	Verification of the breaking capacity.....	227
8.5.1	Arrangement of the fuse.....	227
8.5.5	Test method	227
8.5.8	Acceptability of test results.....	227
8.7.4	Verification of discrimination.....	227
8.9	Verification of resistance to heat	227
8.9.1	Test in heating cabinet	227
8.9.2	Ball-pressure test	229
8.10	Verification of non-deterioration of contacts.....	229
8.10.1	Arrangement of the fuse	229
8.10.2	Test method	229
8.10.3	Acceptability of test results.....	231
8.11	Mechanical and miscellaneous tests.....	231

Fuse system E – Pin-type fuses

1	General	251
1.1	Scope.....	251
2	Terms and definitions	251
2.3	Characteristic quantities	251
3	Conditions for operation in service.....	253
4	Classification.....	253
5	Characteristics of fuses	253
5.3.3	Rated current of the gauge-piece.....	253

5.5	Rated power dissipation of the fuse-link	253
5.6	Limits of time-current characteristics	253
5.6.2	Conventional times and currents.....	253
5.6.3	Gates	253
5.7.2	Rated breaking capacity	255
6	Markings	255
6.1	Markings of fuse-holders	255
6.2	Markings of fuse-links.....	255
6.4	Markings of the gauge-pieces.....	255
7	Standard conditions for construction.....	255
7.1.4	Construction of the gauge-piece	255
7.1.6	Construction of a fuse-carrier	257
7.1.7	Construction of a fuse-link	257
7.1.8	Non-interchangeability.....	257
7.1.9	Construction of a fuse-base.....	257
7.3	Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder.....	257
7.9	Protection against electric shock	259
8	Tests	259
8.3	Verification of temperature rise and power dissipation	259
8.3.1	Arrangement of the fuse	259
8.3.3	Measurement of the power dissipation of the fuse-link.....	259
8.3.4	Test method	261
8.5.5	Test method	263
8.10	Verification of non-deterioration of contacts.....	263
8.10.1	Arrangement of the fuse	263
8.10.2	Test method	263
8.10.3	Acceptability of test results.....	265
 Fuse system F – Cylindrical fuse-links for use in plugs (BS plugtop system)		
1	General	277
1.1	Scope.....	277
2	Terms and definitions	277
3	Conditions for operation in service	277
4	Classification.....	277
5	Characteristics of fuses	277
5.2	Rated voltage.....	277
5.3.1	Rated current of the fuse-link.....	279
5.3.2	Rated current of the fuse-holder	279
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	279
5.6.1	Time-current characteristics, time-current zones and overload curves	279

5.6.2	Conventional times and currents.....	279
5.6.3	Gates	279
5.7.2	Rated breaking capacity	281
6	Markings	281
7	Standard conditions for construction.....	281
7.1.7	Construction of a fuse-link	281
7.1.8	Non-interchangeability.....	281
7.3	Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder.....	281
7.7	I^2t characteristics	281
7.7.1	Pre-arcing I^2t values	281
7.9	Protection against electric shock	283
8	Tests	283
8.1.4	Arrangement of the fuse-link for tests	283
8.1.5	Testing of fuse-links	283
8.2.5	Acceptability of test results.....	287
8.3	Verification of temperature rise and power dissipation.....	287
8.3.1	Arrangement of the fuse	287
8.3.4	Test method	287
8.3.5	Acceptability of test results	287
8.4	Verification of operation	287
8.4.1	Arrangement of the fuse	287
8.5	Breaking-capacity tests	289
8.5.1	Arrangement of the fuse	289
8.5.2	Characteristics of the test circuit.....	289
8.5.4	Calibration of the test circuit.....	291
8.5.5	Test method	291
8.5.8	Acceptability of test results.....	291
8.7	Verification of I^2t characteristics and overcurrent discrimination	291
8.7.3	Verification of compliance for fuse-links at 0,01 s	291
8.10	Verification of non-deterioration of contacts.....	291
8.11.1	Mechanical strength.....	291
Annex B (informative)	(for all fuse systems) – Alternative tests for tests No. 1 and No. 2 of Table 29 of IEC 60269-1.....	305
Annex C (informative)	Recommendations for future designs of fuses (for all fuse systems).....	309
Figure 101	– Time-current zones for "gG" fuse-links	71
Figure 102	– Time-current zones for "gG" fuse-links	73
Figure 103	– Time-current zone for "gG" fuse-links 13A.....	75
Figure 104	– Dummy fuse-links according to 8.3 and 8.9.1.1	77
Figure 105	– Test rigs for fuse-links	79
Figure 106	– Test rigs for fuse-links	81
Figure 107	– Test arrangement for fuse-bases according to 8.9.1.2.....	83
Figure 108	– Example of a torque wrench according to 8.9.2	85

Figure 109 – Measuring points for the voltage drop (B, C) or the temperature rise (A, D).....	87
Figure 110 – Fuse-link, D-type. Sizes DO1-DO3	89
Figure 111 – Fuse-link, D-type. Sizes DII-DIV	91
Figure 112 – Fuse-carrier, D-type. Sizes DO1-DO3	95
Figure 113 – Fuse-carrier, D-type. Sizes DII-DIII	97
Figure 114 – Fuse-carrier, D-type. Size DIV.....	99
Figure 115 – Edison thread for D-type fuses; limit dimensions	101
Figure 116 – Gauges for Edison thread for D-type fuses for screwed shells of fuse-carrier go ring gauges	103
Figure 117 – Gauges for Edison thread, D-type fuses, go and not-go plug gauges for screwed shells of fuse-bases	105
Figure 118 – Fuse-base, D-type. Sizes DO1-DO3	109
Figure 119 – Fuse-base, D-type. Sizes DII-DIV	111
Figure 120 – Fuse-base, D-type for push-in gauge rings. Size DII-DIII	115
Figure 121 – Gauge-piece and hand-key, D-type. Sizes DO1-DO3.....	119
Figure 122 – Gauge-piece and hand-key, D-type. Sizes DII-DIV	121
Figure 123 – Gauge-piece and hand-key, D-type push-in gauge rings. Size DII-DIII.....	125
Figure 124 – Whitworth thread W 3/16 for screw-in gauge rings and corresponding fuse-bases of sizes DII and DIII	129
Figure 125 – Gauges C 17 for concentricity of fuse-bases	131
Figure 201 – Fuse-link	167
Figure 202 – Dummy fuse-link	169
Figure 203 – Test-rig and ferrules for the measurement of the voltage drop and the verification of operating characteristics of the cartridge	171
Figure 204 – Fuse-base, A-type and B-type	175
Figure 205 – Housing for verification of operation of the fuse-links with a test rig according to Figure 203	177
Figure 206 – Test rig and ferrules for verification of breaking capacity	179
Figure 207 – Gauge for verification of the upholding of the cartridge in the fuse-carrier during withdrawal.....	181
Figure 301 – Details of cylindrical fuse-links	195
Figure 302 – Typical outline dimension of carriers and bases for 240 V cylindrical fuse-links	197
Figure 303 – Typical carrier and base for 415 V cylindrical fuse-links, size IIa and IIb.....	199
Figure 304 – Time-current zones for "gG" fuse-link	201
Figure 305 – Time-current zones for "gG" fuse-link	203
Figure 306 – Standard test rig for power-dissipation test.....	205
Figure 307 – Breaking-capacity test rig	207
Figure 401 – Cylindrical fuse-link type C	239
Figure 402 – Fuse-base	241
Figure 403 – Time-current zones	243
Figure 404 – Time-current zones	245

Figure 405 – Test rig.....	247
Figure 406 – Dummy fuse-link	249
Figure 407 – Housing for verification of operation of the fuse-links	249
Figure 501 – Pin-type fuses – Fuse-links	269
Figure 502 – Pin-type fuses – Fuse-holder.....	271
Figure 503 – Pin-type fuses – Gauge-pieces 230 V.....	273
Figure 504 – Dummy fuse-link for the temperature-rise test	275
Figure 601 – Dimensions for cylindrical fuse-links (primarily used in plugs)	295
Figure 602 – Time-current zones for "gG" fuse-links	297
Figure 603 – Test fuse-base	299
Figure 604 – Typical diagram of the circuit used for breaking-capacity tests	303
Figure B.1 – Instant of making for Test No. 1	307
Table 101 – Maximum values of power dissipation.....	35
Table 102 – Conventional time and current for "gG" fuse-links.....	37
Table 103 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents 2 A, 4 A, 6 A, 10 A, 13 A and 35 A	37
Table 104 – Cross-sections of rigid (solid or stranded) or flexible copper conductors.....	39
Table 105 – Creepage distances, clearances and distances through sealing compound	45
Table 106 – Temperature-rise limits for terminals	45
Table 107 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links.....	47
Table 108 – I^2t values for the discrimination with circuit breakers.....	47
Table 109 – Survey of tests on fuse-links.....	49
Table 110 – Survey of tests on fuse-bases, fuse-carriers and gauge-pieces	51
Table 111 – Test torque for verification of temperature rise and power dissipation.....	53
Table 112 – Test according to 8.5.5.1	55
Table 113 – Test currents and I^2t limits for the discrimination test	57
Table 114 – Power dissipation of a dummy fuse-link at rated and conventional fusing currents including tolerances	59
Table 115 – Test-torque for mechanical strength	67
Table 116 – Mechanical strength of screw-thread	67
Table 201 – Maximum values of rated power dissipation and values of rated acceptable power dissipation	137
Table 202 – Conventional times and currents for "gG" fuse-links	139
Table 203 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents lower than 16 A.....	139
Table 204 – Minimum rated breaking capacities.....	139
Table 205 – Nominal section of copper conductors that the terminals shall accept.....	141

Table 206 – Creepage distances and clearances	145
Table 207 – Temperature rise limits for terminals.....	145
Table 208 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links.....	147
Table 209 – Survey of tests on fuse-link	149
Table 210 – Survey of tests on fuse-holder and number of fuse-holders to be tested	149
Table 211 – Screw-thread diameters and applied torques	151
Table 212 – Values concerning the choice and the adjustment of the test base	153
Table 213 – Values for adjustment of the test base	153
Table 214 – Hammer and height of fall for test for verification of resistance to shocks	161
Table 215 – Torque to be applied to the fuse-carrier	163
Table 216 – Mechanical strength of screw-thread	165
Table 301 – Conventional time and current for "gG" fuse-links	185
Table 302 – Temperature-rise limits for terminals	189
Table 303 – Mechanical strength of screw-thread	193
Table 401 – Fuse-links: rated currents, sizes and colours of indicating devices (if any).....	213
Table 402 – Rated currents of fuse-holders	213
Table 403 – Maximum rated power dissipation of fuse-links.....	213
Table 404 – Rated acceptable power dissipation of fuse-holder	215
Table 405 – Conventional times and currents for fuse-links of $I_n < 16$ A	215
Table 406 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents lower than 16 A.....	217
Table 407 – Minimum rated breaking capacities.....	217
Table 408 – Cross-sectional areas.....	217
Table 409 – Creepage distances and clearances	221
Table 410 – Temperature-rise limits for terminals	221
Table 411 – Minimum pre-arcing I^2t values at 0,01 s.....	221
Table 412 – Maximum operating I^2t values at 0,01 s	223
Table 413 – Survey of the complete tests on fuse-holders and number of fuse-holders to be tested	223
Table 414 – Contact forces of the test rig	225
Table 415 – Torque to be applied to the screw-type fuse-carrier	225
Table 416 – Mechanical strength of screw-thread	231
Table 501 – Maximum values of rated power dissipation.....	253
Table 502 – Conventional times and currents for fuse-links of $I_n < 16$ A	253
Table 503 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents lower than 16 A.....	255
Table 504 – Temperature-rise limits for terminals	259
Table 505 – Torques.....	259

Table 506 – Cross-sectional areas	261
Table 507 – Power dissipation of the dummy fuse-link	261
Table 508 – Dummy fuse-link	263
Table 509 – Mechanical strength of screw-thread	267
Table 601 – Conventional times and conventional currents	279
Table 602 – Gates for specified pre-arcing times of "gG" fuse-links for use in plugs	279
Table 603 – Temperature-rise limits for terminals	281
Table 604 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links	283
Table 605 – Survey of tests on fuse-links	285
Table 606 – Values for breaking-capacity tests	289

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Withdrawing

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE FUSES –

**Part 3: Supplementary requirements for fuses
for use by unskilled persons
(fuses mainly for household and similar applications) –
Examples of standardized systems of fuses A to F****FOREWORD**

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International Standard IEC 60269-3 has been prepared by subcommittee 32B: Low-voltage fuses, of IEC technical committee 32: Fuses.

This third edition cancels and replaces the second edition published in 1987 and amendment 1 (2003), as well as IEC 60269-3-1 (2004) and constitutes a minor revision.

The general re-organization of the IEC 60269 series has led to the creation of this new edition.

This part is to be used in conjunction with IEC 60269-1:2006, Part 1: General requirements.

This Part 3 supplements or modifies the corresponding clauses or subclauses of Part 1.

Where no change is necessary, this Part 3 indicates that the relevant clause or subclause applies.

Tables and figures which are additional to those in Part 1 are numbered starting from 101.

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

FDIS	Report on voting
32B/484/FDIS	32B/491/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.

IEC 60269 consists of the following parts, under the general title *Low-voltage fuses*:

Part 1: General requirements

NOTE This part includes IEC 60269-1 (third edition, 1998) and parts of IEC 60269-2 (second edition, 1986) and IEC 60269-3 (second edition, 1987).

Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to I

NOTE This part includes parts of IEC 60269-2 (second edition, 1986) and all of IEC 60269-2-1 (fourth edition, 2004).

Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar application) – Examples of standardized systems of fuses A to F

NOTE This part includes parts of IEC 60269-3 (second edition, 1987) and all of IEC 60269-3-1 (second edition, 2004).

Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices

NOTE This part includes IEC 60269-4 (third edition, 1986) and IEC 60269-4-1 (first edition, 2002).

Part 5: Guidance for the application of low-voltage fuses

NOTE Currently IEC/TR 61818 (2003).

For reasons of convenience, when a part of this publication has come from other publications, a remark to this effect has been inserted in the text.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site 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.

INTRODUCTION

A reorganization of the different parts of the IEC 60269 series has been carried out, in order to simplify its use, especially by the laboratories which test the fuses.

IEC 61269-1, IEC 60269-2, IEC 60269-3 and IEC 60269-3-1 have been integrated into either the new part 1 or the new parts 2 or 3, according to the subjects considered, so that the clauses which deal exclusively with “fuses for authorised persons” are separated from the clauses dealing with “fuses for unauthorised persons”.

As far as IEC 60269-4 and IEC 60269-4-1 are concerned, they have been integrated into the new part 4 which deals with the fuse-links used for semiconductor protection.

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Withdrawn

LOW-VOLTAGE FUSES –

Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F

1 General scope

Fuses for use by unskilled persons according to the following fuse systems comply with all subclauses of IEC 60269-1 and with the requirements laid down in the relevant fuse systems.

This standard is divided into six fuse systems, each dealing with a specific example of standardized fuses for use by unskilled persons:

- Fuse system A: D type fuse system
Remark: previously Section I in IEC 60269-3-1.
- Fuse system B: Cylindrical fuses (NF cylindrical fuse system)
Remark: previously Section IIA in IEC 60269-3-1.
- Fuse system C: Cylindrical fuses (BS cylindrical fuse system)
Remark: previously before Section IIB in IEC 60269-3-1.
- Fuse system D: Cylindrical fuses (Italian cylindrical fuse system)
Remark: previously Section IIC in IEC 60269-3-1.
- Fuse system E: Pin-type fuses
Remark: previously Section III in IEC 60269-3-1.
- Fuse system F: Cylindrical fuse-links for use in plugs (BS plugtop fuse system)
Remark: previously Section IV in IEC 60269-3-1.

NOTE 1 Examples of standardized fuses complying with the requirements of IEC 60269-1 are listed in the present standard. Other examples may be added, provided that they comply with these requirements.

For recommendations for future designs of fuses, see Annex C.

NOTE 2 The following fuse systems are standardized systems with respect to their safety aspects.

The National Committees may select from the examples of standardized fuses one or more systems for their own standards. Colour codes are not specified for each fuse system. Where colour codes are indicated, they apply only to that particular fuse system.

1.2 Normative references

The following referenced documents are indispensable for the application 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 60068-2-32, *Environmental testing – Part 2: Tests. Test Ed: Free fall*

IEC 60269-1, *Low-voltage fuses – Part 1: General requirements*

IEC 60664 (all parts), *Insulation co-ordination for equipment within low-voltage systems*

IEC 60898:1987, *Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60999:1990, *Connecting devices – Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors*

Fuse system A – D type fuse system

Remark: previously Section I in IEC 60269-3-1

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to "gG" fuses for use by unskilled persons for domestic and similar applications with rated currents up to and including 100 A and rated voltages of up to and including 500 V a.c. and 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1.

- rated voltage;
- rated power dissipation of the fuse-link and rated acceptable power dissipation of a fuse-holder;
- time-current characteristic;
- gates, I^2t characteristics and conventional times and currents;
- rated breaking capacity;
- marking on the fuse;
- standard conditions for construction;
- tests.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

For a.c., the standard values of rated voltages are 400 V for size DO1, DO2 and DO3¹⁾ and 500 V for size DII, DIII and DIV.

¹⁾ These three sizes are also applicable for 415 V networks.

For d.c., the rated voltages are 250 V for DO1, DO2 and DO3 and 500 V for DII, DIII and DIV.

5.3.1 Rated current of the fuse-link

The rated currents of the fuse-links are given in Figures 110 and 111.

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-carriers are given in Figures 112, 113 and 114. The rated currents of the fuse-bases are given in Figures 118, 119 and 120.

5.3.3 Rated current of the gauge-piece

The rated current of the gauge-piece is identical with the highest rated current of the fuse-link, which the gauge piece can accept.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of power dissipation of D-type fuse-links are specified in Table 101.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, time-current zones are stated in Figures 101 to 103. The tolerance on time-current characteristics given by the manufacturer shall not deviate by more than $\pm 10\%$ in terms of current.

The time-current zones given in Figures 101 to 103, including manufacturing tolerances, shall be met for all pre-arcing and operating times measured at the test voltage according to 8.7.4.

Table 101 – Maximum values of power dissipation

Remark: this table was previously Table A in IEC 60269-3-1, Section I

Rated current I_n A	Maximum power dissipation W	
	DO1 – DO3	DII – DIV
2	2,5	3,3
4	1,8	2,3
6	1,8	2,3
10	2,0	2,6
13	2,2	2,8
16	2,5	3,2
20	3,0	3,5
25	3,5	4,5
35 ^{a)}	4,0	5,2
50	5,0	6,5
63	5,5	7,0
80	6,5	8,0
100	7,0	9,0

^{a)} In some countries, the rating of 35 A is replaced by 32 A and 40 A.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 102.

Table 102 – Conventional time and current for "gG" fuse-links

Remark: this table refers to Table 2 in IEC 60269-1 and was previously Table II in IEC 60269-3-1, Section I

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
2 and 4	1	$1,5 I_n$	$2,1 I_n$
6 and 10	1	$1,5 I_n$	$1,9 I_n$
$13 \leq I_n \leq 35$	1	$1,25 I_n$	$1,6 I_n$

5.6.3 Gates

For "gG" fuse-links, in addition to the gates of IEC 60269-1, the gates given in Table 103 apply.

Table 103 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents 2 A, 4 A, 6 A, 10 A, 13 A and 35 A

Remark: this table refers to Table 3 in IEC 60269-1 and was previously Table III in IEC 60269-3-1, Section I

I_n A	$I_{min. (10 s)}$ A	$I_{max. (5 s)}$ A	$I_{min. (0,1 s)}$ A	$I_{max. (0,1 s)}$ A
2	3,7	9,2	6,0	23,0
4	7,8	18,5	14,0	47,0
6	11,0	28,0	26,0	72,0
10	22,0	46,5	58,0	111,0
13	26,0	59,8	75,4	144,3
35	89,0	175,0	255,0	445,0

5.7 Breaking range and breaking capacity

5.7.2 Rated breaking capacity

The minimum values of the rated breaking capacity are the following:

- not less than 50 kA a.c.
- not less than 8 kA d.c.

NOTE D-type fuses are frequently used in a.c. installations with short-circuit currents higher than 20 kA, and also in d.c. installations. Therefore, all fuses have to comply with the requirements of this subclause.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links and fuse-holders which meet the requirements and tests of this fuse system may be marked with "IEC 60269-3". For devices according to this standard, national approvals can be awarded by national test-houses. Such national approvals may be marked on the relevant

6.4 Marking of the gauge-pieces

- name of manufacturer or trademark by which he may be readily identified;
- rated current, or colour code.

NOTE For gauge-pieces having very small dimensions, the manufacturer's name may be omitted, provided it is indicated on the packing.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Deviations from the dimensions specified in the standard sheets may be made, but only if they provide a technical advantage and do not adversely affect the purpose and safety of fuses complying with the standard sheets, especially with regard to interchangeability and to non-interchangeability. Fuses with such deviations shall, however, comply with all other requirements of this specification as far as they reasonably apply.

7.1.2 Connections including terminals

The terminals shall be capable of accepting the cross-sections of conductors indicated in Table 104.

The largest cross-sectional areas specified in Table 104 may be reduced to 6 mm² (size DII); 16 mm² (size DIII) and 35 mm² (size DIV), provided that the fuse-base terminals are connected to internal wiring of switchboards, fuse-boxes, etc. and external conductors are consequently fitted to separate supply terminals of a type-tested or partially type-tested assembly.

Table 104 – Cross-sections of rigid (solid or stranded) or flexible copper conductors

Remark: this table was previously Table B in IEC 60269-3-1, Section I

Fuse-base		Cross-section mm ²
Size	I_n A	
DO1	16	1,5 to 4
DO2	63	1,5 to 25
DO3	100	10 to 50
DII	25	1,5 to 10
DIII	63	2,5 to 25
DIV	100	10 to 50

NOTE This table is provisional, awaiting the results of subcommittees 17B and/or 23F.

7.1.3 Fuse-contacts

The fuse-contacts shall be nickel-plated or protected by other materials of at least similar protective properties.

Fuse-link contacts of rated currents 50 A and above shall be silver-plated with a minimum thickness of the silver layer of 3 µm.

7.1.4 Construction of a gauge-piece

The contact pieces, if any, shall be in one piece and made of copper alloy containing at least 50 % copper. Their contact surfaces shall be flat and free from burrs.

The metal portion of gauge-pieces of sizes DII and DIII shall have smooth contact surfaces on both sides without burrs within the prescribed area, and both contact surfaces shall protrude from the adjacent ceramic material.

For DII, DIII and DIV-fuses, the part forming the calibration ring shall be of ceramic material. The colour of the face of the calibration ring shall be in accordance with the colour of the fuse indicator given in the table in Figure 111.

NOTE Gauge-pieces ensure non-interchangeability. Therefore, they are so designed as to be insertable or replaceable only by special hand keys, which are not available to unskilled persons.

Compliance with the requirements of the subclause is to be checked by inspection.

With respect to the two types of fuse-bases of size DII and DIII there are two types of gauge-pieces:

- screw-in gauge-pieces (Figure 122)
- push-in gauge-pieces (Figure 123).

See Figures 121, 122, 123 and 124.

7.1.6 Construction of a fuse-carrier

A fuse-carrier shall be provided with means for retaining the fuse-link in position whether the fuse-carrier is fitted in the fuse-base or not.

A fuse-carrier for fuse-links for which an indicating device is required shall be provided with an appropriate opening for observing the indicator. The opening shall be closed with a securely fixed window of suitable transparent material or other suitable means of protection against material, which could be ejected from the indicator.

The screwed shell shall be of solid copper alloy containing at least 50 % copper and those made from rolled sheet at least 62 % copper.

The insulating parts shall be of ceramic or other sufficiently heat-resistant material.

The hole for the voltage tester is optional.

See Figures 112, 113, 114, 115 and 116.

7.1.7 Construction of a fuse-link

A fuse-link shall be so constructed that it is not possible to remove or to replace parts ensuring non-interchangeability.

In case the fuse has an indicating device, the indication shall be visible when the fuse-link is inserted in the fuse-holder or fuse-carrier.

The fuse-link body shall be of ceramic material. Contact pieces shall be of copper or an alloy containing at least 62 % copper. The colour of the fuse-indicator shall be in accordance with Figure 111.

See Figures 110 and 111.

7.1.8 Non-interchangeability

Fuses shall be so designed that a fuse-link cannot be replaced inadvertently by another rated current exceeding a pre-determined value.

For rated currents below 10 A non-interchangeability is not required.

7.1.9 Construction of a fuse-base

A fuse-base shall be so designed that it can be securely fixed in such a way that its unintentional removal is not possible.

A fuse-base intended for use with gauge pieces shall be provided with suitable means for retaining the gauge pieces in positions and allowing their removal only by the aid of a suitable tool.

Covers of fuse-bases providing protection against access of live parts shall withstand the mechanical stresses occurring during fixing and shall be firmly fixed in such a manner that they can be removed only by the aid of a tool or deliberate action when mounted.

The terminals shall be suitable for accepting conductors with the appropriate cross sectional areas

Current-carrying parts of solid copper alloy shall contain at least 50 % copper and those made from rolled material at least 62 % copper.

A fuse-base for rail-mounting shall not detach when inserting and removing the fuse-link (in case of screw-type fuses 2/3 of the torque designated for fuse-carriers of Table 115 shall be used).

The fuse-base may move back and forth longitudinally on the rail.

A fuse-base for surface-mounting shall not wobble when placed on a flat surface.

For fuse-bases of size DII and size DIII there are two types, which differ with respect to the construction of the gauge-piece:

- fuse-bases for screw-in gauge rings (Figure 119)
- fuse-bases for push-in gauge rings (Figure 120)

See Figures 115, 117, 118, 119, 120 and 124.

7.2 Insulating properties

The minimum creepage distances, clearances and distances through the insulation material or sealing compound shall comply with the values given in Table 105.

Table 105 – Creepage distances, clearances and distances through sealing compound*Remark: this table was previously Table C in IEC 60269-3-1, Section I*

Creepage distance mm	DII – DIV	DO1 – DO3
Between metal parts, including contacts, which are of different polarity when the fuse-link has operated	5	4
Between live parts and accessible metal parts, including fuse-base fixing screws or metallic fixing means for rail mounting, with a fuse-carrier, a fuse-link and a gauge-piece in position	5	3
Between live parts and cover-fixing screws or metallic fixing means for rail mounting which are not earthed and not accessible to the standard test finger	3	2
Clearance mm	DII – DIV	DO1 – DO3
Between metal parts, including contacts, which are of different polarity when the fuse-link has operated	5	3
Between live parts and accessible metal parts, including fuse-base fixing screws or metallic fixing means for rail mounting, with a fuse-carrier, a fuse-link and a gauge-piece in position	5	3
Between live parts and cover-fixing screws or metallic fixing means for rail mounting which are not earthed and not accessible to the standard test finger	3	2
Distance mm	DII – DIV	DO1 – DO3
Between live parts and the surface on which a fuse-base for front connection is mounted	10	6
Through sealing compound between live parts covered with at least 2,5 mm of sealing compound and the surface on which a fuse-base for front connection is mounted	5	3
NOTE 1 The standard test finger referred to in the table is that specified in IEC 60529.		
NOTE 2 Pending the results of SC 17B, TC 23 and SC 28A, the table is provisional.		

7.3 Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder

Instead of Table 5 of IEC 60269-1, following Table 106 applies.

Table 106 – Temperature-rise limits for terminals

Remark: this table refers to Table 5 in IEC 60269-1 and was previously Table IV in IEC 60269-3, Edition 2

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3.4.2 of IEC 60269-1, for the corresponding rated current of the fuse-base shall not exceed	65K
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7.7 I^2t characteristics

7.7.1 Pre-arcing I^2t values

In addition to Table 7 of IEC 60269-1, the following pre-arcing I^2t values apply:

Table 107 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links

Remark: this table refers to Table 7 in IEC 60269-1 and was previously Table VI in IEC 60269-3-1, Section I

I_n A	I^2t_{\min} A ² s	I^2t_{\max} A ² s
2	1,0	23,0
4	6,2	90,2
6	24,0	225,0
10	100,0	676,0
13	170,0	900,0
35	2 250,0	8 000,0

7.7.2 Operating I^2t values

The maximum pre-arcing I^2t values given in Table 107 of this standard and of Table 7 of IEC 60269-1 shall be taken as maximum operating I^2t values and shall be verified by the breaking capacity test specified in 8.7.1 of IEC 60269-1.

7.8 Overcurrent discrimination of "gG" fuse-links

Fuse-links 16 A and above in series, with the rated current ratio of 1:1,6 have to operate selectively in the whole breaking range (see 8.7.4).

With regard to discrimination when circuit-breakers are used, the following I^2t values shall be followed:

Table 108 – I^2t values for the discrimination with circuit breakers

Remark: this table was not numbered in IEC 60269-3-1, Section I

I_n A	I^2t_{\min} A ² s	I_p A
16	250	500
20	450	670
25	810	900
35	2 000	1 410
50	4 000	2 000
63	6 300	2 510
80	10 000	3 160
100	16 000	4 000

7.9 Protection against electric shock

The degree of protection shall be at least IP2X when the fuse is under normal service conditions

For D-type fuses, the operation of replacing a fuse-link is considered in two stages, which are: "removing the fuse-link and the fuse-carrier" and "fuse-link and fuse-carrier removed". The first stage is considered to represent D-type fuses under normal service conditions. Only when the fuse-link and the fuse-carrier are removed, may the degree of protection temporarily be reduced to IP1X.

NOTE The temporary suspension of the complete protection "IP2X" against electric shock (after many years of sufficiently safe application of the D-type fuse system by unskilled users) need not be regarded as dangerous, as there is enough experience with interchanging of incandescent lamps, where comparable degrees of safety exist.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse and dimensions

The thickness of the screwed shell of fuse-bases and fuse-carriers is measured by means of a micrometer with pointed noses. The mean values of two sets of three measurements shall be at least equal to the value specified in Figures 112 to 114 and 118 to 120.

The two sets of measurements are made on one of two different longitudinal lines, which are at least 30°, displaced with respect to each other.

Generally, the three measurements along the longitudinal line are equally distributed over this, if possible, at the most unfavourable points.

For rolled thread, one of the measurements is made at the top, one at the bottom of the thread and the remaining one between these as one likes.

For fuse-carriers the measurements are made at the part of the screwed shell, which protrudes from the insulator.

For fuse-bases no measurement is made in the first course of the thread.

8.1.5.1 Complete tests

The following additional tests are required according to Tables 109 and 110.

Table 109 – Survey of tests on fuse-links

Remark: this table refers to Table 11 in IEC 60269-1 and was previously Table VII in IEC 60269-3-1, Section I

Test according to subclause	Number of test samples					
	3	4	1	1	2	1
8.4.3.2 Verification of rated current	x					
8.7.4 Verification discrimination		x				
8.11.1 Mechanical strength			x	x		
8.11.2.4 Heat storage at elevated temperature					x	x
8.11.2.6 Dimensions and non-interchangeability	x	x				

Table 110 – Survey of tests on fuse-bases, fuse-carriers and gauge-pieces*Remark: this table was previously Table D in IEC 60269-3-1, Section I*

Test according to subclause	Number of test samples									
	Fuse-bases				Fuse-carriers				Gauge-pieces	
	1	1	3	1	1	1	1	3	1	1 1
8.9 Verification of resistance to heat	x				x					
8.11.1 Mechanical strength		x				x	x			x x
8.11.2.4 Heat storage at elevated temperature			x	x				x	x	
8.11.2.6 Dimensions and non-interchangeability										x x

8.1.5.2 Testing of fuse-links of a homogeneous series

In addition to IEC 60269-1, the following applies.

Fuse-links having different contact parts and different shapes of ceramic bodies only intended to provide non-interchangeability and not affecting the performance may be considered to meet the requirements of a homogeneous series.

8.2 Verification of insulating properties

8.2.1 Arrangement of the fuse-holder

In addition to IEC 60269-1, the following applies:

The metal covering (can be aluminium foil) shall not be pressed on to the inspection window. For fuse-carriers, for example, a distance of 3 mm from the outer lower edge of the insulating part shall be left uncovered by metal covering.

8.2.4 Test method

In addition to IEC 60269-1, the following applies.

8.2.4.1 This test shall be performed immediately after the humidity treatment described in 8.2.4.2 of IEC 60269-1. The fuse-holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1.

8.2.6 Creepage distances, clearances and distances through sealing compound

8.2.6.1 Test method

Creepage distances, clearances and distances are measured on the complete fuse, first using conductors with the smallest cross-sectional areas specified in Table 104, and then the largest.

NOTE The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width. Any air gap less than 1 mm wide is ignored in computing the total clearance.

8.2.6.2 Acceptability of test results

Creepage distances, clearances and distances shall not be less than the values in millimetres in Table 105.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The fuse-carrier shall be inserted with a torque as indicated in Table 111.

Table 111 – Test torque for verification of temperature rise and power dissipation

Remark: this table was previously Table E in IEC 60269-3-1, Section I

Size	Couple de torsion
	Nm
DO1	1,0
DO2	1,0
DO3	1,7
DII	2,7
DIII	4,3
DIV	6,7

The torque applied to the screws of the terminals is two-thirds of the values given in Table 116.

8.3.3 Measurement of the power dissipation of the fuse-link

The power dissipation shall be measured between the end caps of the fuse-link (see Figure 109).

8.3.4.1 Temperature rise of the fuse-holder

The test shall be made with a dummy fuse-link as specified in Figure 104 for the rated current of the fuse-holder (see Figure 109).

8.3.5 Acceptability of test results

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3 of IEC 60269-1 for the corresponding rated current of the fuse-base, shall comply with Table 106.

The power dissipation of the fuse-link shall not exceed the values specified in Table 114.

8.4.3.1 Verification of conventional non-fusing and fusing current

This test will be performed using a test rig as shown in Figures 105 and 106.

8.4.3.2 Verification of rated current of fuse-links

Three fuse-links are subjected to 100 operating cycles, each cycle comprising a period of 1 h during which the test current flows and a period of 15 min without the current flowing.

The test current of $1,2 I_n \pm 2,5 \%$ applies only for fuse-links with rated current <16 A. For fuse-links with rated current ≥ 16 A these requirements are deemed to be met by test of 8.4.3.2 of IEC 60269-1, with the exception that three samples are tested.

During these cycles, the fuse-links shall not operate. They are allowed to cool down to approximately room temperature and are then loaded with a current equal to 0,9 times I_{nf} shown in Table 2 of IEC 60269-1 and Table 102 of this standard. The fuse-links shall not operate within the conventional time shown in Table 2 of IEC 60269-1 and Table 102 of this standard.

After the fuses have been allowed to cool down to approximately room temperature, they are loaded with I_f . The fuse-links shall operate within the conventional time.

8.4.3.5 Conventional cable overload protection test

The test procedure described under 8.4.3.5 of IEC 60269-1 is not valid for fuses <16A.

NOTE (for gG fuses only) The tests in IEC 60269-1 are deemed to give satisfactory results at $1,45 I_n$ in typical applications at an ambient temperature of 30 °C. A special test may be required by some countries to prove that fuses and MCBs are equivalent protective devices. Details of the special test are given in Annex A of this standard.

8.4.3.6 Operation of indicating devices and strikers, if any

In addition to IEC 60269-1 concerning indicating devices, the following applies.

If the test is performed at reduced voltages, the test circuit voltage shall be $100 \text{ V} \pm 5 \text{ V}$ and the test current shall be $2 \times I_f + {}^{20}_0 \%$.

8.5.2 Characteristics of the test circuit

For the test with d.c. current, Table 21 of IEC 60269-1 applies, with the following exception.

Table 112 – Test according to 8.5.5.1

Remark; this table was not numbered in IEC 60269-3-1, Section I

	No. 1 No. 2	No. 3 No. 4 No. 5
Time constant	15 ms $^{+5}_0$ ms ^{a)}	≤3 ms
^{a)} The above-mentioned time-constant is within the limits given in IEC 60269-1.		

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1, tests in accordance with Table 20 of IEC 60269-1 shall be made. An alternative test to tests Nos. 1 and 2 of Table 20 is given in Annex B.

8.5.8 Acceptability of test results

In addition to 8.5.8 of IEC 60269-1, the following applies.

After this test, the end caps of the fuse-links may have small holes, blisters, spots and localized bulging as long as the gauge-piece and the fuse-carrier are not damaged. Blackening of the inspection window; if any, is ignored.

8.7.4 Verification of overcurrent discrimination

The samples are arranged as for breaking-capacity test according to 8.5 of IEC 60269-1.

Two samples are tested at the current I_{\min} and two others at the current I_{\max} . The current values are given in Table 113.

The a.c. test voltage is: $\frac{1,1 \times U_n}{\sqrt{3}}$

The other characteristics of the test circuit are the same as for the breaking-capacity test No. 2 (see Table 20 of IEC 60269-1).

The evaluated I^2t values shall meet the I^2t limits specified in Table 113.

Table 113 – Test currents and I^2t limits for the discrimination test

Remark: this table was previously Table F in IEC 60269-3-1, Section I

Minimum pre-arcing I^2t value			Operating I^2t value		Selectivity ratio
I_n A	Prospective I_{\min} kA r.m.s.	I^2t_{\min} A ² s	Prospective I_{\max} kA r.m.s.	I^2t_{\max} A ² s	
2	0,013	0,67	0,064	16,4	1:1,6
4	0,035	4,90	0,130	67,6	
6	0,064	16,40	0,220	193,6	
10	0,130	67,60	0,400	640,0	
13	0,200	160,0	0,480	922,0	
16	0,270	291,00	0,550	1 210,0	
20	0,400	640,00	0,790	2 500,0	
25	0,550	1 210,00	1,000	4 000,0	
32	0,790	2 500,00	1,200	5 750,0	
35	0,870	3 030,00	1,300	6 750,0	
40	1,000	4 000,00	1,500	9 000,0	
50	1,200	5 750,00	1,850	13 700,0	
63	1,500	9 000,00	2,300	21 200,0	
80	1,850	13 700,00	3,000	36 000,0	
100	2,300	21 200,00	4,000	64 000,0	

The pre-arcing I^2t values measured at the test current I_{\min} shall be higher than the I^2t value, specified in column 3 of Table 113. The operating I^2t values measured at the test current I_{\max} shall be lower than I^2t values specified in column 5 of Table 113.

8.9 Verification of resistance to heat

8.9.1 Fuse-base

The test is carried out only on fuse-bases of non-ceramic insulating material.

8.9.1.1 Test arrangement

The fuse-base to be tested is fitted with a dummy fuse-link according to Figure 104, whose power dissipation at test current lies within the limits indicated in Table 114.

The torque applied to the fuse-carrier shall be two-thirds of the torque specified in Table 115. The cross-sectional area of the conductors connected depends on the maximum rated current of the largest fuse-link to be inserted in the fuse-base (see IEC 60269-1, Table 17).

Table 114 – Power dissipation of a dummy fuse-link at rated and conventional fusing currents including tolerances

Remark: this table was previously Table G in IEC 60269-3-1, Section I

Size		DO1	DO2	DO3	DII	DIII	DIV
Power dissipation at I_n	W	2,5	5,5	7,0	4,0	7,0	9,0
Power dissipation at test current I_f ^{a)}	W	6,7	14,1	17,9	10,3	17,9	23,0
Force applied to the dummy fuse-link	N	35,0	50,0	75,0	50,0	75,0	110,0

^{a)} For these values a tolerance of $\pm 3\%$ applies.

The fuse is placed in a test arrangement according to Figure 107 and placed in a heating chamber, the conductors emerging from the cabinet are sealed. The length of the connected conductors shall be at least 1 m outside the heating chamber. The heating chamber must be such that during the test, the air temperature is kept at $80\text{ °C} \pm 5\text{ °C}$, measured in the plane of the sample at a distance of approximately 15 cm.

8.9.1.2 Test method

The air temperature in the heating chamber is raised to $80\text{ °C} \pm 5\text{ °C}$ and is maintained for 2 h. Immediately afterwards, but while maintaining the temperature of the heating chamber, the sample is loaded with a test current corresponding to approximately I_f . At this test current the power dissipation of the dummy fuse-link shall lie within the limits indicated in Table 114. The current shall be kept constant during the whole test duration of 2 h. At the end of the test, a weight is applied straight and not jerkily at position 4 (see Figure 107), which (taking into account the lever-arm relations) generates along arrow G a force according to Table 114 on the dummy fuse-link. To apply the force, the inspection window has to be removed. The sample may be connected to a reduced voltage source ($\geq 42\text{ V}$).

8.9.1.3 Acceptability of test results

After applying the force, a current shall continue to flow through the sample. The force is maintained for 15 min and the current shall continue to flow unchanged through the sample. Furthermore, after this test, the fuse-base shall not show any damage impairing its further use.

8.9.2 Fuse-carrier

8.9.2.1 Test arrangement

A fuse-base shall be mounted on a 15 mm thick plywood board. The arrangement shall be the same as in normal use. The fuse-base is fitted with a dummy fuse-link according to Figure 104. The cross-sectional area of conductors depends on the rated current of the fuse-base (see IEC 60269-1, Table 17). The length of the conductors shall be at least 1 m outside the heating chamber in which the test arrangement is to be placed.

The torque applied to the fuse-carrier shall correspond to Table 115. For tightening and later loosening of the fuse-carrier, a nut is used, the interior form of which enables a tight connection to the insulated part of the fuse-carrier. The nut is tightened with a torque wrench with a square-section shank – as is usual in service – (see Figure 108). The nut and the described test device shall be placed in the above-mentioned heating chamber.

8.9.2.2 Test method

The air temperature in the heating chamber is raised to $80\text{ °C} \pm 5\text{ °C}$ and maintained for 2 h. Immediately afterwards, the fuse is loaded with a test current, corresponding to approximately I_f , for 2 h and the test current must be adjusted in such a way that the power dissipation of the dummy fuse-link lies within the limits indicated in Table 114.

The test current shall be kept constant during the 2 h test. Immediately after the opening of the test chamber, the nut heated up during the test is fitted to the torque wrench, and with this torque wrench, the fuse-carrier is loosened twice and tightened again.

8.9.2.3 Acceptability of test results

After this test, the fuse-carrier shall show no damage impairing its further use; especially, the insulating material shall not show any fissures or inadmissible shrinkage.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies, with the following addition.

The dummy fuse-link is given in Figure 104 of this standard.

Torques to be applied to the fuse-carrier are equal to 40 % of the values given in Table 115.

8.10.2 Test method

The following wording is added after the first paragraph of 8.10.2 in IEC 60269-1.

The test-current is the conventional non-fusing current.

The load period is 75 % of the conventional time.

The no-load period is 25 % of the conventional time.

The conventional time, as well as the non-fusing current, is stated in Table 2 of IEC 60269-1. A test voltage lower than the rated voltage may be used.

During the no-load period, the samples are cooled down to a temperature lower than 35 °C; additional cooling (for example, a fan) is allowed.

The third paragraph of 8.10.2 in IEC 60269-1 is replaced by the following wording.

Before the beginning of the cycling test, the temperature rise of the contacts shall be measured at rated current when steady-state conditions have been obtained. The measurement shall be repeated after 250 cycles and, if necessary, after 750 cycles.

The voltage drop of the contacts is measured after 50, 250 and 750 cycles at direct current of $I_m = (0,05 \text{ to } 0,30) I_n$. However, the current I_m has to be chosen in such a way as to give a voltage drop of at least 100 µV.

The tolerance of I_m during the measurement shall not be greater than $^{+10}_0$ %. The points between which the voltage drop is measured are marked A, B, C and D in Figure 109.

The resistance of the contact is then determined on the basis of the voltage drop. Before measurement, the sample has to be cooled down to room temperature. If the room temperature during the measurement deviates from 20 °C, the following formula may be applied.

$$R_{20} = \frac{R_T}{1 + \alpha_{20} \times (T - 20)}$$

where

R_{20} is the resistance at temperature 20 °C;

R_T is the resistance at temperature T ;

α_{20} is the temperature coefficient.

8.10.3 Acceptability of test results

At the end of 250 cycles (equation 1) and at the end of 750 cycles (equation 2), the following limits shall not be exceeded.

$$\frac{R_{250} - R_{50}}{R_{50}} \leq 15 \% \quad (1)$$

$$\frac{R_{750} - R_{50}}{R_{50}} \leq 40 \% \quad (2)$$

Alternatively, the temperature measured according to Figure 109 can be used for verification. As measuring points, the terminating lugs of the fuse-base (Figure 109) should be chosen. In this case, the following limits shall not be exceeded:

After 250 cycles, the measured temperature rise values shall not exceed the temperature at the beginning of the test by more than 15 K and after 750 cycles, the measured temperature rise values shall not exceed the values measured at the beginning of the tests by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1 Mechanical strength

8.11.1.1 Mechanical strength of the gauge-piece

The following tests refer only to gauge-pieces of sizes DII and DIII (screw-in gauge-pieces).

Gauge-pieces shall be so constructed that the current-carrying parts are in one piece and that they withstand the mechanical stress occurring in normal use.

Compliance is checked by inspection and by the following tests.

The gauge-piece is screwed into a fuse-base by applying a torque of 1 Nm for 1 min. It is then withdrawn with the aid of the appropriate hand-key. In addition, an axial force of 10 N is applied in both directions between the metal part and the ceramic part of the gauge-piece. The test is made on the gauge-piece as delivered. For gauge-pieces having parts which are cemented or glued together, the test is repeated after the samples have been immersed for 24 h in water at the temperature of $20\text{ °C} \pm 5\text{ °C}$, and again after the samples have been conditioned for 1 h at a temperature of $200\text{ °C} \pm 5\text{ °C}$.

After these tests, the samples shall show no change impairing their future use; in particular, the thread shall not be damaged and the ceramic parts shall still be securely fixed to each other and shall not be detached from the metal part.

8.11.1.2 Mechanical strength of the fuse-carrier

A force of 2,5 N (fuse-carrier DO1 and DO2) and 5 N (in all other cases) is applied gently to the inspection window from the inside, using a steel rod of 6 mm diameter. The inspection window shall neither break nor be displaced during the test.

A test mandrel, having the maximum diameter of the fuse-link d_3 or d_4 as specified in Figure 110 or Figure 111 is inserted five times in the fuse-carrier. After this test, a fuse-link (smooth ceramic surface) with a minimum outside diameter d_3 or d_4 according to Figure 110 or Figure 111 shall be retained in the fuse-carrier when this is turned upside down.

8.11.1.3 Mechanical strength of the fuse-link

The fuse-links shall have adequate mechanical strength and their contacts shall be securely fixed. For compliance they shall be tested as follows.

The fuse-link is placed in the appropriate fuse-carrier complying with Figure 112, 113 or 114, which is screwed into a fuse-base complying with Figure 118, 119 or 120, a gauge-piece complying with Figure 121, 122 or 123 being in position. The gauge-piece has a diameter d_1 equal to the minimum value specified for the relevant rated current.

The torque applied to the fuse-carrier is equal to that specified in Table 115 and the fuse-carrier is then withdrawn. The fuse-carrier is screwed in and withdrawn five times. After this test, the fuse-link shall show no damage within the meaning of this standard. It shall not be possible to remove the fuse-link end caps by hand.

8.11.1.4 Mechanical strength of the fuse

The fuse-carrier fitted with a fuse-link complying with the standards is screwed five times into the fuse-base fitted with the gauge-piece by applying a torque as given in Table 115 and withdrawn five times. After this test, the samples shall show no change impairing their further use.

NOTE The tests specified in 8.11.1.3 and 8.11.1.4 may be performed at the same time.

Table 115 – Test-torque for mechanical strength

Remark: this table was previously Table H in IEC 60269-3-1, Section I

Size	Torque Nm
DO1	1,5
DO2	1,5
DO3	2,5
DII	4,0
DIII	6,5
DIV	10,0

Mechanical strength of screw thread:

For screws, which are operated during the installation of the fuse, including screws of terminals and screws for fixing covers – but not screws for fixing the fuse-base to the supporting surface – the following test is performed.

The screws are tightened and loosened five times in the case of metallic thread and ten times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 116.

For testing terminal screws, a conductor of the largest cross sectional area specified by the manufacturer or in IEC 60269-1 shall be placed in the terminal. The conductor shall be moved after each operation to present a new surface to the terminal screw.

Table 116 – Mechanical strength of screw-thread

Remark: this table was previously Table C in IEC 60269-3, Edition 2

Nominal diameter of thread	Torque Nm
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 10,0	7,5

During the test, no change impairing the further use of the screwed connection shall occur.

8.11.2.4 Resistance to storage at elevated temperature

8.11.2.4.1 Test arrangement

Three fuse-carriers and three fuse-bases shall be placed in a heating chamber at a temperature of $180\text{ °C} \pm 5\text{ °C}$ for a period of 168 h for the test on insulating parts other than ceramics supporting current-carrying parts.

Covers shall be placed in a heating chamber at the following temperature for a period of 168 h: $100\text{ °C} \pm 5\text{ °C}$.

A complete fuse shall be exposed for 1 h to a temperature of $150\text{ °C} \pm 5\text{ °C}$ to meet the requirements for cemented parts, sealing compound and colour markings.

8.11.2.4.2 Test method

After cooling down to room temperature the following shall be tested.

One fuse-carrier and fuse-base shall be exposed to humid atmospheric conditions as described in 8.2.4.2 of IEC 60269-1. Immediately after this treatment, the insulating properties shall be verified at a test voltage of 2,0 kV, according to 8.2.1, 8.2.2 and 8.2.4.1 of IEC 60269-1, with the exception of Table 15.

The other two fuse-carriers and fuse-bases shall be tested as follows.

The fuse-carriers fitted with a fuse-link complying with the standards are screwed five times into the fuse-bases fitted with gauge-pieces by applying a torque as given in Table 111 and withdrawn five times.

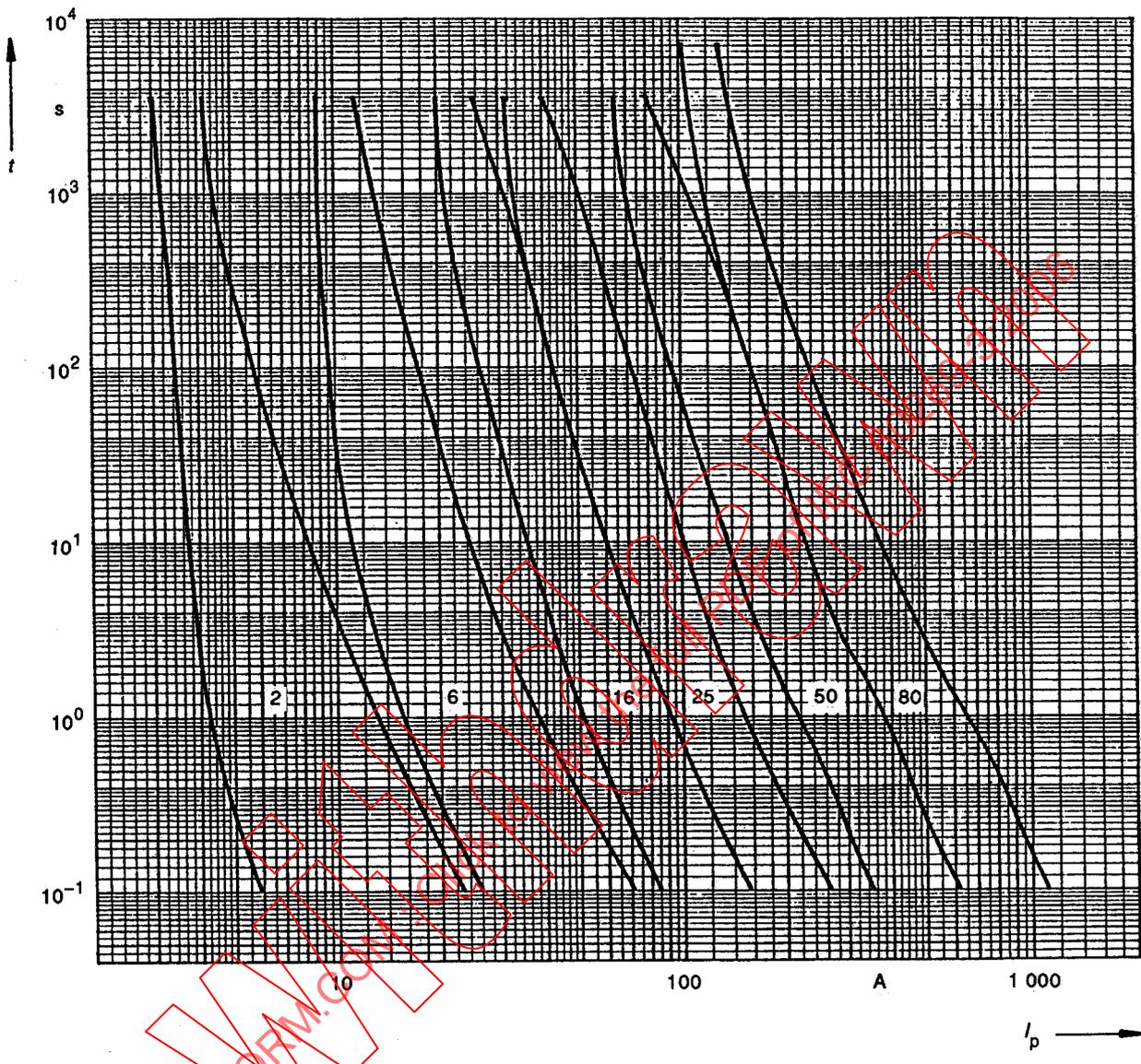
8.11.2.4.3 Acceptability of test results

After this test, the test samples shall show no change impairing their further use. The mechanical strength, especially of the cemented parts, shall be maintained.

The sealing compound shall not have moved to such an extent that live parts are exposed. After this test, the identification colour shall not have changed appreciably.

8.11.2.6 Dimensions and non-interchangeability

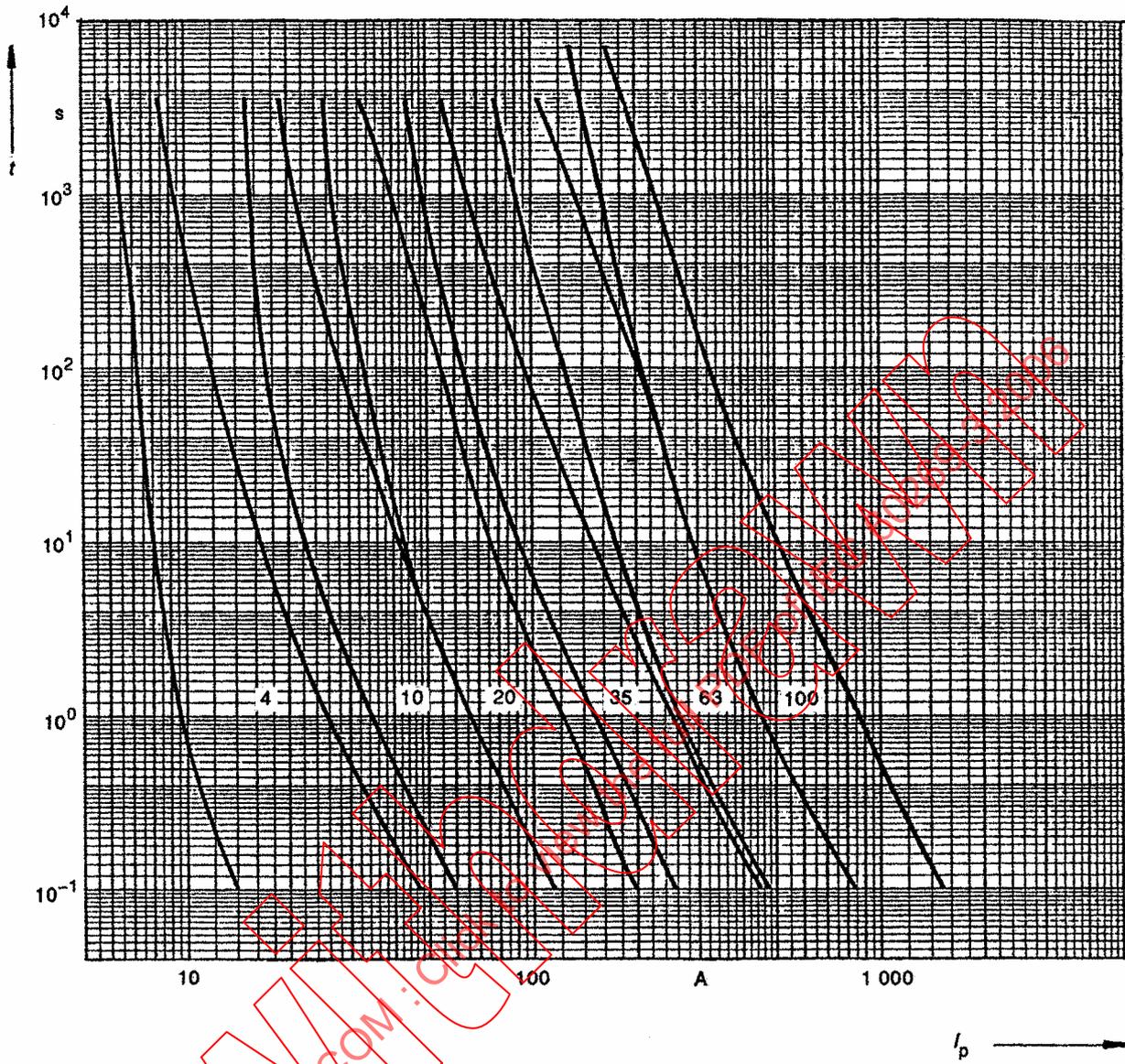
Compliance with 8.1.4 of 60269-1 and 7.1.8. of this standard shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.



IEC 596/01

Figure 101 – Time-current zones for "gG" fuse-links

Remark: this figure was previously Figure 1a in IEC 60269-3-1, Section I



IEC 597/01

Figure 102 – Time-current zones for "gG" fuse-links

Remark: this figure was previously Figure 1b in IEC 60269-3-1, Section I

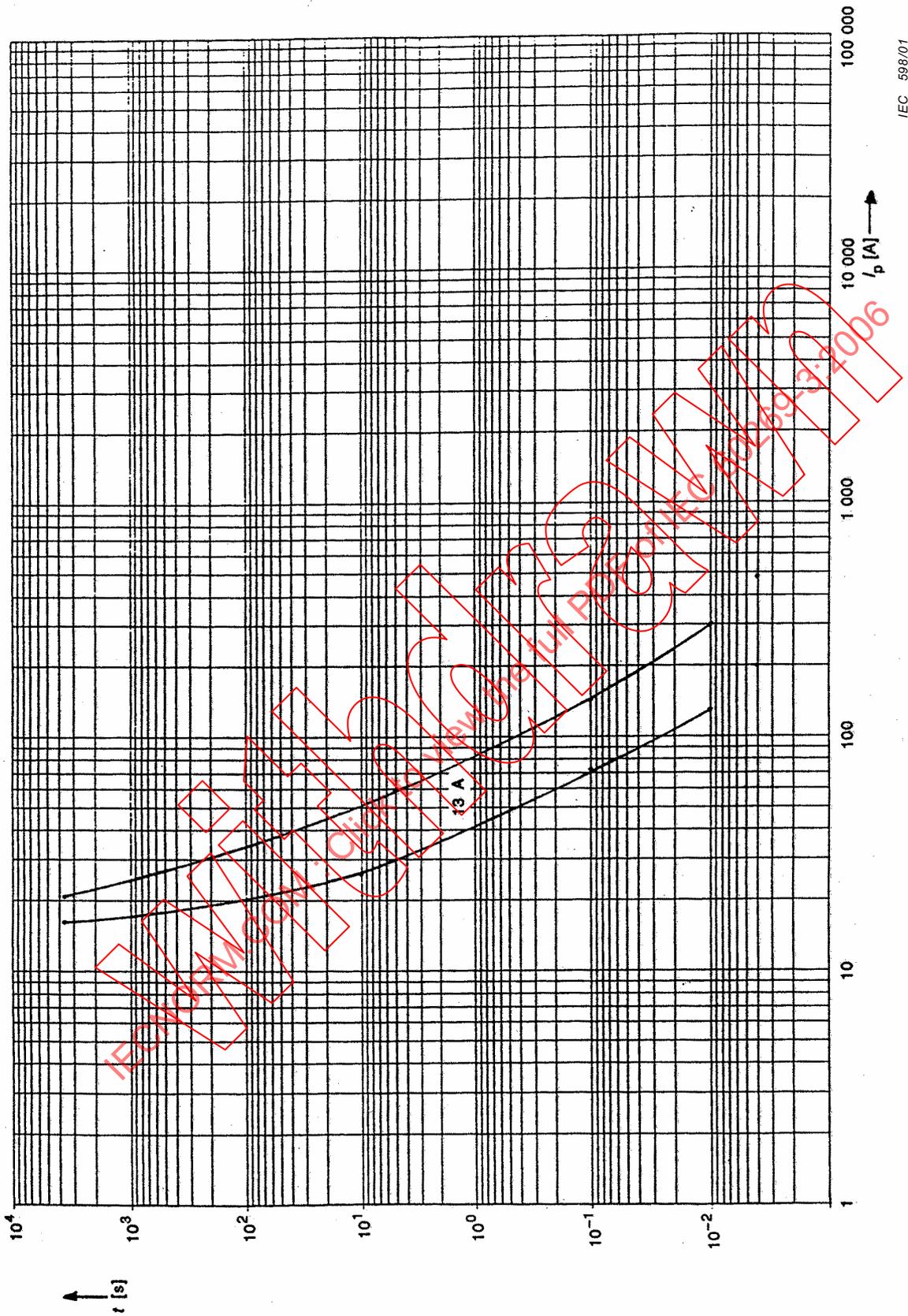
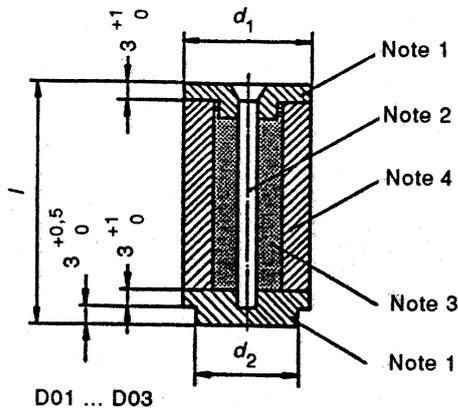


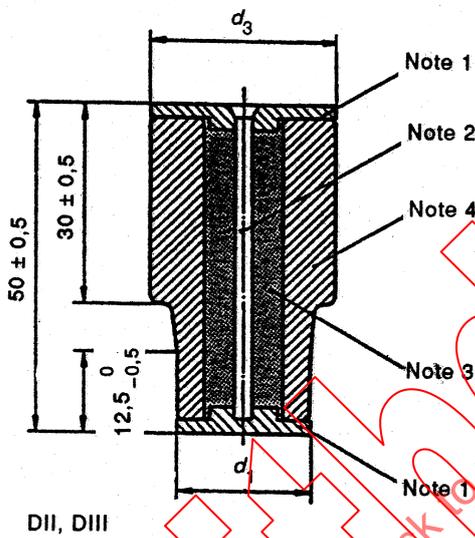
Figure 103 – Time-current zone for "gG" fuse-links 13A

Remark: this figure was previously Figure 1c in IEC 60269-3-1, Section I



Size	$d_1 -0,5^0$	$d_2 -0,5^0$	$l \pm 0,5$
DO1	10,5	6	36
DO2	15	10	36
DO3	22	18	43

Size	$d_1 +0,2 -0,4$	$d_3 -1,5^0$
DII	14	22,5
DIII	20	28

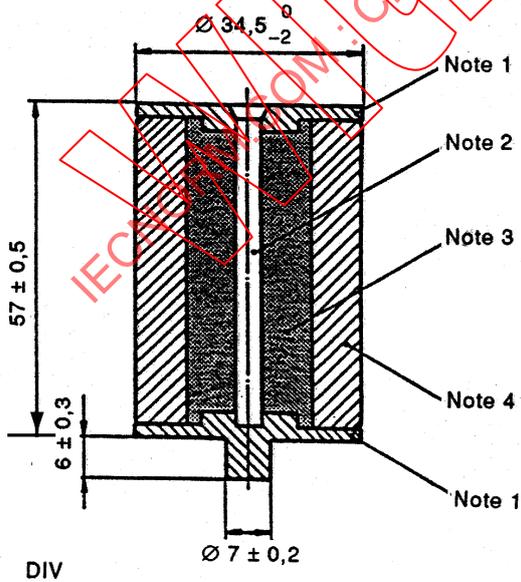


NOTE 1 Contact CuZn, silver plated.

NOTE 2 CuNi 56/44 or an equivalent material with similar values of specific resistance and temperature coefficient

NOTE 3 Quartz sand

NOTE 4 Ceramic body.

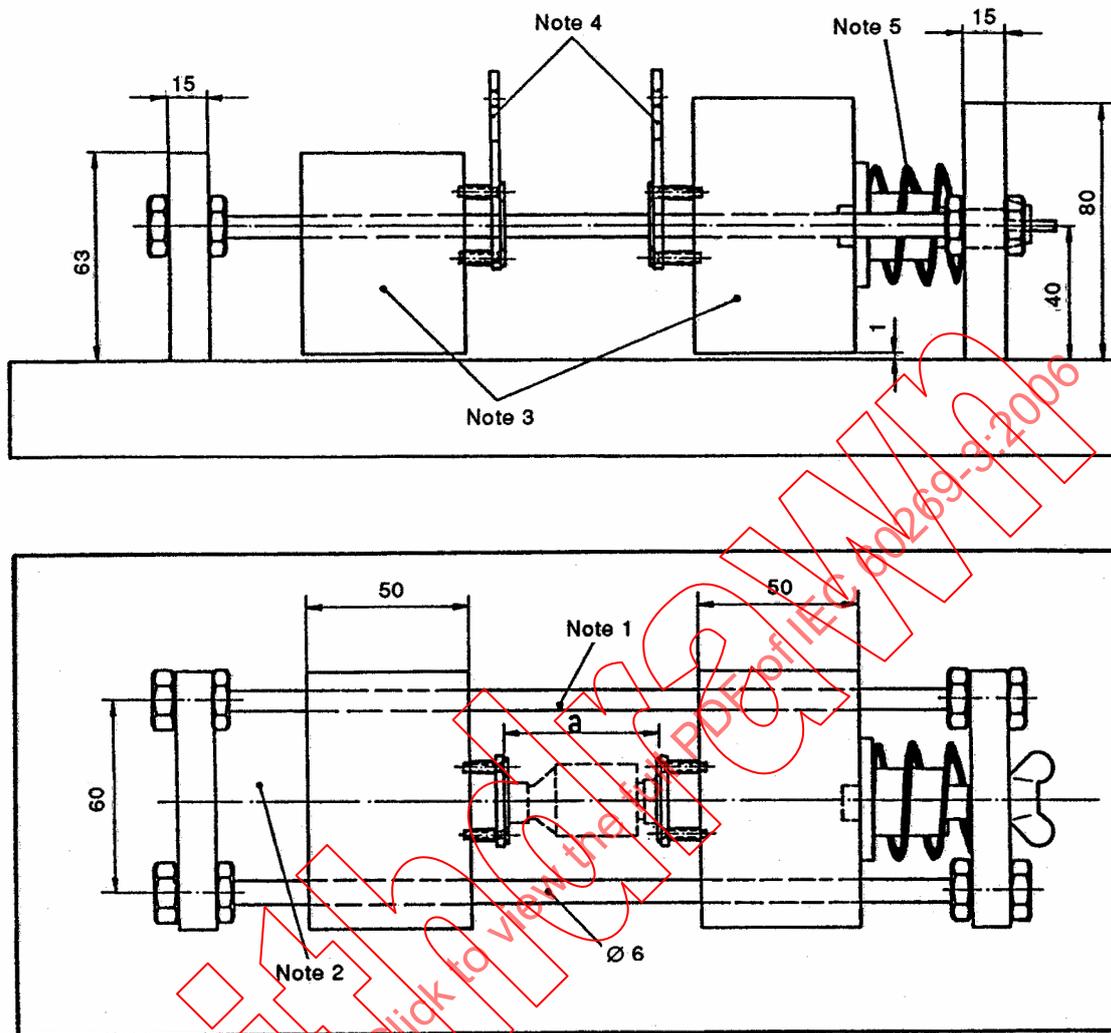


IEC 599/01

Dimensions in millimetres

Figure 104 – Dummy fuse-links according to 8.3 and 8.9.1.1

Remark: this figure was previously Figure 2 in IEC 60269-3-1, Section I



IEC 600/01

Dimensions in millimetres
Dimension a see Figure
106

- NOTE 1 Metallic rod.
NOTE 2 Distance for adjusting of the contact force.
NOTE 3 Insulating material.
NOTE 4 Silver-plated contact pieces.
NOTE 5 Steel spring.

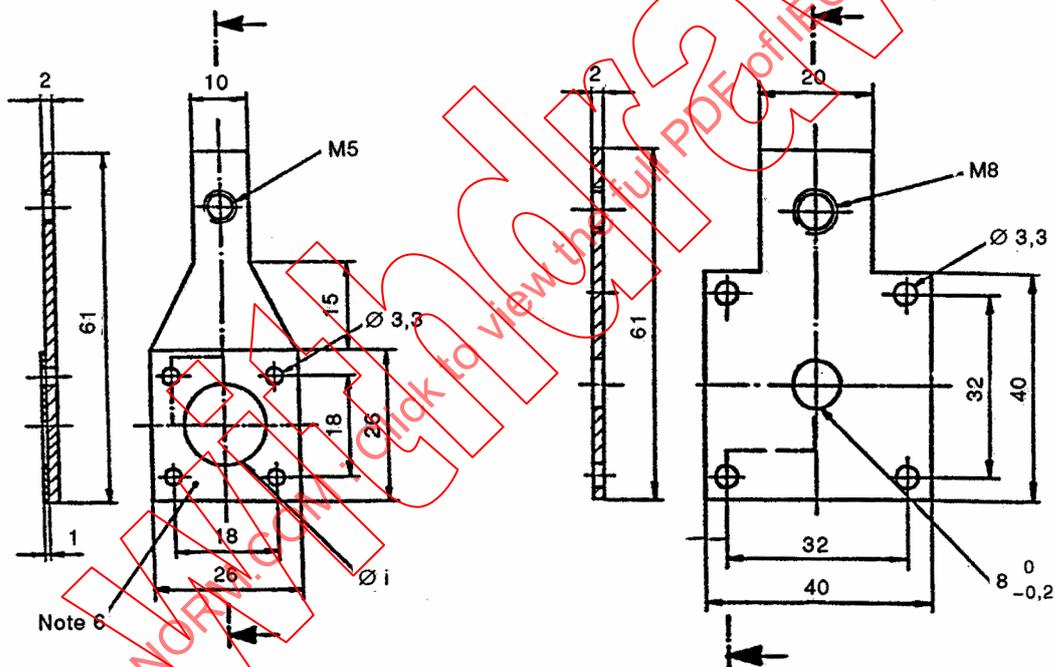
Figure 105 – Test rigs for fuse-links

Remark: this figure was previously Figure 3a in IEC 60269-3-1, Section I

Size	Dimensions		Contact force N
	a	Ø i	
DO1	35 $^{+2}_0$	11,5	40 ± 10 %
DO2	35 $^{+2}_0$	16,0	80 ± 10 %
DO3	42 $^{+2}_0$	23,0	120 ± 10 %
DII	49 $^{+2}_0$	14,5	200 ± 10 %
DIII	49 $^{+2}_0$	20,5	320 ± 10 %
DIV	56 $^{+2,5}_0$	-	550 ± 10 %

Dimensions in millimetres

Silver-plated contact pieces (see Note 4 of Figure 105)



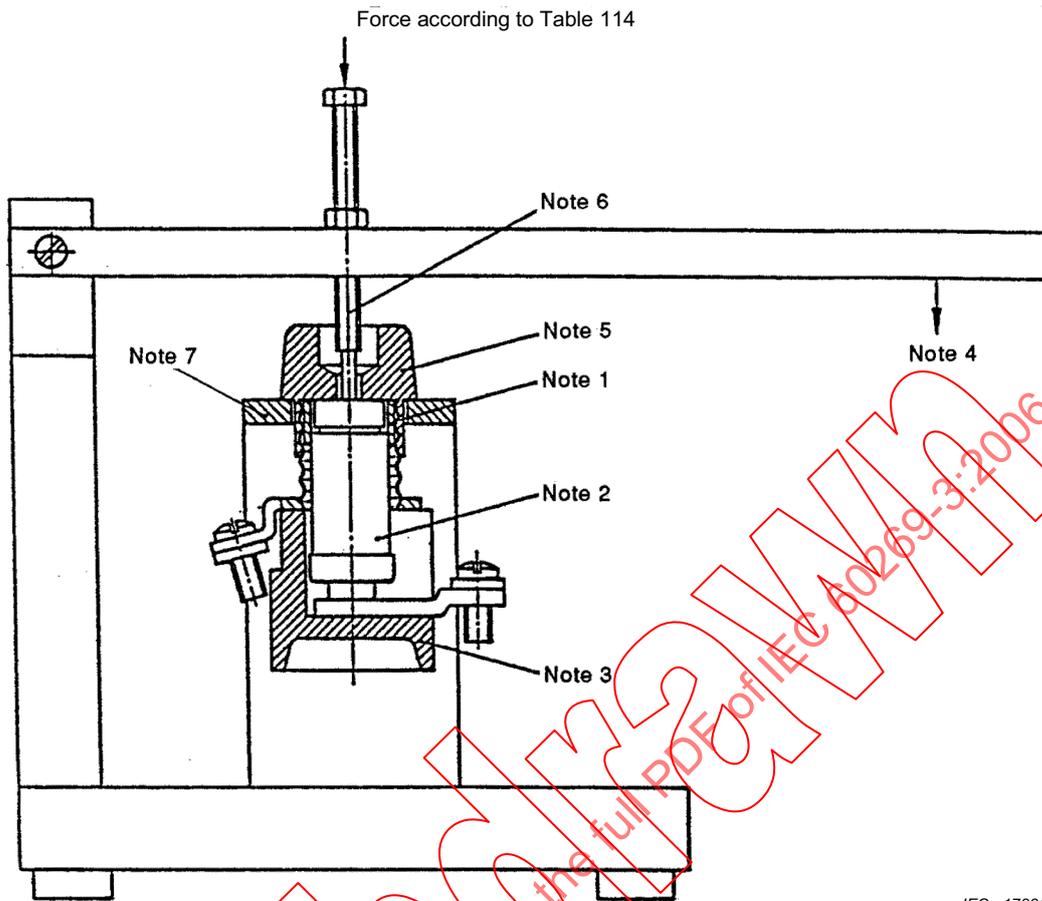
Sizes DO1 to DO3 and DII, DIII

Size DIV

NOTE 6 Centring plate of insulating material.

Figure 106 – Test rigs for fuse-links

Remark: this figure was previously Figure 3b in IEC 60269-3-1, Section I

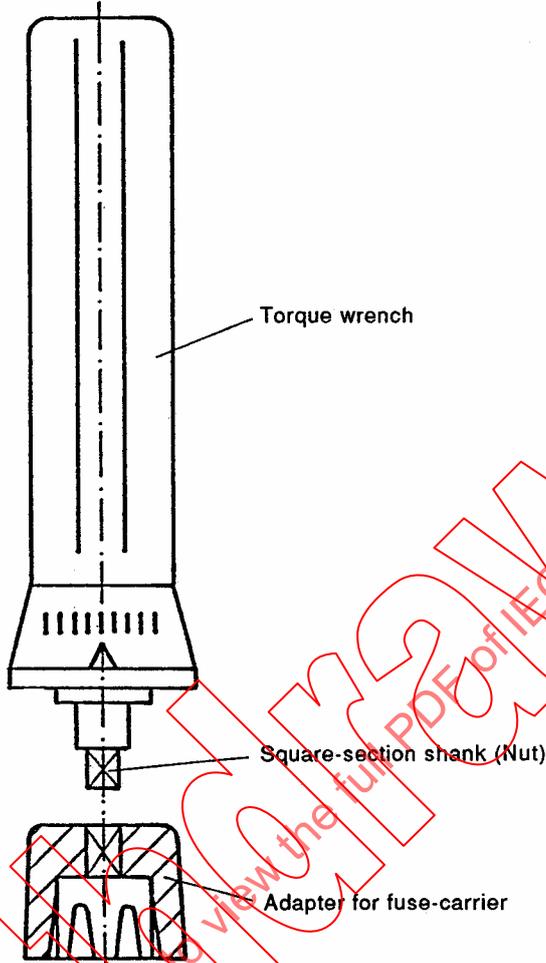


IEC 1783/06

- NOTE 1 Isolation between the end-cap and the screwed shell except at the face.
 NOTE 2 Dummy fuse-link.
 NOTE 3 Fuse-base.
 NOTE 4 Direction of the applied force.
 NOTE 5 Fuse-carrier.
 NOTE 6 Piston.
 NOTE 7 Assembly platform.

Figure 107 – Test arrangement for fuse-bases according to 8.9.1.2

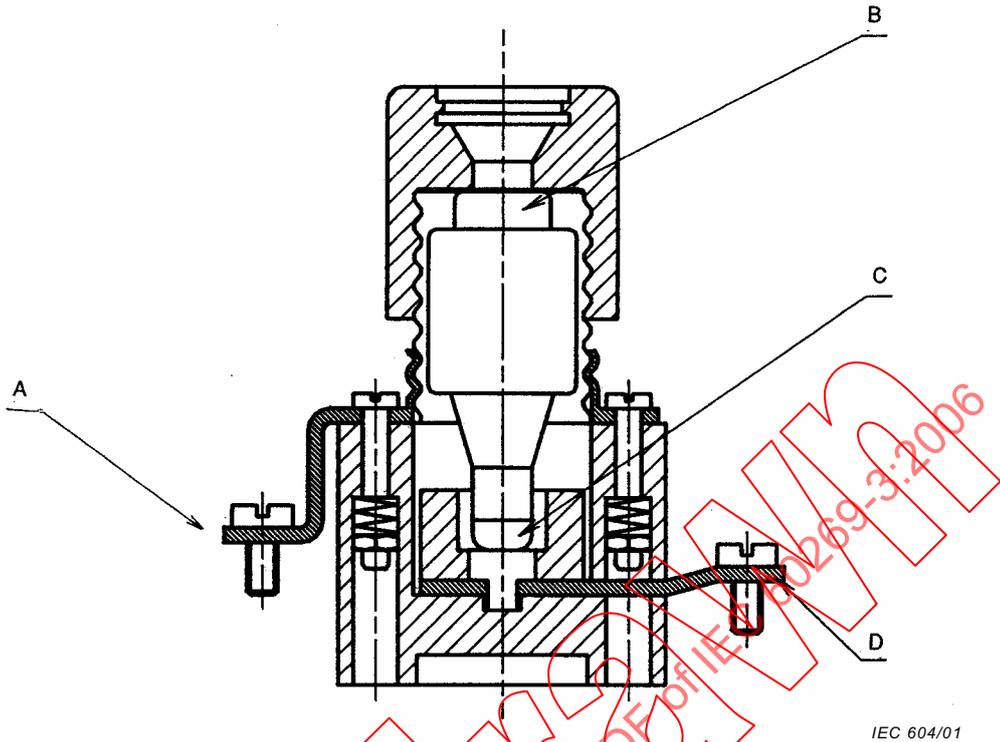
Remark: this figure was previously Figure 4 in IEC 60269-3-1, Section I



IEC 603/01

Figure 108 - Example of a torque wrench according to 8.9.2

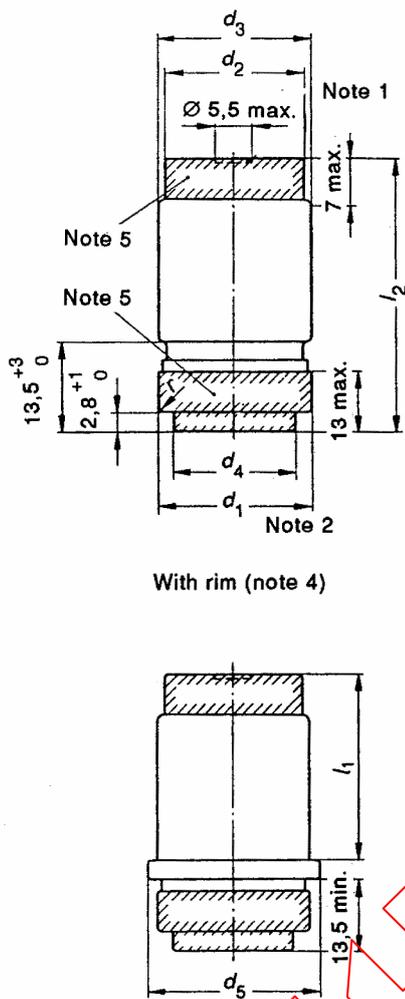
Remark: this figure was previously Figure 5a in IEC 60269-3-1, Section I



IEC 604/01

Figure 109 – Measuring points for the voltage drop (B, C) or the temperature rise (A, D)

Remark: this figure was previously Figure 5b in IEC 60269-3-1, Section I



With rim (note 4)

	I_n A	d_1 (note 2) $\pm 0,3$	d_2 (min.)	d_3	d_4 (max.)	d_5 (note 4)	l_1 (note 4)	$l_2 \pm 1$	r (max.)
DO1	2	7,3							
	4	7,3							
	6	7,3	9,8	$11 \begin{smallmatrix} 0 \\ -0,7 \end{smallmatrix}$	6	-	-	36	1
	10	8,5							
	13	8,5							
	16	9,7							
DO2	20	10,9				16,7 (max.)			
	25	12,1				16,7 (max.)			
	35 (note 3)	13,3				16,7 (max.)			
	50 (note 4)	14,5	13,8	$15,3 \begin{smallmatrix} 0 \\ -1,3 \end{smallmatrix}$	10	$16,7 \begin{smallmatrix} 0 \\ -1,3 \end{smallmatrix}$	18,5	36	1
	63	15,9				16,7 (max.)			
DO3	80 (note 4)	22	20,6	$22,5 \begin{smallmatrix} 0 \\ -1 \end{smallmatrix}$	18	$25,6 \begin{smallmatrix} 0 \\ -2,3 \end{smallmatrix}$	22,5	43	1,6
	100	25				25,6 (max.)			

IEC 605/01

NOTE 1 Diameter of fuse-indicator.

NOTE 2 The maximum value of d_1 shall not be exceeded within a range of 13,5 mm.

NOTE 3 In some countries the rating of 35 A is replaced by 32 A and 40 A.

NOTE 4 Choice of manufacturer, obligatory for 50 A and 80 A. The rim is necessary for the 50 A and 80 A rating to ensure correct insertion. The rim may be used for other ratings in sizes DO2 and DO3.

NOTE 5 Hatched areas specify contact areas.

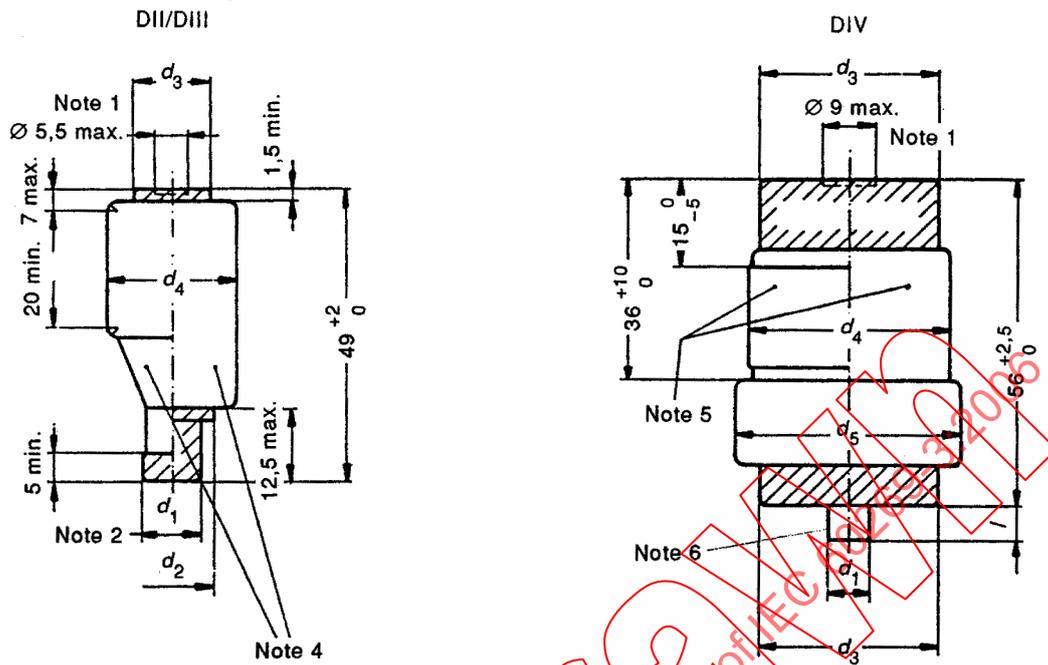
Body of the fuse-link of ceramic material.

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 110 – Fuse-link, D-type. Sizes DO1-DO3

Remark: this figure was previously Figure 6a in IEC 60269-3-1, Section I



IEC 606/01

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

Hatched areas specify contact areas.

Body of the fuse-link of ceramic material.

	I_n	d_1 (note 2)	d_2 (max.)	d_3	d_4	d_5 $\begin{smallmatrix} 0 \\ -2 \end{smallmatrix}$	l $\pm 0,3$
DII	A						
	.2	6					
	.4	6		11 min			
	.6	8	$\begin{smallmatrix} +0,2 \\ -0,4 \end{smallmatrix}$	14,2		$\begin{smallmatrix} 0 \\ -1,5 \end{smallmatrix}$	-
	.10	8					
	.13	10					
	.20	12			13 min		
DIII	25	14					
	35 (3)	16					
	50	18	$\begin{smallmatrix} +0,2 \\ -0,4 \end{smallmatrix}$	20,2	15 min	$\begin{smallmatrix} 0 \\ -2 \end{smallmatrix}$	-
DIV	63	20					
	80 (6)	5	$\pm 0,2$	-	$\begin{smallmatrix} 0 \\ -8 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -2 \end{smallmatrix}$	38,5
	100	7					6

Figure 111 – Fuse-link, D-type. Sizes DII-DIV (figure continued on page 93)

Remark: this figure was previously Figure 6b in IEC 60269-3-1, Section I

I_n A	Colour of fuse-indicator
2	Pink
4	Brown
6	Green
10	Red
13	Black
16	Grey
20	Blue
25	Yellow
35 (note 3)	Black
50	White
63	Copper
80	Silver
100	Red

NOTE 1 Diameter of fuse-indicator.

NOTE 2 The maximum value of d_1 shall not be exceeded within a range of 10 mm for fuse-links DII and DIII measured from the bottom contact.

NOTE 3 In some countries, the rating of 35 A is replaced by 32 A and 40 A.

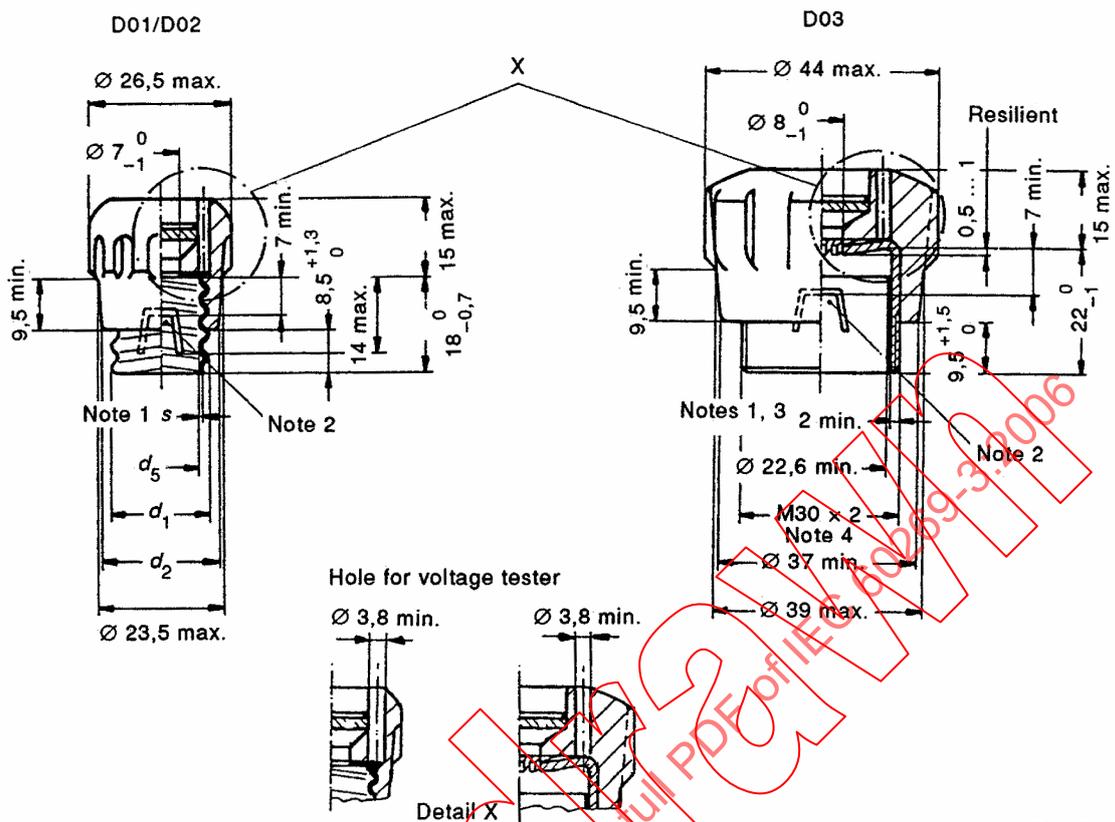
NOTE 4 Alternative shape.

NOTE 5 Optional metal cover.

NOTE 6 The gauge-pin is not mandatory for fuse-links with rated current 80 A.

The use of these colours is mandatory also for sizes D01-D03.

Figure 111 – (concluded)



IEC 607/01

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n A	d_1	d_2 (min.)	d_5 (max.)	s (note 1) (min.)
DO1	16	E14	18	11,1	0,27
DO2	63	E18	22	15,4	0,37

NOTE 1 Mean value

NOTE 2 Retaining clip, other retaining means are allowed.

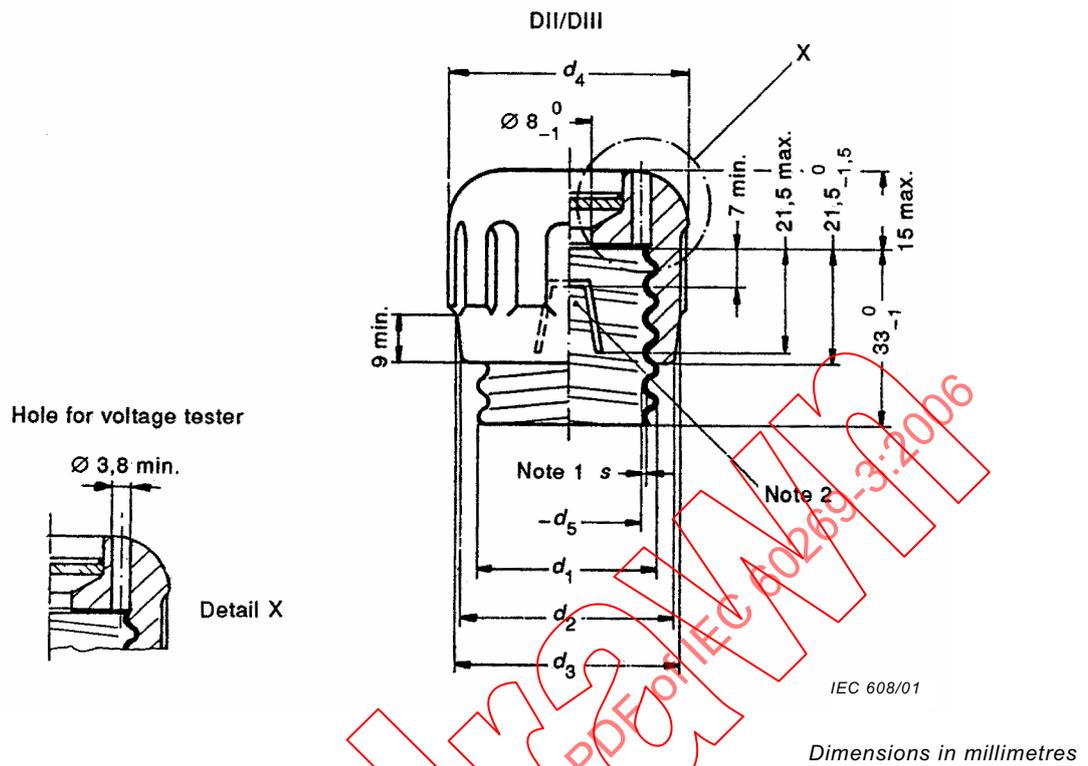
NOTE 3 Tolerance in the first turn of the thread $\begin{matrix} 0 \\ -0,25 \end{matrix}$.

NOTE 4 Thread according to ISO 965-1, class designation 8 g.

NOTE 5 The hole for the voltage tester is optional.

Figure 112 – Fuse-carrier, D-type. Sizes DO1-DO3

Remark: this figure was previously Figure 7a in IEC 60269-3-1, Section I



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n A	d_1	d_2 (min.)	d_3 (max.)	d_4 (max.)	d_5 (min.)	s (note 1) (min.)
DII	25	E27	32	34	38	22,6	0,27
DIII	63	E33	40	43	48	28,1	0,37

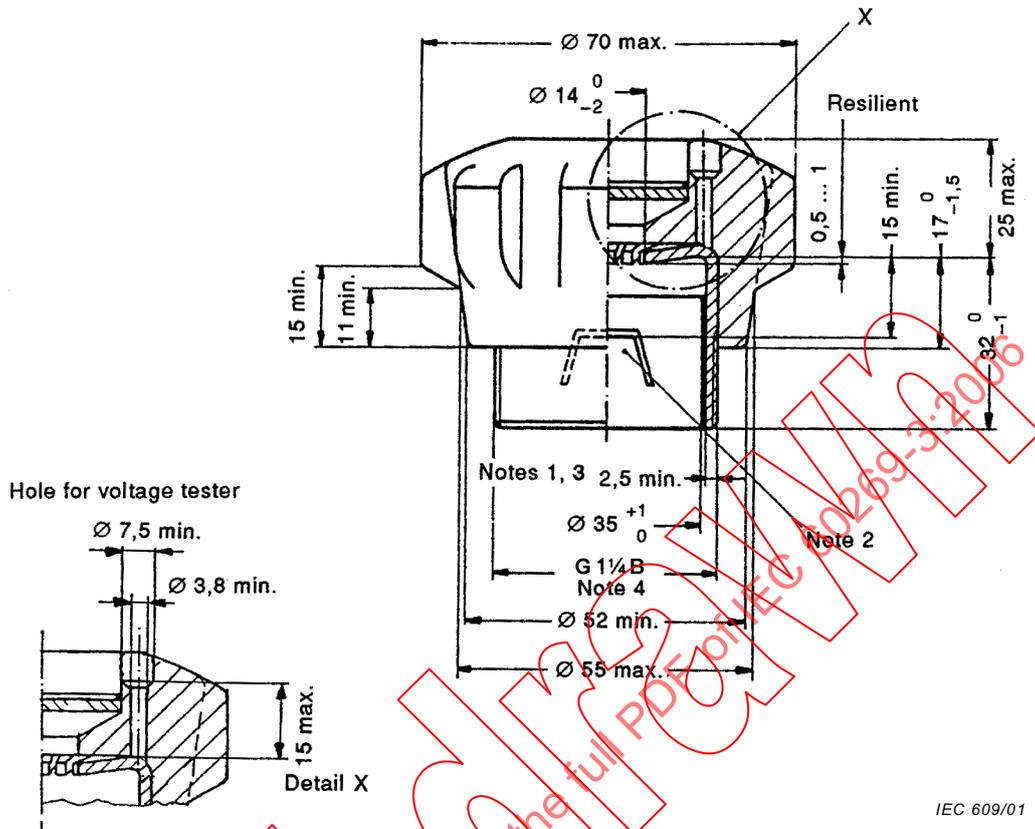
NOTE 1 Mean value.

NOTE 2 Retaining clip, other retaining means are allowed.

NOTE 3 The hole for the voltage tester is optional.

Figure 113 – Fuse-carrier, D-type. Sizes DII-DIII

Remark: this figure was previously Figure 7b in IEC 60269-3-1, Section I



IEC 609/01

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

NOTE 1 Mean value.

NOTE 2 Retaining clip, other retaining means are allowed.

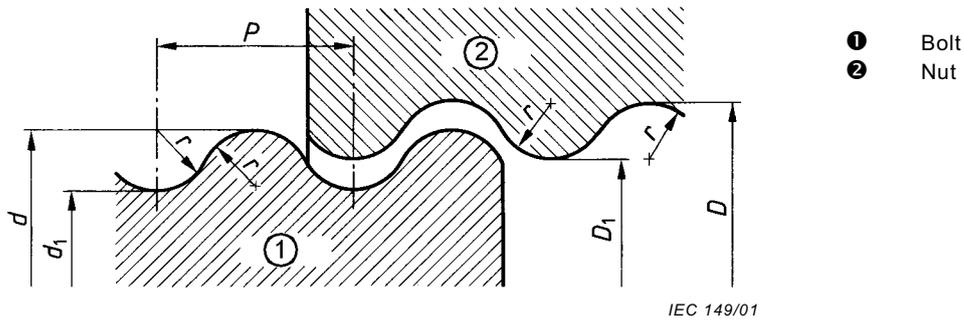
NOTE 3 Tolerance in the first turn of the thread $\begin{matrix} 0 \\ -0,5 \end{matrix}$.

NOTE 4 Thread according to ISO 228-1; limit gauges according to ISO 228-2.

NOTE 5 The hole for the voltage tester is optional.

Figure 114 – Fuse-carrier, D-type. Size DIV

Remark: this figure was previously Figure 7c in IEC 60269-3-1, Section I



IEC 149/01

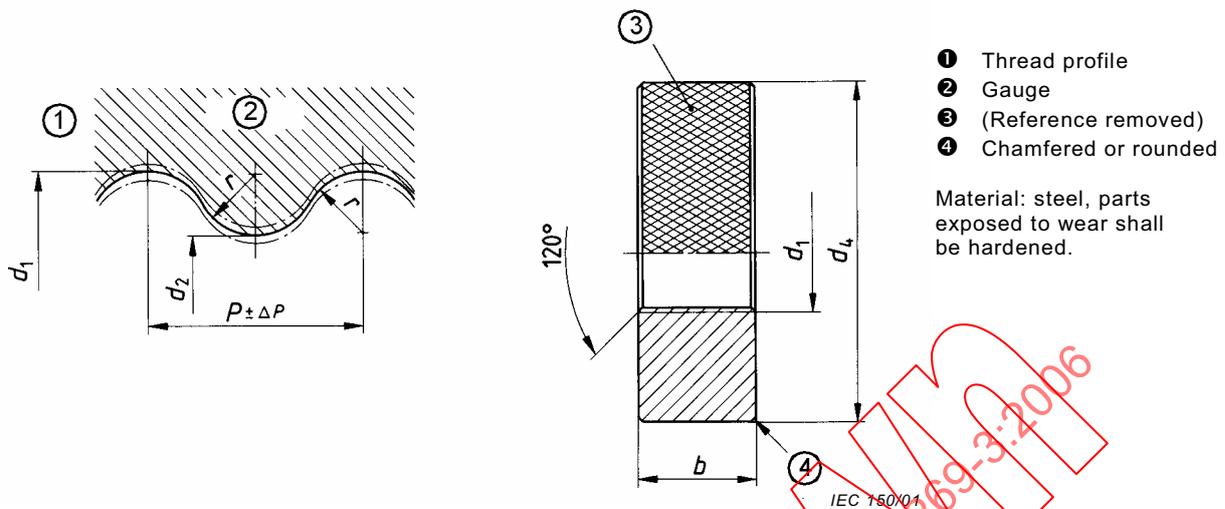
Dimensions in millimetres

Abbreviation	Bolt				Nut			
	External diameter d		Core diameter d_1		External diameter D		Core diameter D_1	
	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.
E 14	13,89	13,7	12,29	12,1	13,97	14,16	12,37	12,56
E 18	18,5	18,25	16,8	16,55	18,6	18,85	16,9	17,15
E 27	26,45	26,15	24,26	23,96	26,55	26,85	24,36	24,66
E 33	33,05	32,65	30,45	30,05	33,15	33,55	30,55	30,95

Abbreviation	Threads per 25,4 mm z	Pitch P	Rounding r
E 14	9	2,822	0,822
E 18	$\approx 8,5$	3	0,875
E 27	7	3,629	1,025
E 33	6	4,233	1,187

Figure 115 – Edison thread for D-type fuses; limit dimensions

Remark: this figure was previously Figure 7d in IEC 60269-3-1, Section I



Dimensions in millimetres

Ring gauge	<i>b</i>	<i>d</i> ₁ ^a	<i>d</i> ₂ ^b	<i>d</i> ₄	<i>P</i>	<i>r</i>	Torques <i>M</i> Nm
E 14-D	16	13,89	12,29	38	2,822	0,822	1
E 18-D	20	18,5	16,8	45	3	0,875	1
E 27-D	24	26,45	24,26	63	3,629	1,025	1
E 33-D	32	33,05	30,45	71	4,233	1,187	1,5

^a Maximum value of the external diameter of the bolt thread according to Figure 115.
^b Maximum value of the core diameter of the bolt thread according to Figure 115.

Ring gauge	Manufacturing tolerance for <i>d</i> ₁ and <i>d</i> ₂	Permissible wear for <i>d</i> ₁ and <i>d</i> ₂	Tolerance for the pitch <i>T</i> _{<i>p</i>} ^c
E 14-D	0 -0,025	+0,02 0	±0,01
E 18-D	0 -0,025	+0,02 0	±0,01
E 27-D	0 -0,03	+0,03 0	±0,01
E 33-D	0 -0,03	+0,04 0	±0,01

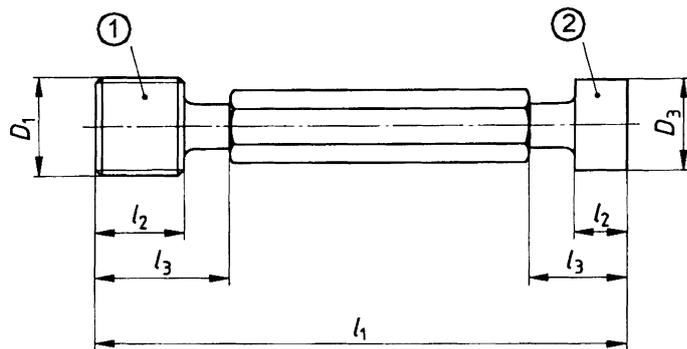
^c The tolerance for the pitch is valid for any number of threads within the length of thread of the ring gauge.

It shall be possible to screw the go gauge on the whole length of the thread with the maximum torque *M*.

The not go gauge shall not slip on the thread under its own weight.

Figure 116 – Gauges for Edison thread for D-type fuses for screwed shells of fuse-carrier go ring gauges

Remark: this figure was previously Figure 7e in IEC 60269-3-1, Section I



- ① Thread plug gauge go
② Thread plug gauge not-go

For details, see the drawing on the next page.
Material: steel, parts exposed to wear shall be hardened.

IEC 151/01

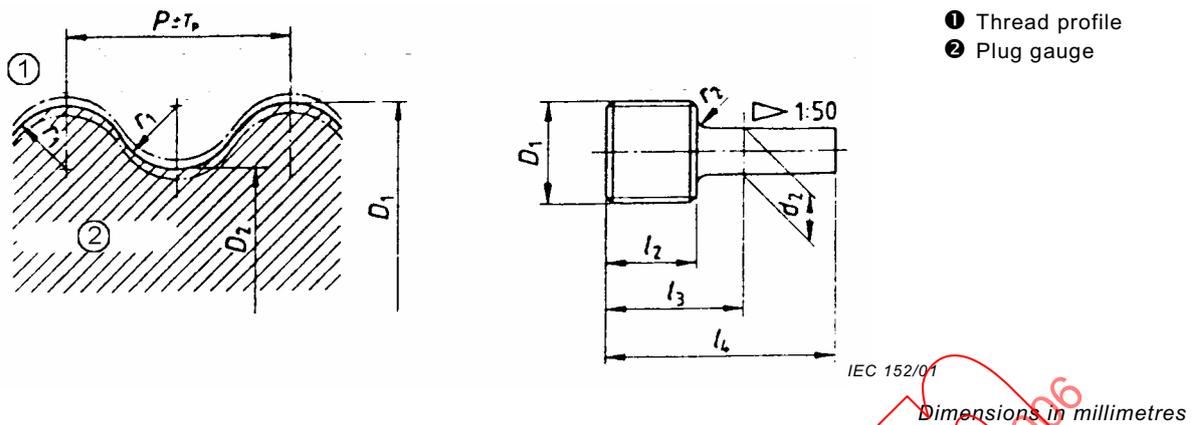
Dimensions in millimetres

Plug gauge	D_1^a	D_3^b	l_1^c	l_2		l_3	
				Thread go gauge $\begin{matrix} 0 \\ -0,3 \end{matrix}$	Not go gauge $\begin{matrix} 0 \\ -0,3 \end{matrix}$	Thread go gauge	Not go gauge
E 14-D-Gd	13,97	12,56	103	16	8	24	16
E 18-D-Gd	18,6	17,15	120	20	10	30	20
E 27-D-Gd	26,55	24,66	142	24	14	36	26
E 33-D-Gd	33,15	30,95	167	32	15	47	30

^a See the following table.
^b Maximum value of the core diameter of the nut thread according to Figure 115.
^c The total length l_1 is an approximate dimension.

Figure 117 – Gauges for Edison thread, D-type fuses, go and not-go plug gauges for screwed shells of fuse-bases (figure continued on page 107)

Remark: this figure was previously Figure 7f in IEC 60269-3-1, Section I



Go plug gauge	D_1^a	D_2^b	d_2 $\pm 0,01$	l_2 0 $-0,3$	l_3 min.	l_4	P	r_1	r_2
E 14-D-Gk	13,97	12,37	7	16	24	44	2,822	0,822	2
E 18-D-Gk	18,6	16,9	12	20	30	52	3	0,875	2,5
E 27-D-Gk	26,55	24,36	12	24	36	60	3,629	1,025	2,5
E 33-D-Gk	33,15	30,55	16	32	47	72	4,233	1,187	4

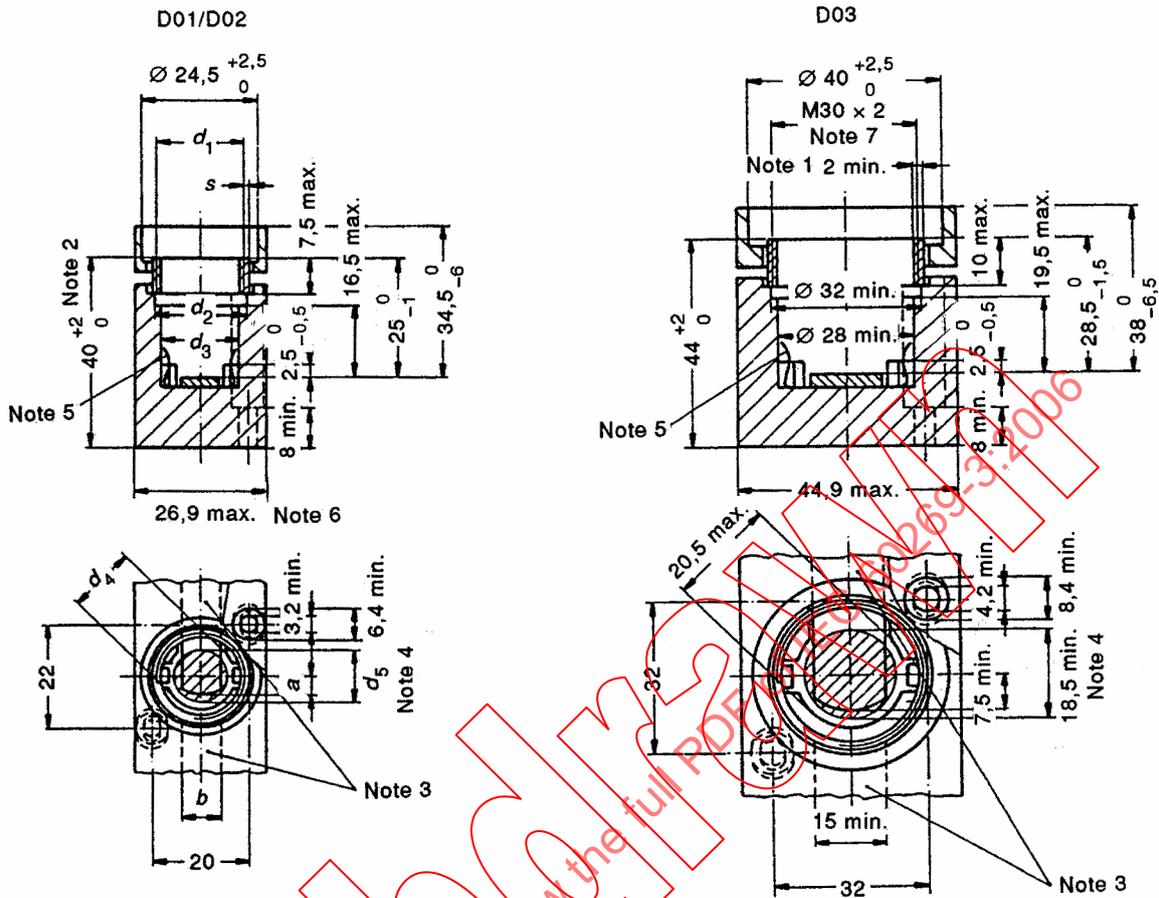
^a Lower limit of the external diameter of the nut thread according to Figure 115.
^b Lower limit of the core diameter of the nut thread according to Figure 115.

Go plug gauge	Manufacturing tolerance for D_1 and D_2	Permissible wear for D_1 and D_2	Tolerance for the pitch T_p^c	Torque M Nm
E 14-D-Gk	+0,025 0	0 -0,02	$\pm 0,01$	1
E 18-D-Gk	+0,025 0	0 -0,02	$\pm 0,01$	1
E 27-D-Gk	+0,03 0	0 -0,03	$\pm 0,01$	1
E 33-D-Gk	+0,03 0	0 -0,04	$\pm 0,01$	1,5

^c The tolerance for the pitch T_p is valid for any number of the thread being within the length of thread.

It shall be possible to screw the go gauge home at least with the maximum torque M . The not-go gauge shall not engage under its own weight.

Figure 117 – (concluded)



IEC 610/01

	I_n	a (min.)	b (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4	d_5 (min.)	s (min.)		Q (note 3) (min.) (mm ²)	
										Tolerance (note 1)		
DO1	16	2,5	5	E14	15	13	9,7 max.	6,5	0,3	-0,05	10	
DO2	63	4	6	E18	19,5	17	13,7 max.	10,5	0,65	-0,15	30	
D03	100	See sketch									-0,25	60

NOTE 1 Tolerance in first turn of the thread.

NOTE 2 Preferred value – for fuse-bases for rail-mounting, this value refers to the top edge of the mounting rail.

NOTE 3 Cross-sectional area of the connecting strips at least Q mm². The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy containing at least 62 % copper. Connecting strips made of pure copper or other materials with better conductivity than that of the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece. A conductive connection between the grip and live parts is not allowed.

NOTE 6 For multiple fuse-bases, the multiple value is relevant.

NOTE 7 Thread according to ISO 965-1, class designation 7 H.

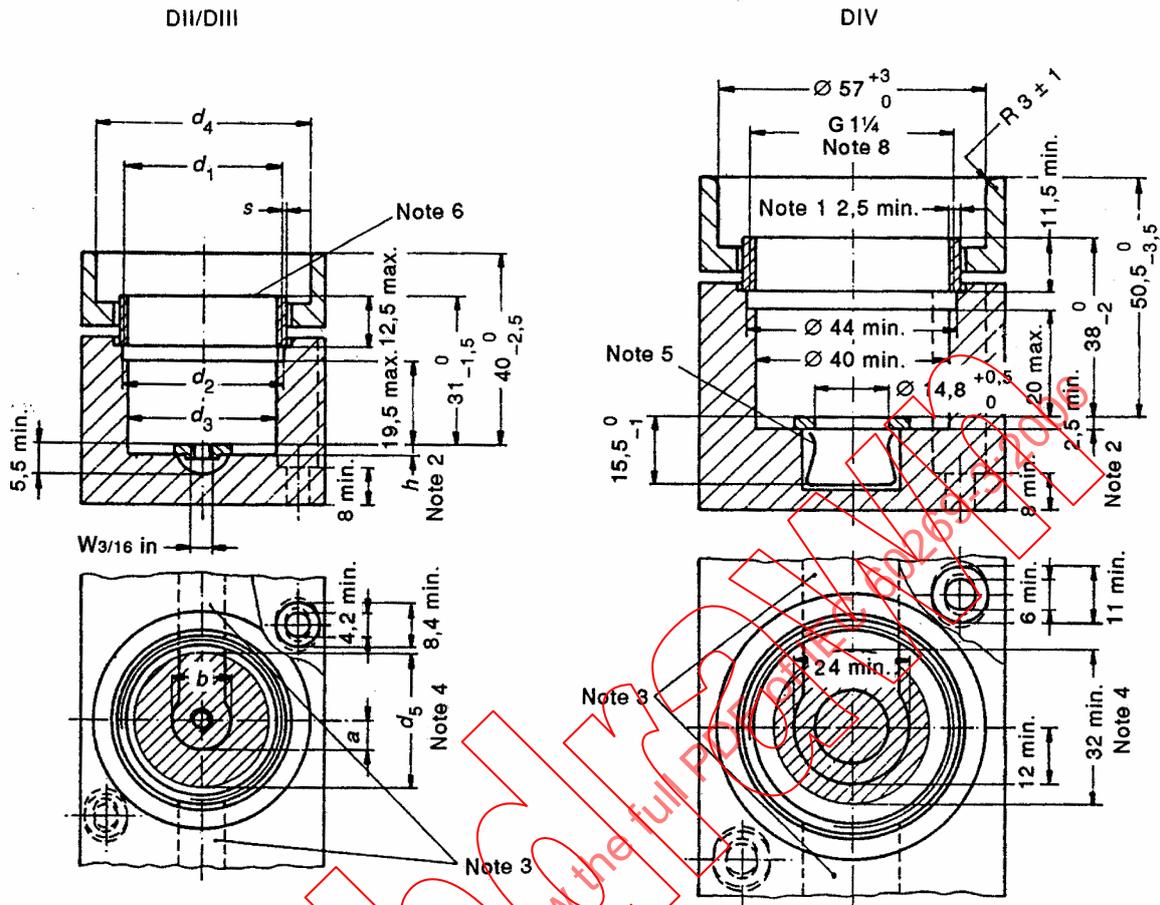
Insulating parts of ceramic or other sufficiently heat resistant material.

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 118 – Fuse-base, D-type. Sizes DO1-DO3

Remark: this figure was previously Figure 8a in IEC 60269-3-1, Section I



IEC 611/01

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n	a (min.)	b (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4 (note 7)	d_5 (min.)	h (note 2) (min.)	s (min.)		Q (note 3) (min.) (mm ²)
											Tolerance (note 1)	
DII	25	5	10	E27	27	25,5	35^{+2}_0	24,5	2	0,5	-0,1	15
DIII	63	6	12	E33	33,5	31,5	$45^{+2,5}_0$	30,5	2,5	0,65	-0,15	30
DIV	100	See sketch									-0,5	60

Figure 119 – Fuse-base, D-type. Sizes DII-DIV
(figure continued on page 113)

Remark: this figure was previously Figure 8b in IEC 60269-3-1, Section I

NOTE 1 Tolerance in first turn of the thread.

NOTE 2 Only the thickness of the bottom of the connecting strip, minimum effective length of thread in connecting strip: 2,2 mm (DII) and 3,2 mm (DIII) for W3/16 in.

NOTE 3 Cross-sectional area of the connecting strip at least $Q \text{ mm}^2$. The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy, containing at least 62 % copper. Connecting strips, made of pure copper or other materials with improved electrical and thermal conductivity than the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece.

NOTE 6 Effective thread length at least 7 mm from the top of the screwed shell.

NOTE 7 When fuse-bases of size DIII are used in assemblies (for example, consumer units) the tolerance of the diameter d_4 of the corresponding protection covers may be reduced to $45_{-1,5}^0$.

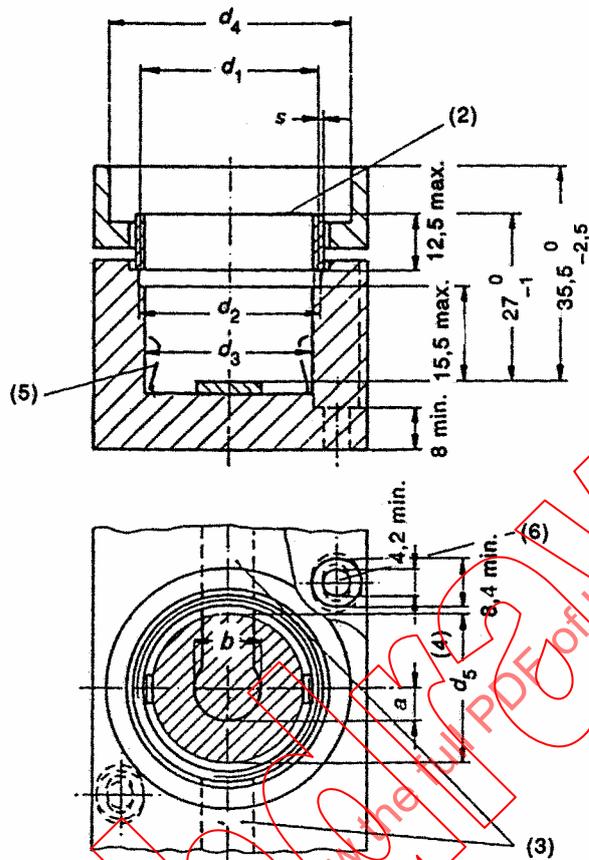
NOTE 8 Thread according to ISO 228-1; limit gauges according to ISO 228-2.

Figure 119 – (concluded)

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Without a watermark

The sketches are not intended to govern design except as regards the dimensions shown.



IEC 612/01

Dimensions in millimetres

	I_n A	a (min.)	b (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4 (note 7)	d_5 (min.)	h (note 2) (min.)	s (min.)		Q (note 3) (mm ²) (min.)
											Tolerance (note 1)	
DII	25	5	10	E27	27	25,5	35^{+2}_0	24,5	2	0,5	-0,1	15
DIII	63	6	12	E33	33,5	31,5	$45^{+2,5}_0$ (7)	30,5	2,5	0,65	-0,15	30

Insulating parts of ceramic or other sufficiently heat-resistant material.

Current-carrying parts of copper or copper alloy.

Figure 120 – Fuse-base, D-type for push-in gauge rings. Size DII-DIII
(figure continued on page 117)

Remark: this figure was previously Figure 8c in IEC 60269-3-1, Section I

NOTE 1 Tolerance in first turn of the thread: $\begin{matrix} 0 \\ -0,1 \end{matrix}$ (E27)
 $\begin{matrix} 0 \\ -0,15 \end{matrix}$ (E33).

NOTE 2 Effective thread length at least 7 mm from the top of the screwed shell.

NOTE 3 Cross-sectional area of the connecting strips: at least $Q \text{ mm}^2$. The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy, containing at least 62 % copper. Connecting strips, made of pure copper or other material with improved electrical and thermal conductivity than the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area, no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece.

NOTE 6 Alternatively closed or open, oval holes permitted.

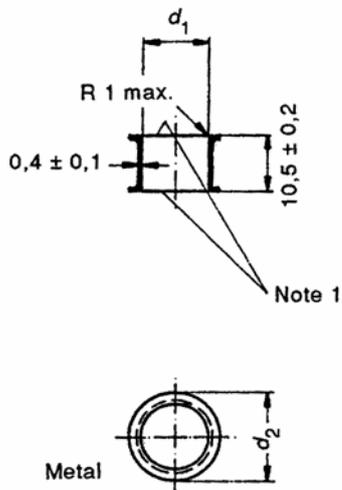
NOTE 7 When fuse-bases size DIII are used in assemblies (for example, consumer units), the tolerance of the diameter d_4 of corresponding protection covers may be reduced to $45 \begin{matrix} 0 \\ -1,5 \end{matrix} \text{ mm}$.

Figure 120 – (concluded)

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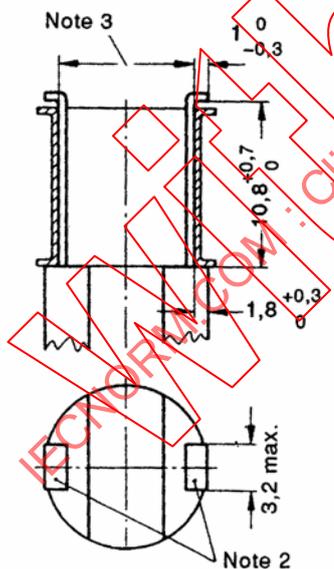
Withdrawing

Gauge-piece D01/D02/D03



	I_n A	d_1 $\pm 0,1$	d_2 $\pm 0,1$
DO1	2	7,9	12
	4	7,9	
	6	7,9	
	10	9,1	
	13	9,1	
	16	(note 4)	
DO2	20	11,5	16,6
	25	12,7	
	35	13,9	
	50	15,1	
	63	(note 4)	
DO3	80	23	27
	100	(note 4)	

Working head of hand-key



NOTE 1 Coloured according to Figure 111 (table).
 NOTE 2 Grip of the working head.
 NOTE 3 Resilient between 5 mm and 24 mm.
 NOTE 4 Gauge-pieces do not apply to the maximum rating.

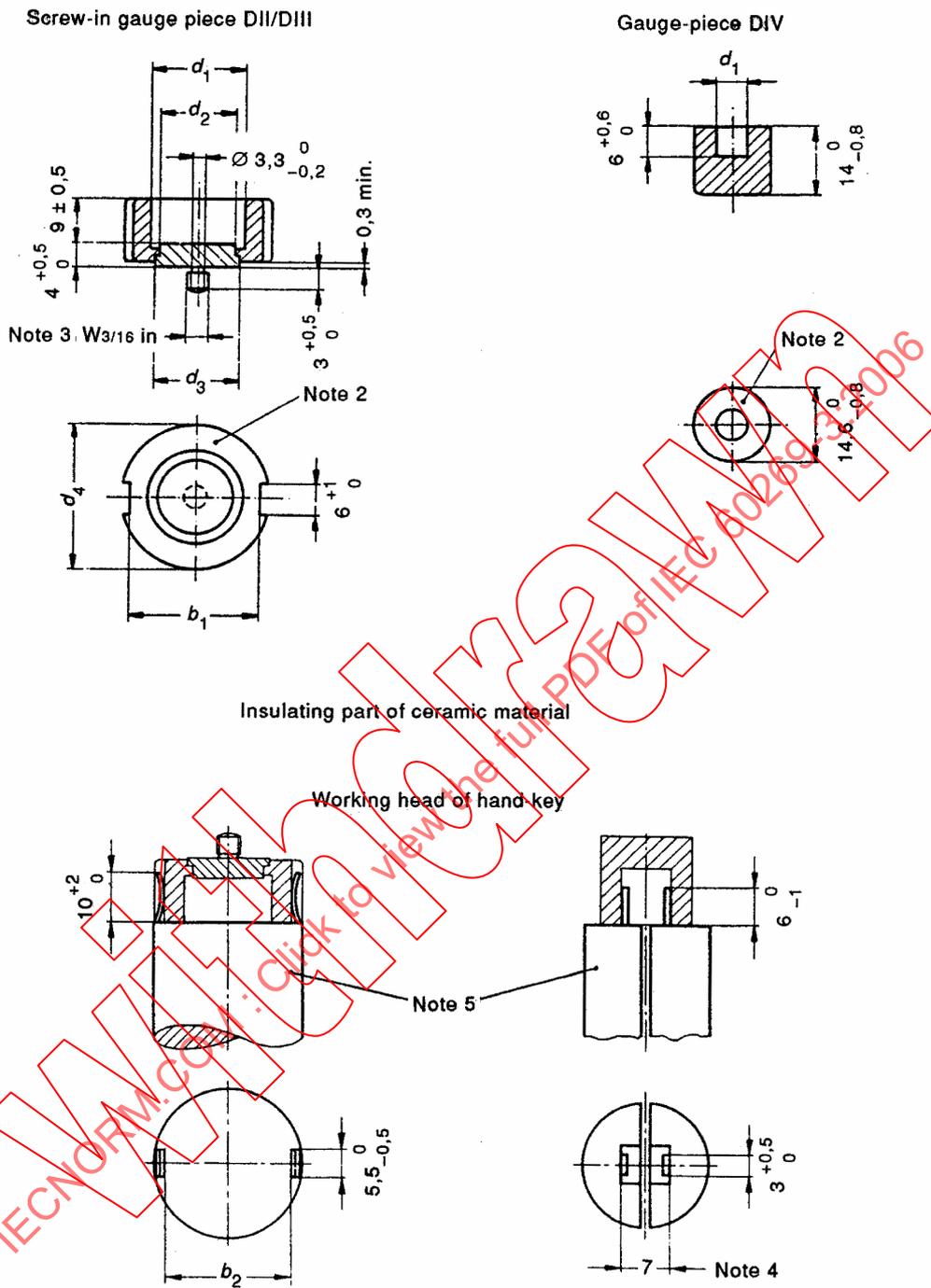
IEC 613/01

Dimensions in millimetres

The sketches are not intended to govern design except as regards the dimensions shown.

Figure 121 – Gauge-piece and hand-key, D-type. Sizes D01-D03

Remark: this figure was previously Figure 9a in IEC 60269-3-1, Section I



IEC 614/01

Dimensions in millimetres

The sketches are not intended to govern design except as regards the dimensions shown.

Figure 122 – Gauge-piece and hand-key, D-type. Sizes DII-DIV
(figure continued on page 123)

Remark: this figure was previously Figure 9b in IEC 60269-3-1, Section I

	I_n A	d_1 +0,8 0	d_2 (min.)	d_3 (min.)	d_4 0 -1,5	b_1 (min.) 0 -1,5	b_2 (max.)
DII	2	6,5	4,5	6,5	24	20	19 (note 6)
	4						
	6						
	10	8,5 } 0 +0,8	6,5				
	13						
	16		8,5	8,5			
	20		9,5	9,5			
	25		14,5				
DIII	35 (note 1)	16,5 } 0 +0,8	15	15	30	26	25 (note 7)
	50						
	63						
DIV	80	6 } ±0,5	-	-	-	-	-
	100		8	-	-	-	-

NOTE 1 In some countries, the rating of 35 A is replaced by 32 A and 40 A.

NOTE 2 Coloured according to Figure 111 (table).

NOTE 3 Effective thread length at least 2,5 mm.

NOTE 4 Resilient between 5 mm and 9 mm.

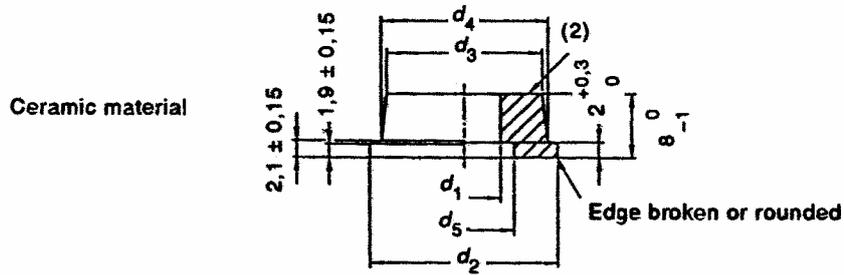
NOTE 5 Insulating material.

NOTE 6 Resilient between 18 mm and 20,5 mm.

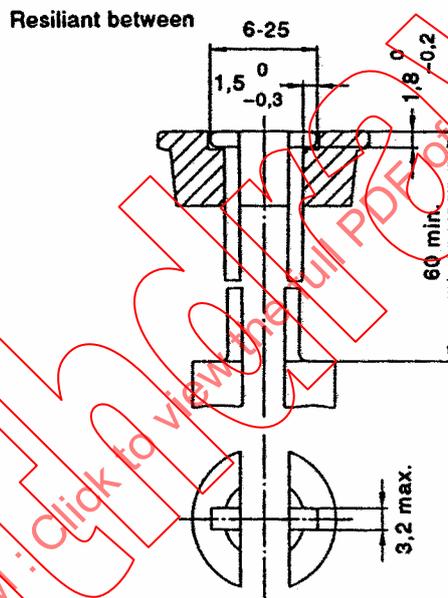
NOTE 7 Resilient between 24 mm and 26,5 mm.

Figure 122 – (concluded)

Gauge-piece DII/DIII



Working head of hand-key



IEC 615/01

Dimensions in millimetres

The sketches are not intended to govern design except as regards the dimensions shown

Figure 123 – Gauge-piece and hand-key, D-type push-in gauge rings. Size DII-DIII
(figure continued on page 127)

Remark: this figure was previously Figure 9c in IEC 60269-3-1, Section I

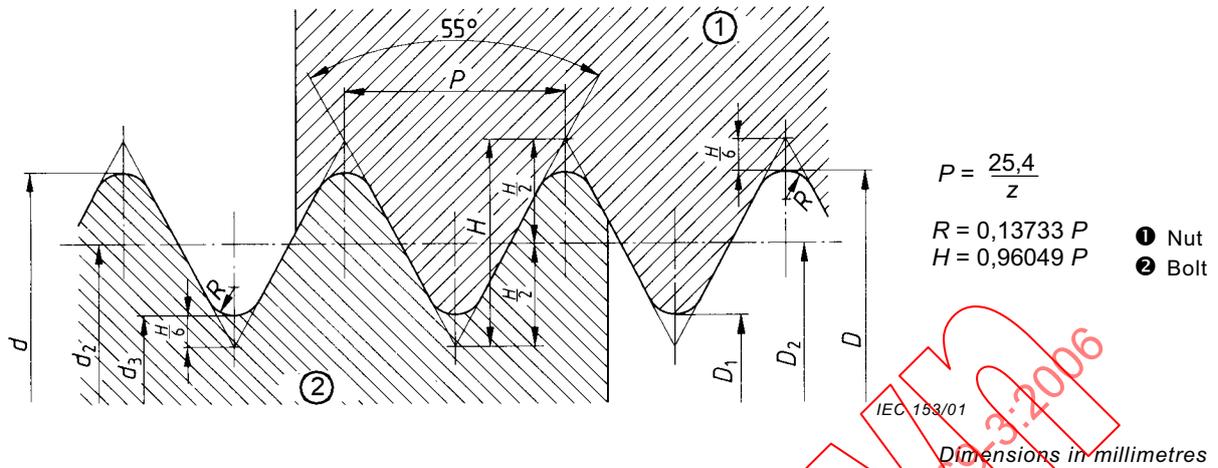
	I_n A	d_1 $+0,8$ 0	d_2 $\pm 0,5$	d_3 $\pm 0,5$	d_4 $\pm 0,5$	d_5 (min.)	Colour of the front surface
DII	2	6,5	22,5	18,5	20,5	10	Pink
	4						Brown
	6						Green
	10	8,5				12	Red
	16	10,5				14	Grey
	20	12,5				15,5	Blue
	25	(see Note 3)					
DIII	2	6,5	28,5	24,5	26,5	10	Pink
	4						Brown
	6						Green
	10	8,5				12	Red
	16	10,5				14	Grey
	20	12,5				16	Blue
	25	14,5				18	Yellow
	35 (see Note 1)	16,5				20	Black
	50	18,5				21,5	White
	63	(see Note 3)					

NOTE 1 In some countries the rating of 35 A is replaced by 32 A and 40 A.

NOTE 2 Coloured surface.

NOTE 3 Gauge-pieces do not apply to the maximum ratings.

Figure 123 –(concluded)



Nominal sizes

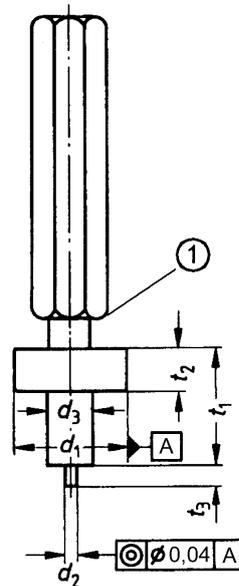
Abbreviation	Full thread $d = D$	Threads per 25,4 mm z	Pitch P	Thread-pitch diameter $d_2 = D_2$	Core diameter $d_3 = D_1$	Core cross- section mm ²
W ³ / ₁₆	4,762	24	1,058	4,084	3,406	9,1

Thread limits

Abbreviation	Bolt thread						Nut thread					
	External diameter d		Thread-pitch diameter d_2		Core diameter d_3		External diameter D		Thread-pitch diameter D_2		Core diameter D_1	
	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.	Min.	
W ³ / ₁₆	4,732	4,593	4,054	3,965	3,376	3,183	4,762	4,216	4,084	3,744	3,406	

Figure 124 – Whitworth thread W 3/16 for screw-in gauge rings and corresponding fuse-bases of sizes DII and DIII

Remark: this figure was previously Figure 9d in IEC 60269-3-1, Section I

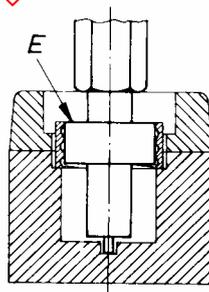


① Slightly rounded edge

IEC 154/01

Dimensions in millimetres

Size	d_1		d_2		d_3	t_1		t_2		t_3		Gauge
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	Max.	Min.	
DII	24,3	24,2	3	2,9	12	31	30,5	11,5	11	5	4,5	C 17 A
DIII	30,5	30,4	3	2,9	12	31	30,5	11,5	11	5	4,5	C 17 B
DIV	38,9	38,8	14,4	14,3	24	38	37,5	17	16,5	14	13,5	C 17 C
D01	12,3	12,2	6,2	6,1	10	22	21,75	7	6,5	3	2,75	C 17 E
D02	16,85	16,75	10,2	10,1	14	22	21,75	7	6,5	3	2,75	C 17 F
D03	27,7	27,6	18,2	18,1	22	25,5	25,25	9,5	9	3	2,75	C 17 G



IEC 155/01

The gauges are intended for checking that the hole for the gauge-piece in the bottom contact (sizes DII to DIV) or that the hollow space (sizes D01 to D03) is concentric with the thread of the screwed shell.

It shall be possible to introduce the gauge without undue force into the fuse-base so that the surface E is approximately level with the upper edge of the screwed shell.

Material: steel.

Figure 125 – Gauges C 17 for concentricity of fuse-bases

Remark: this figure was previously Figure 10 in IEC 60269-3-1, Section I

Annex A (informative)

Special test for cable overload protection ¹⁾ (for fuse system A)

Fuses with $I_n > 10$ A shall be tested as follows.

A.1 Arrangement of the fuse

One fuse comprising fuse-base, fuse-carrier, gauge-piece, cover and the relevant fuse-link is submitted to the test.

The test arrangement is that specified in 8.3.1 of IEC 60269-1. The test shall be carried out at an ambient air temperature of 30 ± 5 °C.

NOTE A lower temperature may be used with the manufacturer's consent.

A.2 Test method and acceptability of test results

A test current equal to $1,13 I_n$ flows through the fuse during the conventional time as given in Table 2 of IEC 60269-1. The fuse-link shall not operate. The test current is then raised without interruption within 5 s to $1,45 I_n$. The fuse-link shall operate within the conventional time.

¹⁾ See note to 8.4.3.5.

Fuse system B – Cylindrical fuses (NF cylindrical fuse system)

Remark: previously Section IIA in IEC 60269-3-1

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to “gG” fuses for use by unskilled persons for domestic and similar applications having fuse-links, satisfying the dimensional requirements given in Figure 201 of this fuse system. Their rated current does not exceed 63 A and their rated voltages are 230 V or 400 V a.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- rated voltage;
- rated power dissipation of the fuse-link and rated acceptable power dissipation of a fuse-holder;
- time-current characteristic;
- gates, I^2t characteristics and conventional times and currents;
- rated breaking capacity;
- marking on the fuse;
- standard conditions for construction;
- tests.

2 Terms and definitions

IEC 60269-1 applies with the following supplementary requirements.

Definitions concerning terminals are given in IEC 60999.

For the purpose of this fuse system, the following terms and definitions apply.

2.1.201

Remark: previously 2.1.12 in IEC 60269-3-1, Section IIA

screw-type terminal

terminal for the connection and subsequent disconnection of a conductor or the interconnection of the two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

2.1.202

Remark: previously 2.1.13 in IEC 60269-3-1, Section IIA

pillar terminal

terminal with screw-clamping in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw(s). The clamping pressure may be applied direct by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

The rated voltage shall be 230 V or 400 V a.c.

5.3.1 Rated current of the fuse-link

The maximum rated currents of fuse-links are given in the table of Figure 201.

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-holders are the same as the maximum values of the fuse-links (see 5.3.1 of this fuse system).

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation of the fuse-links and the rated acceptable power dissipation of the fuse-holders are given in Table 201.

Table 201 – Maximum values of rated power dissipation and values of rated acceptable power dissipation

Remark: this table was previously IEC 60269-3-1, Section IIA

Dimensions mm	Rated current I_n A	Rated voltage U_n V	Power dissipation / acceptable power dissipation W
6,3 × 23	6	230	1,0
8,3 × 23	10	230	1,3
10,3 × 25,8	16	230	2,3
8,5 × 31,5	20	400	2,6
10,3 × 31,5	25	400	3,2
10 × 38	32	400	3,2
16,7 × 35	63	400	6,8

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 202.

Table 202 – Conventional times and currents for "gG" fuse-links

Remark: this table refers to Table 2 in IEC 60269-1 and was previously Table II in IEC 60269-3-1, Section IIA

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_n
$I_n \leq 4$	1	$1,5 I_n$	$2,1 I_n$
$4 < I_n < 16$	1	$1,5 I_n$	$1,9 I_n$
$16 \leq I_n \leq 63$	1	$1,25 I_n$	$1,6 I_n$

5.6.3 Gates

For "gG" fuse-links, in addition to the gates of IEC 60269-1, the gates given in Table 203 apply.

Table 203 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents lower than 16 A

Remark: this table refers to Table 3 in IEC 60269-1 and was previously Table III in IEC 60269-3-1, Section IIA

I_n A	$I_{min. (10 s)}$ A	$I_{max. (5 s)}$ A	$I_{min. (0,1 s)}$ A	$I_{max. (0,1 s)}$ A
6	11,0	28,0	26,0	72,0
10	22,0	46,5	47,0	110,0

5.7.2 Rated breaking capacity

The minimum breaking capacities are specified in table 204.

Table 204 – Minimum rated breaking capacities

Remark: this table was previously Table A in IEC 60269-3, Edition 2

Rated voltage V	Minimum rated breaking capacity kA
230	6
400	20

6 Markings

IEC 60269-1 applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of the cartridge shall be in accordance with Figure 201.

7.1.2 Connections including terminals

See IEC 60269-1 and also IEC 60999.

Within the framework of this standard, only those terminals intended for receiving external copper conductors are included.

The base shall be fitted with terminals designed to receive copper conductors of cross-sectional area and current rating as in the following table.

Table 205 – Nominal section of copper conductors that the terminals shall accept

Remark: this table was previously Table J1 in IEC 60269-3-1, Section IIA

Rated current of fuse-base	Flexible conductors (note 2)	Rigid conductors of solid core or cables
A	mm ²	mm ²
6	0,5 to 1	0,75 to 1,5
10	0,75 to 1,5	1 to 2,5
16	1 to 2,5	1,5 to 4
20	1,5 to 4	1,5 to 4
25	1,5 to 4	2,5 to 6
32	2,5 to 6 (note 1)	4 to 10
63	6 to 16	10 to 25

NOTE 1 Attention is drawn to the fact that, for certain applications, more space is necessary.

NOTE 2 It is admitted that for conductors sizes 1 mm² to 6 mm², the terminals are intended only for clamping rigid solid conductors.

Verification is to be carried out by measurement and by the insertion of conductors of the smallest and largest section successively.

7.1.6 Construction of a fuse-carrier

A fuse-carrier shall be provided with means for retaining the fuse-link in position whether the fuse-carrier is fitted in the fuse-base or not

A fuse-carrier for fuse-links for which an indicating device is required shall be provided with an appropriate opening for observing the indicator. The opening shall be closed with a securely fixed window of suitable transparent material or other suitable means of protection against material which could be ejected from the indicator.

7.1.7 Construction of a fuse-link

A fuse-link shall be so constructed that it is not possible to remove or to replace parts ensuring non-interchangeability.

In case the fuse has an indicating device, the indication shall be visible when the fuse-link is inserted in the fuse-holder or fuse-carrier.

7.1.8 Non-interchangeability

Fuses shall be so designed that a fuse-link cannot be replaced inadvertently by another rated current exceeding a pre-determined value.

7.1.9 Construction of a fuse-base

A fuse-base shall be so designed that it can be securely fixed in such a way that its unintentional removal is not possible.

A fuse-base intended for use with gauge pieces shall be provided with suitable means for retaining the gauge pieces in positions and allowing their removal only by the aid of a suitable tool.

Covers of fuse-bases providing protection against access of live parts shall withstand the mechanical stresses occurring during fixing and shall be firmly fixed in such a manner that they can be removed only by the aid of a tool or deliberate action when mounted.

The terminals shall be suitable for accepting conductors with the appropriate cross sectional areas.

7.2 Insulating properties

As described in 7.2 of IEC 60269-1 and pending the application of the requirements of IEC 60664, the clearances and creepage distances given in Table 206 shall be respected.

The verification of this prescription is made by measurements. The measurements are performed on a sample without conductors, or on a sample fitted with conductors of the maximum cross-sectional area specified in Table 205.

The requirements stated above do not apply to metal covers and enclosures, if these are isolated with an internal insulating sheet.

If an enclosure of insulating material is covered internally by a metal sheet, this is in any case considered as an accessible metal part.

The thickness of the filling material exceeding a groove is not to be taken into account for evaluation of creepage distance.

The verification of this condition is made by examination.

Table 206 – Creepage distances and clearances

Remark: this table was previously Table K in IEC 60269-3-1, Section IIA

	mm
Minimum creepage distances and clearances	
1 Between live parts of the same polarity separated during breaking operation:	3
2 Between live parts of different polarities:	3
3 Between live parts and:	3
a) metallic accessible parts not listed in Clause 5, decorative parts and metallic covers, parts of mechanism, if these are isolated from live parts;	
b) screws of fixing means for surface mounting base of devices;	
c) screws or fixing means for the base of devices in flush-mounting housings;	
d) screws of covers or cover sheets;	
e) conduits entering the apparatus:	3
4 Between metallic parts of the mechanism and the accessible metallic parts, including frameworks used as support to flush-mounting device bases if an insulation is required.	3
5 Between live parts other than terminals for one part, and for the other part, metallic enclosures, or cases as well as the supporting surface of the bases:	4
6 Between terminals and the metallic enclosures or bases, as well as the supporting surface of the bases:	6
Shortest distance	3
7 Between live parts covered by a minimum 2 mm of sealing compound and the supporting surface of the bases:	3
NOTE The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width. Any air gap less than 1 mm is ignored in computing the total clearance.	

7.3 Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder

Instead of Table 5 of IEC 60269-1, Table 207 applies.

Table 207 – Temperature rise limits for terminals

Remark: this table refers to Table 5 in IEC 60269-1 and was previously Table IV in IEC 60269-3, Edition 2

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3.4.2 of IEC 60269-1, for the corresponding rated current of the fuse-base shall not exceed	65K
---	-----

7.7 I^2t characteristics

7.7.1 Pre-arcing I^2t values

In addition to Table 7 of IEC 60269-1, the pre-arcing I^2t values given in Table 208 of this fuse system apply.

Table 208 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links

Remark: this table refers to Table 7 in IEC 60269-1 and was previously Table VI in IEC 60269-3-1, Section IIA

I_n A	I^2t_{\min} A ² s	I^2t_{\max} A ² s
6	24,00	225,00
10	100,00	576,00

7.7.2 Operating I^2t values

The maximum pre-arcing I^2t values given above are considered as the maximum operating I^2t values. For fuse-links with rated currents greater than 16 A, the maximum pre-arcing I^2t values of Table 7 of IEC 60269-1 are considered as the maximum operating I^2t values.

7.8 Overcurrent discrimination of "gG" fuse-links

Fuse-links rated 16 A and above in series and with the rated current ratio of 1:1,6 have to operate selectively over the whole breaking range (see 8.7.4 of this fuse system).

7.9 Protection against electric shock

The degree of protection shall be at least IP2X when the fuse is under normal service conditions.

As specified in 7.9 of IEC 60269-1, the following details are given with regard to this subclause:

- the fuses shall be so designed that no contact can be made between different poles with fuse-carriers and fuse-links;
- it shall be possible to replace easily a fuse-link without touching the live parts;
- the live parts of devices protected against direct contact shall not be accessible when the fuse-base is installed and connected with conductors as in normal use, either fitted with its fuse-link or not, the fuse-carrier being in place;

NOTE In case of a fuse unprotected against direct contact and intended to be incorporated in appliances, this requirement does not apply to parts for which the protection should be provided by screens or by construction in the appliance itself.

- when the fuse-carrier is withdrawn, the accessibility to the live parts shall be possible only after a deliberate action.

These requirements are verified by the test according to 8.8 of this fuse system.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.5.1 Complete tests

The following additional test is required according to Table 209.

Table 209 – Survey of tests on fuse-link

Remark: this table refers to Table 11 in IEC 60269-1 and was previously Table VII in IEC 60269-3-1, Section IIA

Test according to subclause	Number of test samples			
	1	1	1	1
8.7.4 Verification of overcurrent discrimination	x	x	x	x

8.1.6 Testing of fuse-holders

The following additional test is required according to Table 210.

Table 210 – Survey of tests on fuse-holder and number of fuse-holders to be tested

Remark: this table refers to Table 14 in IEC 60269-1 and was previously Table VIII in IEC 60269-3-1, Section IIA

Test according to subclause	Number of test samples
	1
8.12 Verification of the reliability of terminals	x

8.2.4.1 This test shall be performed immediately after the humidity treatment described in 8.2.4.2 of IEC 60269-1.

The fuse holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1.

8.3.1 Arrangement of the fuse

The screws of the screw terminals shall be tightened with a torque of two-thirds the torque given in Table 211.

Table 211 – Screw-thread diameters and applied torques*Remark: this table was previously Table L in IEC 60269-3-1, Section IIA*

Nominal diameter of thread mm		Torque Nm		
		I	II	III
Up to and including	2,8	0,2	0,4	0,4
Over	2,8 up to and including	0,25	0,5	0,5
Over	3,0 up to and including	0,3	0,6	0,6
Over	3,2 up to and including	0,4	0,8	0,8
Over	3,6 up to and including	0,7	1,2	1,2
Over	4,1 up to and including	0,8	1,8	1,8
Over	4,7 up to and including	0,8	2,0	2,0
Over	5,3 up to and including	1,2	2,5	3,0
Over	6,0 up to and including	2,5	3,5	6,0
Over	8,0 up to and including	–	4,0	10,0
Over	10,0 up to and including		(Under consideration)	
Over	12,0 up to and including		(Under consideration)	

Column I applies to screws without heads, if the screw, when tightened, does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to other screws, which are tightened by means of a screwdriver.

Column III applies to screws and nuts, which are tightened by means other than a screwdriver.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-links are tested in open air, in a vertical position in one of the test rigs according to Figures 203 and 204, according to the indications given in Table 212.

The sliding pin shall be well guided.

The ferrules and other parts of the fuse-base shall be made from brass with 58 % to 70 % copper, except springs, screws for connections, and the test piece used as specified in the following subclauses for measuring the contact resistance. Furthermore, the ferrules shall be silver-plated.

After each test, it is necessary to verify the good condition of the contact surface.

Table 212 – Values concerning the choice and the adjustment of the test base*Remark: this table was previously Table M in IEC 60269-3-1, Section IIA*

Cartridge Rated current A	No. of the base (see Figure 203)	No. of the ferrule (see Figure 203)	Distance <i>b</i>	Contact force
			mm	N
6	1	1	48	6 to 8
10	1	2	48	6 to 8
16	2	3	56	14 to 17
20	2	3	62	14 to 17
25	2	3	62	14 to 17
32	2	3	68	18 to 22
63	3	4	80	38 to 42

8.3.4.1 Temperature rise of the fuse-holder

The dummy fuse-link shall have the maximum power dissipation given in Table 201 and the dimensions in accordance with Figure 202.

8.4 Verification of operation**8.4.1 Arrangement of the fuse**

The fuse-links are tested in one of the test-rigs according to Figure 203, chosen from the indications given in Table 212. The cartridge is placed under a housing in polyacryl resin according to Figure 205. Before each test, it is necessary to verify the good condition of the ferrule surface.

8.4.3.6 Operation of indicating devices and strikers, if any

In addition to IEC 60269-1, the following applies.

If the tests are performed at reduced voltages, the test circuit voltage shall be $100 \text{ V} \pm 5 \text{ V}$.

8.5 Verification of the breaking capacity**8.5.1 Arrangement of the fuse**

The fuse-links are tested in a test-base according to Figure 206 adjusted according to indications given in Table 213. The contact ferrules are of silver-plated brass.

Before beginning the test, it is necessary to verify the good condition of the ferrule surfaces.

Table 213 – Values for adjustment of the test base*Remark: this table was previously Table N in IEC 60269-3-1, Section IIA*

Cartridge rated current A	No. of the ferrule	Distance <i>b</i>	Contact force
		mm	N
6	5	70	8 to 10
10	5	70	8 to 10
16	6	73	14 to 16
20	5	79	14 to 16
25	6	79	14 to 16
32	6	85	22 to 24
63	7	85	38 to 42

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1, tests in accordance with Table 20 of IEC 60269-1 shall be made. An alternative test to tests Nos. 1 and 2 of Table 20 is given in Annex B.

8.5.8 Acceptability of test results

Subclause 8.5.8 of IEC 60269-1 applies, under the following restrictions. The following is permissible:

- malfunction of the indicating device;
- any crack of the cartridge which does not prevent its withdrawal without a tool;
- small blisters, localized bumps on the ferrules also small holes, provided that these are not sufficient to damage the fuse-base or the fuse-carrier.

8.7.4 Verification of overcurrent discrimination

To verify the requirements specified in 7.7.1 and 7.7.2 of this fuse system, four supplementary samples are tested, two to verify the minimum pre-arcing I^2t values and the other two to verify the total I^2t values.

The samples are arranged as for the breaking capacity test according to 8.5 of IEC 60269-1.

The test voltage to verify the operating I^2t values shall be

$$\frac{1,1 \times 380 \text{ V a.c.}}{\sqrt{3}}$$

for 400 V fuses and $1,1 \times 230 \text{ V a.c.}$ for 240 V fuses.

8.8 Verification of the degree of protection of enclosures

8.8.1 Verification of protection against electric shock

To verify the requirements given in 7.9, the procedure is as follows:

- requirement b) is verified by examination;
- requirement c) is verified by means of the test finger shown in Figure 9 of IEC 60898;
- requirement d) is verified by means of the test finger shown in Figure 9 of IEC 60898.

In the case of the protecting screen or of parts intended to be knocked out, the test finger is applied with a 20 N force.

NOTE It is recommended to use a lamp to detect the contact, the supply voltage being at least 40 V.

8.9 Verification of resistance to heat

The following two tests are performed.

Test in a heating cabinet

This test is performed with the specimen being kept in a heating cabinet at a temperature of $100\text{ °C} \pm 5\text{ °C}$ for 1 h.

At the end of this test, significant deteriorations shall not be observed, and live parts protected with sealing compound shall not become exposed.

NOTE Slight displacement of the sealing compound is permitted.

Ball pressure test

External parts of insulating material other than ceramic are, furthermore, submitted to a ball pressure test by means of the apparatus shown in Figure 16 of IEC 60898.

A steel ball of 5 mm diameter is pressed with a force of 20 N against one part of the external surface placed horizontally. The test is performed in a heating cabinet at a temperature of $125\text{ °C} \pm 5\text{ °C}$. After 1 h in the heating cabinet, the pressure is released, the ball is removed and after 5 min, the diameter of the impression is measured, which shall not exceed 2 mm.

Following these tests, the fuse-carrier is (without fuse-link) withdrawn and inserted by hand 50 times.

After this operation, it is verified that the force to withdraw the cover from the fuse-base, exerted in a direction perpendicular to the mounting plane of the fuse-base, is higher than 1,5 N.

The force is exerted without jerks by means of a mass of 150 g. The cover shall not be separated from the fuse-base.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

A dummy fuse-link with its maximum power dissipation and its dimensions is given in 8.3.4.1 of this fuse system and Figure 202. A typical fuse-base with its spring-loaded contact pieces is given in Figure 204.

Torques to be applied to the screws of the terminals are specified in 8.3.1 of this fuse system.

In addition, 7.3 of this fuse system and 8.3.1 of IEC 60269-1 apply.

8.10.2 Test method

The load period is 75 % of the conventional time.

The no-load period is 25 % of the conventional time.

The test current is the non-fusing current.

The conventional time, as well as the non-fusing current, is stated in Table 2 of IEC 60269-1.

A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature rise values of terminals shall not exceed the temperature rise measured at the beginning of the test (first cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature rise values of terminals shall not exceed the values measured at the beginning of the tests (first cycle) by more than 20 K.

8.11.1.1 Mechanical strength of the fuse-holder

To verify that a fuse has satisfied the requirements of 7.11 of IEC 60269-1 it is submitted to the following tests.

8.11.1.1.1 Verification of resistance to shock

The verification is made by means of the apparatus described in 8.11.1.1.1.1 of this fuse system. The test conditions are given in 8.11.1.1.1.2 of this fuse system.

8.11.1.1.1.1 Test apparatus

The test apparatus, according to Figure 10 of IEC 60898, consists of an arm swinging round an axis and fitted at its lower part with a hammer.

The arm is made with a steel tube of 9 mm external diameter and 8 mm internal diameter and includes

- on its higher part, a device fitted with a swinging axis, the distance of which to the frame of the apparatus is adjustable, so that the pendulum can move only in a vertical plane perpendicular to the supporting side of the frame;
- on its lower part, a device designed to hold one of the hammers described below.

The length of the tube is such that the distance between the swinging axis of the pendulum and the hammer axis mounted on the pendulum arm is equal to 1 m.

The hammer has, as applicable, such a mass as, fixed on the tube by means of the device shown in Figure 11 of IEC 60898, the vertical force to apply in the axis of the hammer to maintain the pendulum arm horizontal, is:

- 2 N in case of type a, hammer so-called "of 150 g" shown in Figure 11 of IEC 60898.

According to dimensions, the apparatus is fixed on one of the supports shown in Figure 12 of IEC 60898.

The support is so arranged that it is possible

- to place the apparatus so that the target is in the vertical plane passing by the pendulum swinging axis;
- to turn the apparatus round one vertical axis;
- to displace the apparatus horizontally, in parallel to the pendulum swinging axis.

8.11.1.1.1.2 Test procedure

The enclosure is fixed on the support as in normal use; the conductor apertures are left open and the cover screws are tightened with a torque equal to two-thirds of that given in Table 211 of 8.3.1.

Enclosures intended for flush mounting are placed in the recessed portion of a block of plywood so that the edge of the enclosure box, if any, is flush with the surface of the block.

The enclosure box is tested separately and maintained against the support, its front side being directed towards the hammer.

By acting on the position of the support and that of the swinging axis of the pendulum, the enclosure is placed in such a way that the target is in the vertical plane passing by the pendulum axis and the hammer is allowed to fall down from the prescribed height, measured vertically between the target on the enclosure and the strike point of the hammer at its free fall point.

NOTE The blows are not applied to the knock-out holes.

The hammer to be used and the height of fall according to the enclosure classification with regard to the resistance to shocks are indicated in Table 214.

Table 214 – Hammer and height of fall for test for verification of resistance to shocks

Remark: this table was previously Table P in IEC 60269-3-1, Section IIA

Type of apparatus	Type of hammer	Height of fall cm
Ordinary enclosure	a	15

The apparatus is subjected to 10 blows, evenly distributed over the enclosure and if any, over the cover sheet.

The first series of five blows is applied as follows:

- in the case of flush-fitting enclosures, one blow on the centre, one blow on each end of the cover sheet and the two remaining at about half-distance;
- in the case of other types, one blow on the centre, one blow on each lateral side and the two remaining blows on intermediary positions, the enclosure being turned after each blow, with the appropriate angle but not more than 60°, around a vertical axis.

The second series of five blows is then applied in the same way but after having turned the enclosure to 90° around its perpendicular axis to the support.

If there are cable entries, the two lines of targets on the specimens are chosen to be at the mid-way of the cable entries.

After the test, the enclosure shall show no damage that could decrease its protective function. It shall neither show any cracks nor deformations that could impair the operating characteristics, or alter the guaranteed qualities of the specimens.

Small cracks, which do not alter the protection against direct contact, may be neglected.

Fracture of the external cover sheet is permissible provided that this sheet is double and the second one satisfies the test, the live parts not being exposed.

8.11.1.1.2 Verification of the constructional requirements

The fuse-carriers shall comprise a device intended to maintain the fuse-link in place during the withdrawal of the fuse-carrier.

The efficiency of this device is verified by using a fuse-base corresponding to the fuse-carrier under test.

The fuse-carrier is equipped with a gauge-piece, the dimensions of which are in accordance with those given in Figure 207 for the rated current of the fuse considered, and fitted together with the fuse-base as in normal use.

The fuse-carrier is then withdrawn from the fuse-base and, where an elastic device (for example, a spring clip) is used to hold the fuse-link, the fuse-carrier is kept in its most unfavourable position during about 10 s.

The test-piece shall not fall out from the fuse under the effect of its own weight.

In the case of the screw-type fuse-carrier, the threaded sleeve shall be fixed securely and shall not present a rough surface on the live surface of contact.

The verification of these conditions is made by examination and by the following test:

The fuse-carrier of a fuse-link having the maximum dimensions is screwed in fully and unscrewed 50 times consecutively as in normal use, by exerting during each screwing stroke a torque as indicated in Table 215.

Table 215 – Torque to be applied to the fuse-carrier

Remark: this table was previously Table Q in IEC 60269-3-1, Section IIA

Rated current of the fuse-base A	Torque Nm
6	0,6
10	0,6
16	1,0
20	1,0
25	1,0
32	1,0
63	1,7

8.11.1.4 Mechanical strength of screw thread

For screws, which are operated during the installation of the fuse, including screws of terminals and screws for fixing covers – but not screws for fixing the fuse-base to the supporting surface – the following test is performed.

The screws are tightened and loosened five times in the case of metallic thread and 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 216.

For testing terminal screws, a conductor of the largest cross-sectional area specified by the manufacturer or in IEC 60269-1 shall be placed in the terminal. The conductor shall be moved after each operation to present a new surface to the terminal screw.

Table 216 – Mechanical strength of screw-thread

Remark: this table was previously Table C in IEC 60269-3, Edition 2

Nominal diameter of thread mm	Torque Nm
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 10,0	7,5

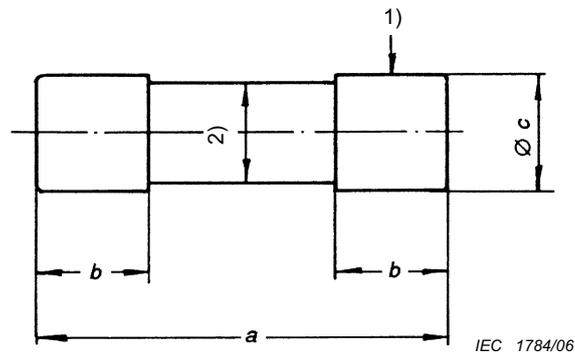
During the test, no change impairing the further use of the screwed connection shall occur.

8.11.2.6 Dimensions and non-interchangeability

Compliance with 8.1.4 of IEC 60269-1 and 7.1.8 of this fuse system shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.

8.12 Verification of the reliability of terminals

Follow the tests described in IEC 60999, Clause 8.



- 1) Cylindrical part within the specified tolerances shall not be exceeded.
- 2) The diameter of the cartridge between the end caps shall not exceed diameter c .

230 V/400 V					
Dimensions	$I_n \text{ max}$ A	U_n V	a	b	c
6,3 × 23	6	230	$23,0^{0}_{-0,8}$	$5,0^{+0,2}_{-0,6}$	$6,3 \pm 0,1$
8,5 × 23	10	230	$23,0^{0}_{-0,8}$	$5,0^{+0,2}_{-0,6}$	$8,5 \pm 0,1$
10,3 × 25,8	16	230	$25,8 \pm 0,4$	$6,3 \pm 0,4$	$10,3 \pm 0,1$
8,5 × 31,5	20	400	$31,5 \pm 0,5$	$6,3 \pm 0,4$	$8,5 \pm 0,1$
10,3 × 31,5	25	400	$31,5 \pm 0,5$	$6,3 \pm 0,4$	$10,3 \pm 0,1$
10 × 38	32	400	$38,0 \pm 0,6$	$10,0^{+0,5}_{-0,3}$	$10,3 \pm 0,1$
16,7 × 35	63	400	$35,0^{+0,8}_{-0,1}$	$9,5 \pm 0,5$	$16,7 \pm 0,1$

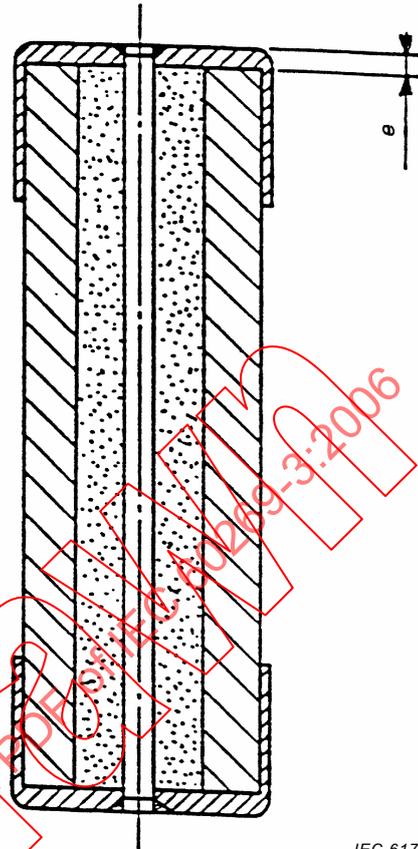
Dimensions in millimetres

The sketch is not intended to govern the design except as regards the dimensions shown.

Figure 201 – Fuse-link

Remark: this figure was previously Figure 10 in IEC 60269-3-1, Section IIA

Dimension e	
6 A	0,5 mm
10 A	1 mm
16 A	1,5 mm
20 A	1,5 mm
25 A	1,5 mm
32 A	2 mm
63 A	2 mm



IEC 617/01

The end caps are of nickel-plated and silver-plated copper.

The body is of ceramic material.

The fuse-element is of CuNi 56/44 alloy or of an equivalent material with similar values of specific resistance and temperature coefficient and is connected to the end caps by welding or brazing.

The filling and arc extinction material is identical to that commonly used in fuse-links.

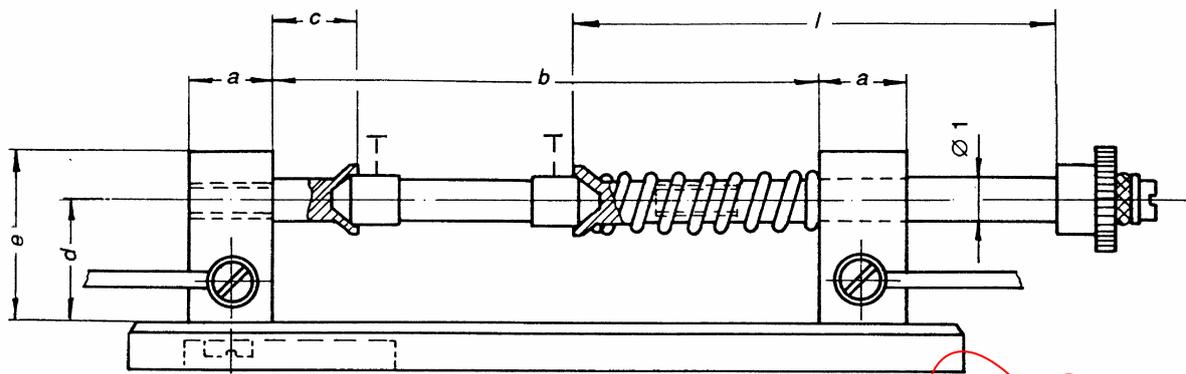
The other dimensions are indicated in Figure 201.

The values of power dissipation are indicated in Table 201 with a tolerance of ${}^{+5}_{0}$ %.

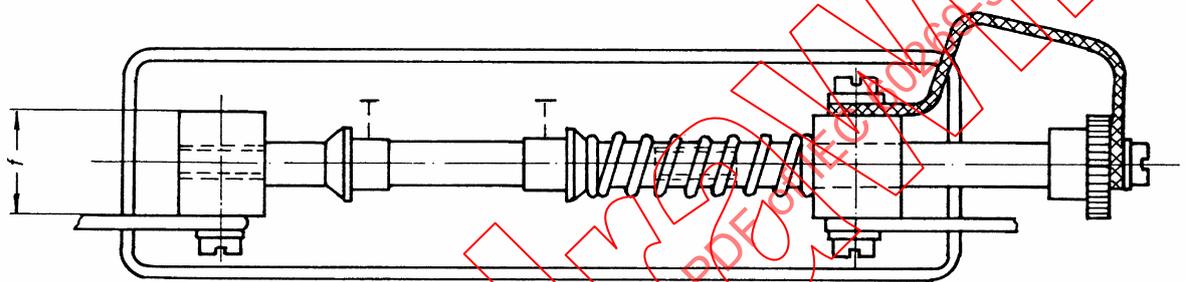
The sketch is not intended to govern the design except as regards the dimensions shown.

Figure 202 – Dummy fuse-link

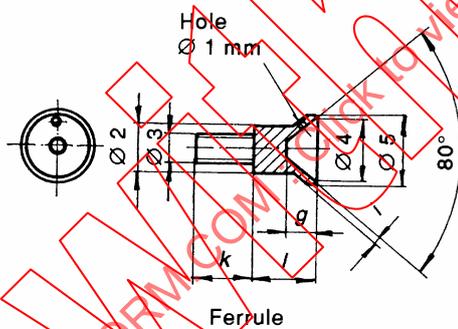
Remark: this figure was previously Figure 11 in IEC 60269-3-1, Section IIA



Flexible braided conductor in copper with cross-section "s"



Test base



Ferrule

IEC 618/01

Dimensions in millimetres

NOTE The measurement of the voltage drop should be made on the points T indicated in Figure 203.

Figure 203 – Test-rig and ferrules for the measurement of the voltage drop and the verification of operating characteristics of the cartridge
(figure continued on page 173)

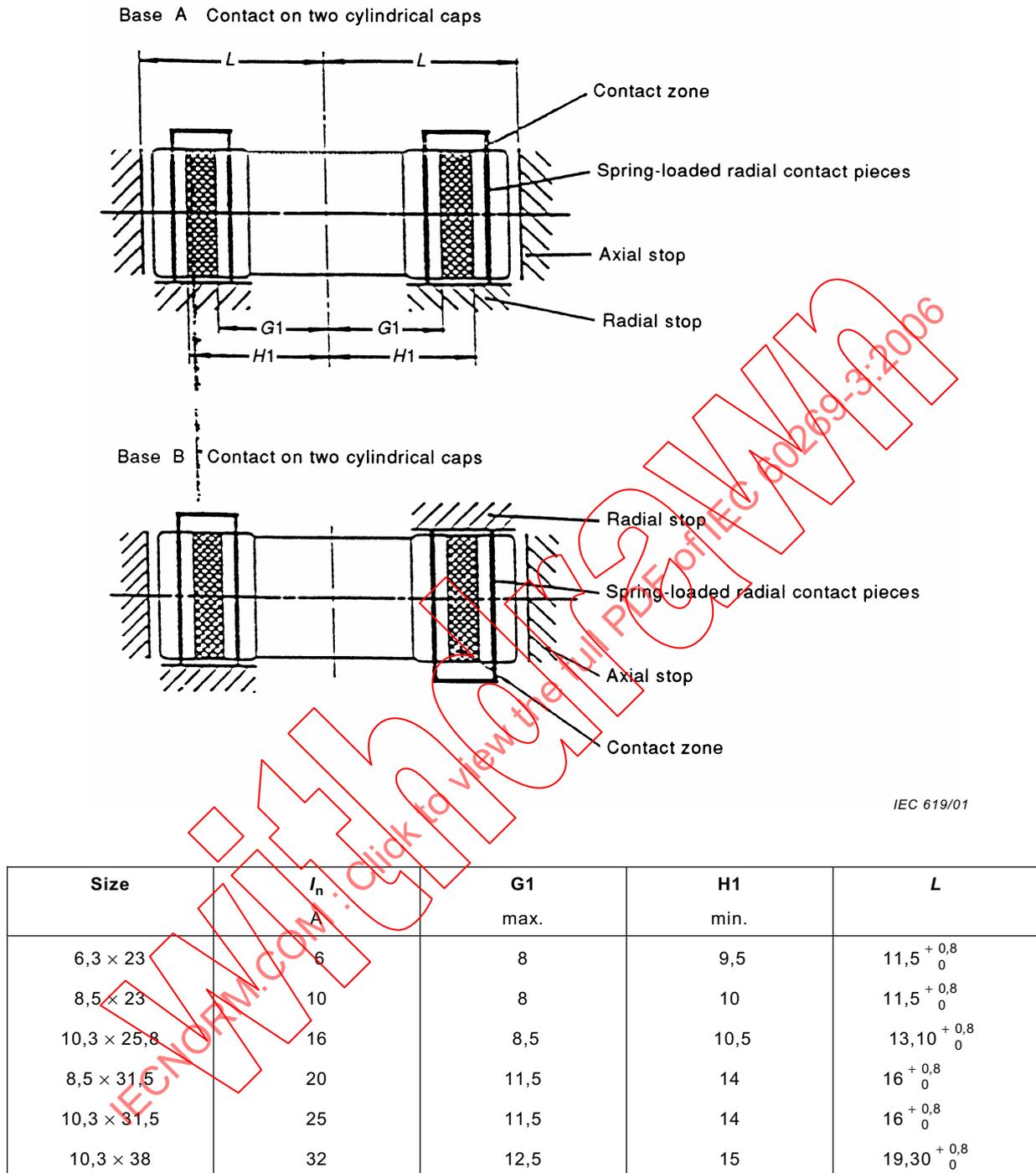
Remark: this figure was previously Figure 12 in IEC 60269-3-1, Section IIA

No. of test base	a	b*	c	d	e	f	l	Ø1	s mm ²
1	8		10	12	17,5	8	50	5	4,6
2	12		10	17,5	24	15	65	6	13
3	20		10	30	40	20	75	12	30

* This dimension is given in Table 212.

No. of the ferrule	Ø2	Ø3	Ø4	Ø5	g	l	l	k
1	5	4	9	10	4	1	10	8
2	5	4	13	14	5	1	10	8
3	10	4	15	17	6	1,5	10	8
4	12	8	21,5	24	7	2	10	18

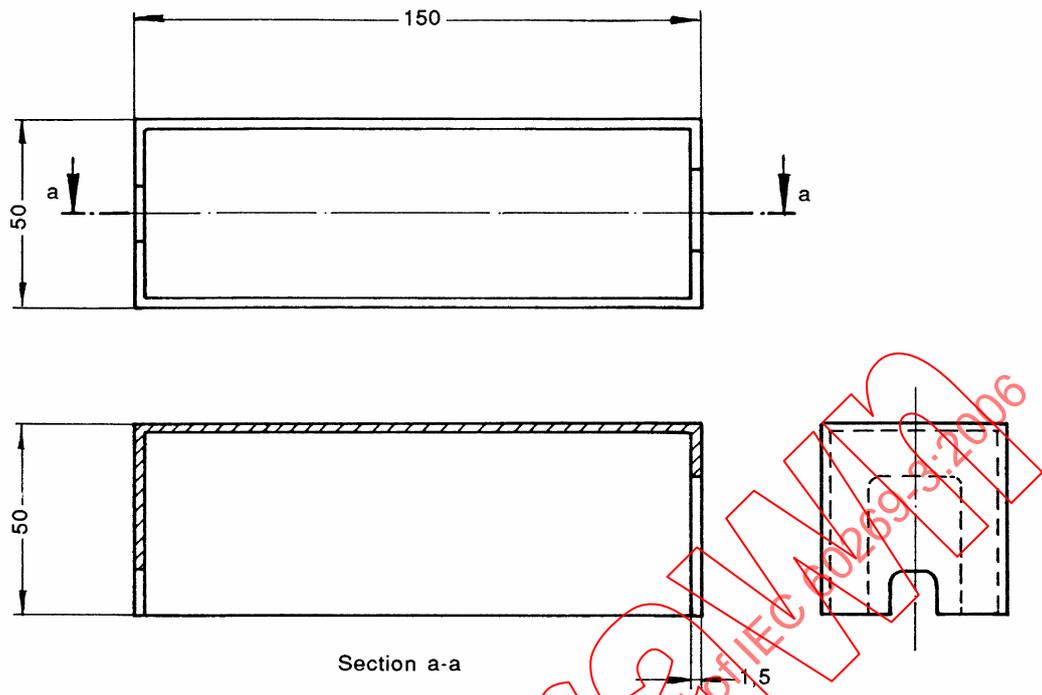
Figure 203 – (concluded)



Dimensions in millimetres

Figure 204 – Fuse-base, A-type and B-type

Remark: this figure was previously Figure 13 in IEC 60269-3-1, Section IIA

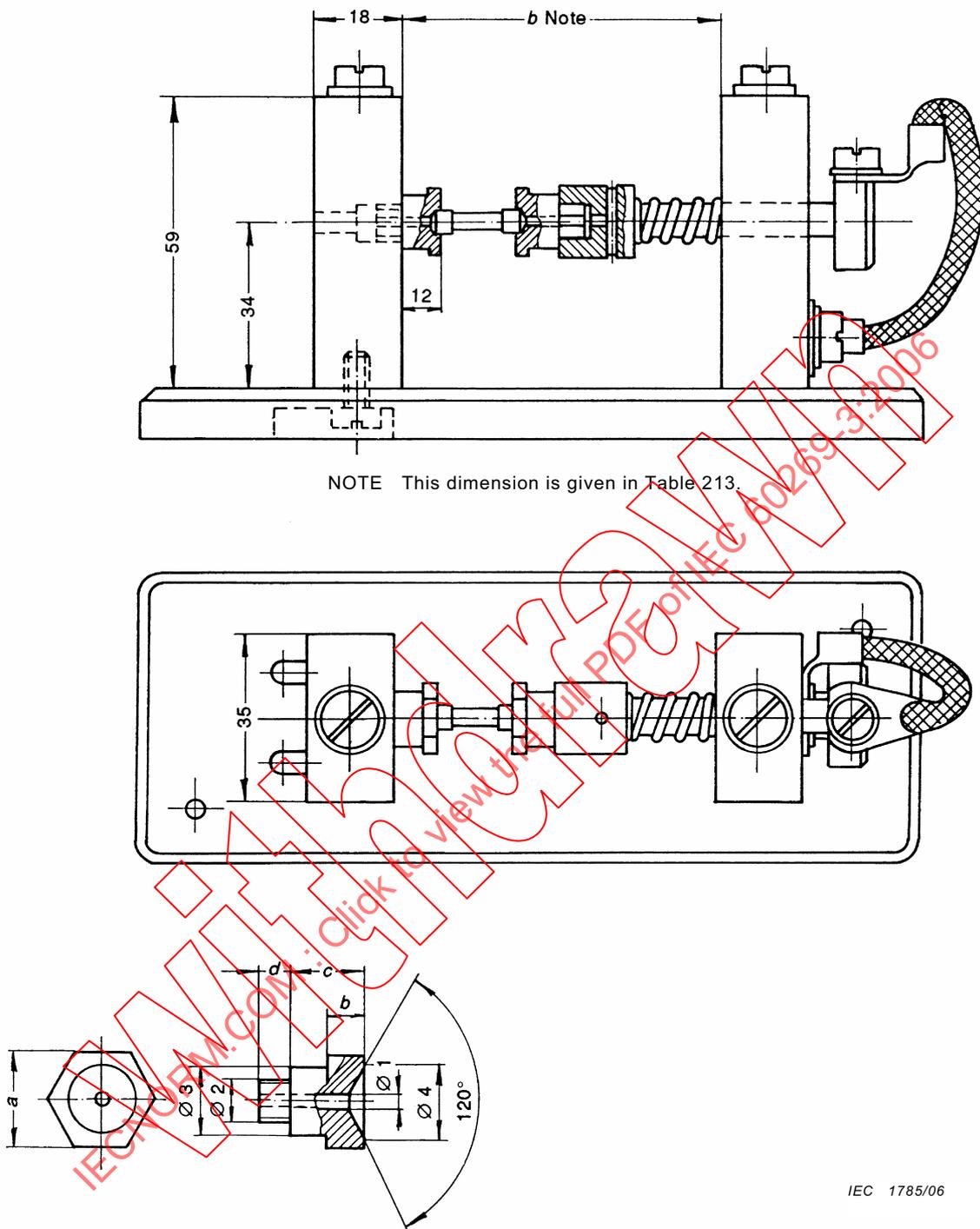


IEC 620/01

Dimensions in millimetres

Figure 205 – Housing for verification of operation of the fuse-links with a test rig according to Figure 203

Remark: this figure was previously Figure 14 in IEC 60269-3-1, Section IIA



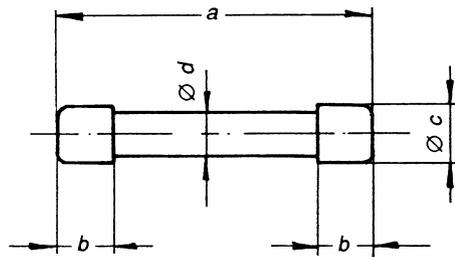
IEC 1785/06

Dimensions in millimetres

No. of the ferrule	Ø 1	Ø 2	Ø 3	Ø 4	a	b	c	d
5	2,5	8	12	10	14	5	12	5
6	2,5	8	12	12	17	6	12	5
7	2,5	8	12	18,5	24	8	12	5

Figure 206 – Test rig and ferrules for verification of breaking capacity

Remark: this figure was previously Figure 15 in IEC 60269-3-1, Section IIA



IEC 622/01

Material: solid steel parts exposed to wear shall be hardened.

Dimensions mm	Rated voltage A	Rated voltage V	a mm	b mm	c mm	d mm
6,3 × 23	6	230	22,2 ⁰ _{-0,1}	4,4 ^{+0,1} ₀	6,2 ⁰ _{-0,02}	5,2 ⁰ _{-0,05}
8,5 × 23	10	230	22,2 ⁰ _{-0,1}	4,4 ^{+0,1} ₀	8,4 ⁰ _{-0,02}	7,4 ⁰ _{-0,05}
10,3 × 25,8	16	230	25,4 ⁰ _{-0,1}	5,9 ^{+0,1} ₀	10,2 ⁰ _{-0,02}	9,2 ⁰ _{-0,05}
8,5 × 31,5	20	400	31,0 ⁰ _{-0,1}	5,9 ^{+0,1} ₀	8,4 ⁰ _{-0,02}	7,4 ⁰ _{-0,05}
10,3 × 31,5	25	400	31,0 ⁰ _{-0,1}	5,9 ^{+0,1} ₀	10,2 ⁰ _{-0,02}	9,2 ⁰ _{-0,05}
10 × 38	32	400	37,4 ⁰ _{-0,1}	9,7 ^{+0,1} ₀	10,2 ⁰ _{-0,02}	9,2 ⁰ _{-0,05}
16,7 × 35	63	400	34,9 ⁰ _{-0,1}	9,1 ^{+0,1} ₀	16,6 ⁰ _{-0,02}	15,6 ⁰ _{-0,05}

Figure 207 – Gauge for verification of the upholding of the cartridge in the fuse-carrier during withdrawal

Remark: this figure was previously Figure 16 in IEC 60269-3-1, Section IIA

Fuse system C – Cylindrical fuses (BS cylindrical fuse system)

Remark: previously Section IIB in IEC 60269-3-1

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to “gG” fuses for use by unskilled persons in domestic or similar applications having cylindrical fuse-links:

Type I: rated currents up to and equal 45 A a.c. and a rated voltage of 240 V a.c.

Type II: rated currents up to and equal 100 A a.c. and a rated voltage of 415 V a.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- rated voltage;
- rated power dissipation of the fuse-link and rated acceptable power dissipation of a fuse-holder;
- time-current characteristic;
- gates, I^2t characteristics and conventional times and currents;
- rated breaking capacity;
- marking on the fuse;
- standard conditions for construction;
- tests.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.3 Rated current

5.3.1 Rated current of the fuse-link

The maximum rated currents are shown in Figure 301.

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-holders are shown in Figures 302 and 303.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum power dissipation of the fuse-links is given in Figure 301.

The acceptable power dissipation of the fuse-holders is given in Figure 303.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current curves and overload curves

In addition to the limits of the pre-arcing time given by the gates and the conventional time and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 304 and 305. The tolerances on individual time-current characteristics shall not deviate by more than $\pm 10\%$ in terms of current.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 301.

Table 301 – Conventional time and current for "gG" fuse-links

*Remark: this table refers to Table 2 in IEC 60269-1
and was previously Table II in IEC 60269-3-1, Section IIB*

Rated current I_n A	Conventional time h	Conventional currents	
		I_{nf}	I_f
$I_n < 16$	1	$1,25 I_n$	$1,6 I_n$

5.7 Breaking range and breaking capacity

5.7.2 Rated breaking capacity

The rated breaking capacity shall be 31,5 kA for 415 V fuse-links and 20 kA for 240 V fuse-links.

6 Markings

IEC 60269-1 applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

7.1.2 Connections including terminals

Reference is made to IEC 60999, Clause 7.

7.1.6 Construction of a fuse-carrier

A fuse-carrier shall be provided with means for retaining the fuse-link in position whether the fuse-carrier is fitted in the fuse-base or not.

A fuse-carrier for fuse-links for which an indicating device is required shall be provided with an appropriate opening for observing the indicator. The opening shall be closed with a securely fixed window of suitable transparent material or other suitable means of protection against material, which could be ejected from the indicator.

7.1.7 Construction of a fuse-link

A fuse-link shall be so constructed that it is not possible to remove or to replace parts ensuring non-interchangeability.

In the case where the fuse has an indicating device, the indication shall be visible when the fuse-link is inserted in the fuse-holder or fuse-carrier.

7.1.8 Non-interchangeability

Fuses shall be so designed that a fuse-link cannot be replaced inadvertently by another rated current exceeding a pre-determined value.

7.1.9 Construction of a fuse-base

A fuse-base shall be so designed that it can be securely fixed in such a way that its unintentional removal is not possible.

A fuse-base intended for use with gauge pieces shall be provided with suitable means for retaining the gauge pieces in position and allowing their removal only by the aid of a suitable tool.

Covers of fuse-bases providing protection against access of live parts shall withstand the mechanical stresses occurring during fixing and shall be firmly fixed in such a manner that they can be removed only by the aid of a tool or deliberate action when mounted.

The terminals shall be suitable for accepting conductors with the appropriate cross-sectional areas.

7.3 Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder

Instead of Table 5 of IEC 60269-1, Table 302 applies.

Table 302 – Temperature-rise limits for terminals

Remark: this table refers to Table 5 in IEC 60269-1 and was previously Table IV in IEC 60269-3, Edition 2

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3.4.2 of IEC 60269-1, for the corresponding rated current of the fuse-base shall not exceed	65K
---	-----

7.9 Protection against electric shock

The degree of protection against electric shock shall be at least IP2X for all three stages.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1 General

8.1.4 Arrangement of the fuse

The dimensions of the fuse-links are given in Figure 301 and the fuse-holders in Figures 302 and 303.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The test arrangement for fuse-links is given in Figures 302 and 303. The test arrangement shall be mounted vertically. The connections to the test arrangements for the 100 A fuse-link shall be 25 mm² PVC-insulated copper conductors. The connectors for other current ratings shall be as specified in Table 17 of IEC 60269-1.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-link shall be tested in the test rig shown in Figure 306.

8.4 Verification of operation

8.4.1 Arrangement of fuse

The test arrangement for the fuse-link is specified in 8.3.1 of this fuse system.

8.5 Verification of breaking capacity

8.5.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 307.

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1, tests in accordance with Table 20 of IEC 60269-1 shall be made. An alternative test to tests Nos. 1 and 2 of Table 20 is given in Annex B.

8.5.8 Acceptability of test results

The requirements of IEC 60269-1 apply, and, in addition, fuse-links shall operate without the melting of the fine wire fuse which indicates arcing to the metal enclosure and without mechanical damage to the test rig.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

The test arrangement is given in 8.3.1 of this fuse system.

The test shall be made in accordance with 8.3.4.1 of IEC 60269-1 by using fuse-links as given in Figure 301 as dummy fuse-links.

The dummy fuse-links shall have dimensions that comply with Figure 301.

The power dissipation of the dummy fuse-links shall not be less than the maximum rated power dissipation given in Figure 301 when tested in the standardized power-dissipation test rig according to Figure 306.

The dummy fuse-links shall be so constructed that they do not operate during passage of the overload current I_{nf} .

8.10.2 Test method

The load period is 75 % of the conventional time.

The no-load period is 25 % of the conventional time.

The test current is the non-fusing current.

The conventional time, as well as the non-fusing current, are stated in Table 2 of IEC 60269-1.

A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature rise values of terminals shall not exceed the temperature rise measured at the beginning of the tests (1st cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature rise values of terminals shall not exceed the values measured at the beginning of the tests (1st cycle) by more than 20 K.

8.11.1.4 Mechanical strength of screw thread

For screws which are operated during the installation of the fuse, including screws of terminals and screws for fixing covers – but not screws for fixing the fuse-base to the supporting surface – the following test is performed.

The screws are tightened and loosened five times in the case of metallic thread and 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 303.

For testing terminal screws, a conductor of the largest cross-sectional area specified by the manufacturer or in IEC 60269-1 shall be placed in the terminal. The conductor shall be moved after each operation to present a new surface to the terminal screw.

Table 303 – Mechanical strength of screw-thread

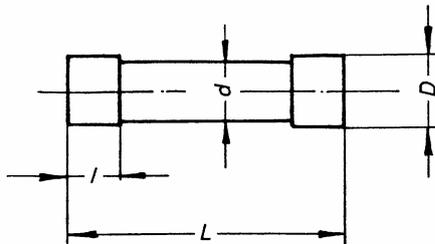
Remark: this table was previously Table C in IEC 60269-3, Edition 2

Nominal diameter of thread mm	Torque Nm
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 10,0	7,5

During the test, no change impairing the further use of the screwed connection shall occur.

8.11.2.6 Dimensions and non-interchangeability

Compliance with 8.1.4 of IEC 60269-1 and 7.1.8. of this standard shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.



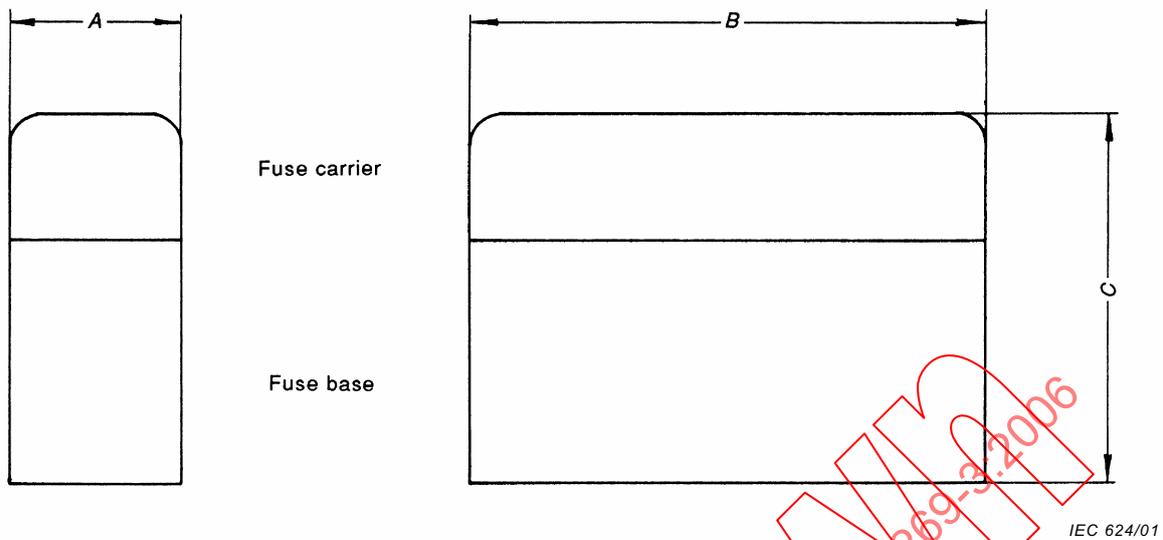
IEC 623/01

Size	Maximum rated current A	Maximum power dissipation W	Length L mm	Length l of endcap mm	Diameter D of endcap mm
Ia	5	1,1	$23^{+0}_{-0,8}$	$4,8 \pm 0,5$	$6,35 \pm 0,1$
Ib	16	2,0	$26^{+0,2}_{-0,6}$	$6,4 \pm 0,5$	$10,32 \pm 0,1$
	20	2,5			
Ic	32	3,0	$29 \pm 0,4$	$8,0 \pm 0,5$	$12,7 \pm 0,1$
Id	45	3,5	$35^{+0,8}_{-0,1}$	$9,5 \pm 0,5$	$16,67 \pm 0,1$
IIa	63	5	$57 \pm 1,0$	$16 \pm 0,5$	$22,23 \pm 0,1$
IIb	100	6	$57 \pm 1,0$	$16 \pm 0,5$	$30,16 \pm 0,1$

The maximum diameter (d) of the cartridge between the endcaps shall be less than the diameter D of the end caps.

Figure 301 – Details of cylindrical fuse-links

Remark: this figure was previously Figure 17 in IEC 60269-3-1, Section IIB

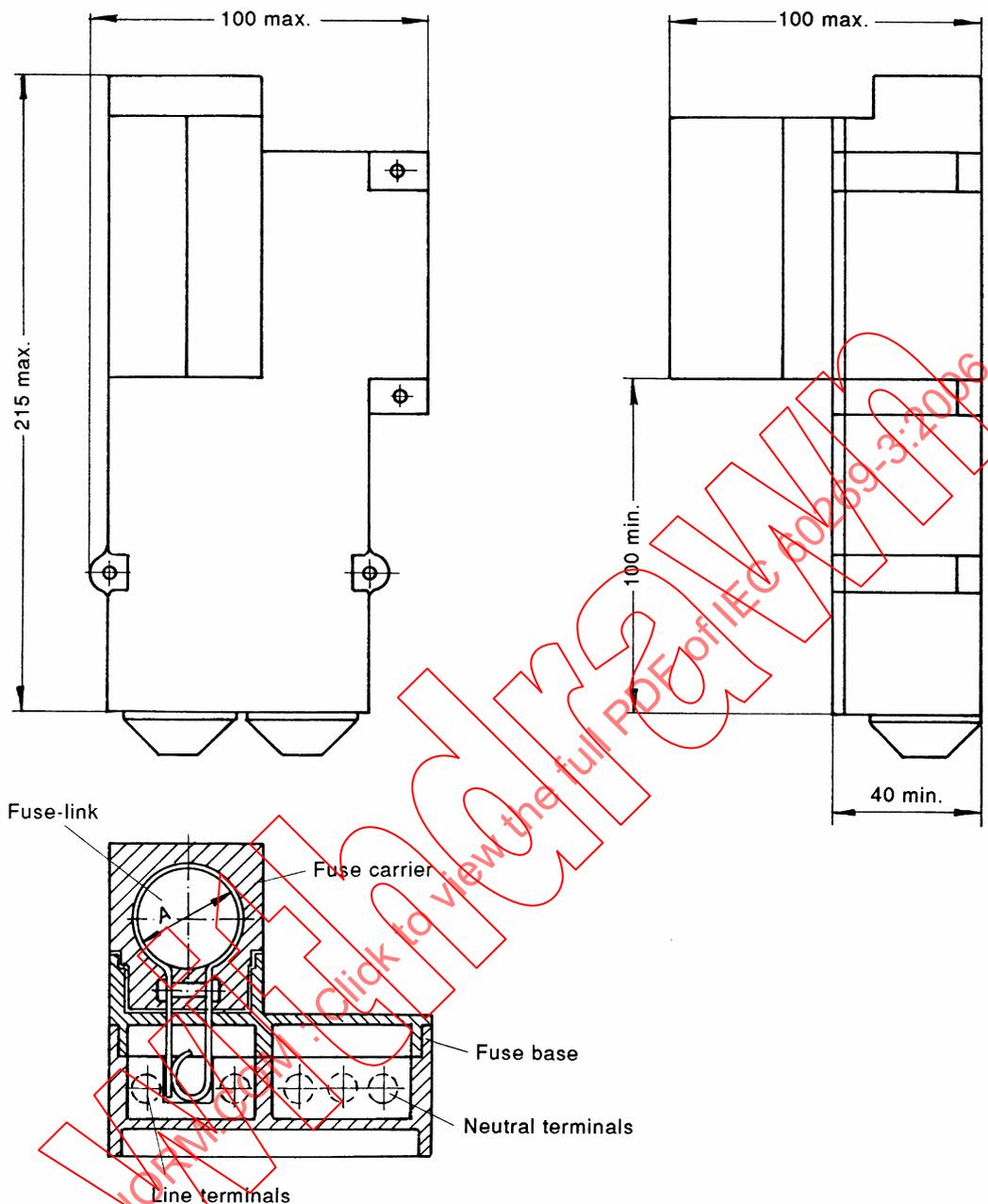


Rated current	Fuse-link size	Acceptable power dissipation	A max.	B max.	C max.
A		W	mm	mm	mm
20	Ia, Ib	2,5	25,4	77,0	56,0
32	Ic	3,0	28,0	77,0	56,0
45	Id	3,5	30,0	80,0	60,0

NOTE This drawing is included by way of illustration only and does not prejudice the use of other shapes or forms, provided they fall within the dimensions listed above.

Figure 302 – Typical outline dimension of carriers and bases for 240 V cylindrical fuse-links

Remark: this figure was previously Figure 18 in IEC 60269-3-1, Section IIB



IEC 625/01

Dimensions in millimetres

NOTE 1 Third-angle projection.

NOTE 2 This drawing is included by way of illustration only, and does not prejudice the use of other shapes or forms, provided they fall within the dimensions listed above.

Maximum rated current	Fuse-link size	Rated acceptable power dissipation	A
A		W	mm
63	IIa	5,0	22,2
100	IIb	6,0	30,1

Figure 303 – Typical carrier and base for 415 V cylindrical fuse-links, size IIa and IIb

Remark: this figure was previously Figure 19 in IEC 60269-3-1, Section IIB

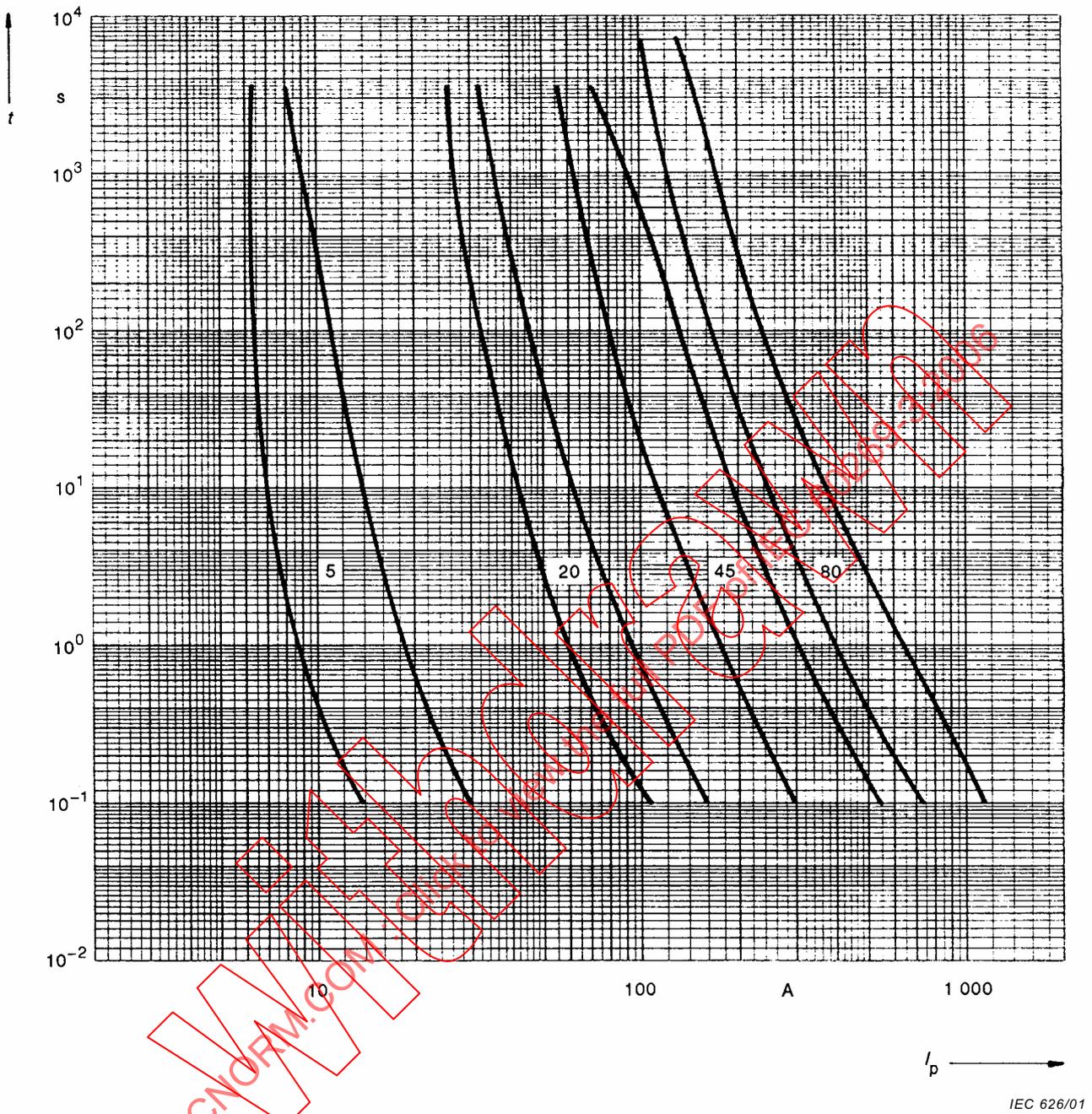


Figure 304 – Time-current zones for "gG" fuse-link

Remark: this figure was previously Figure 20a in IEC 60269-3-1, Section IIB

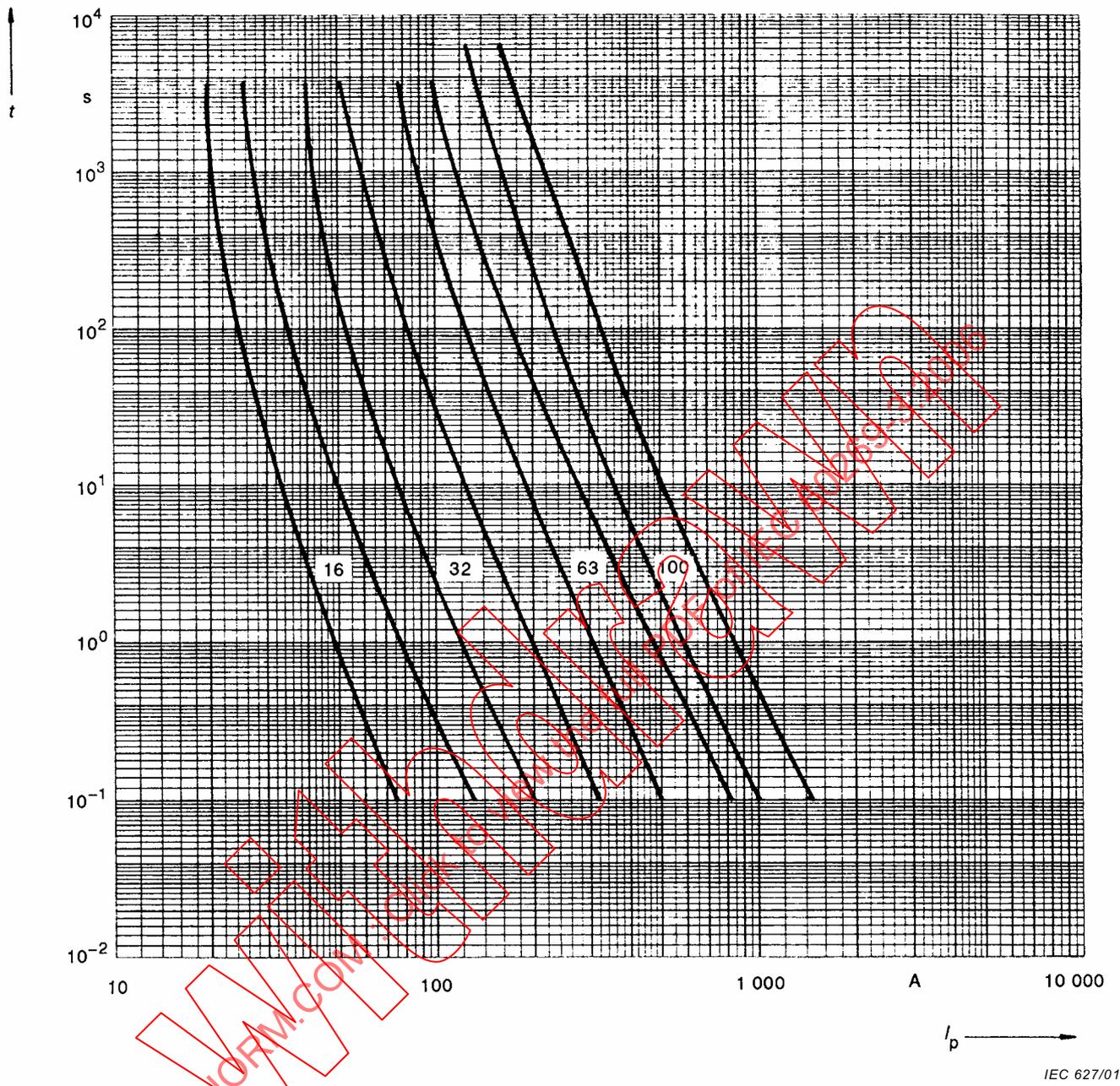
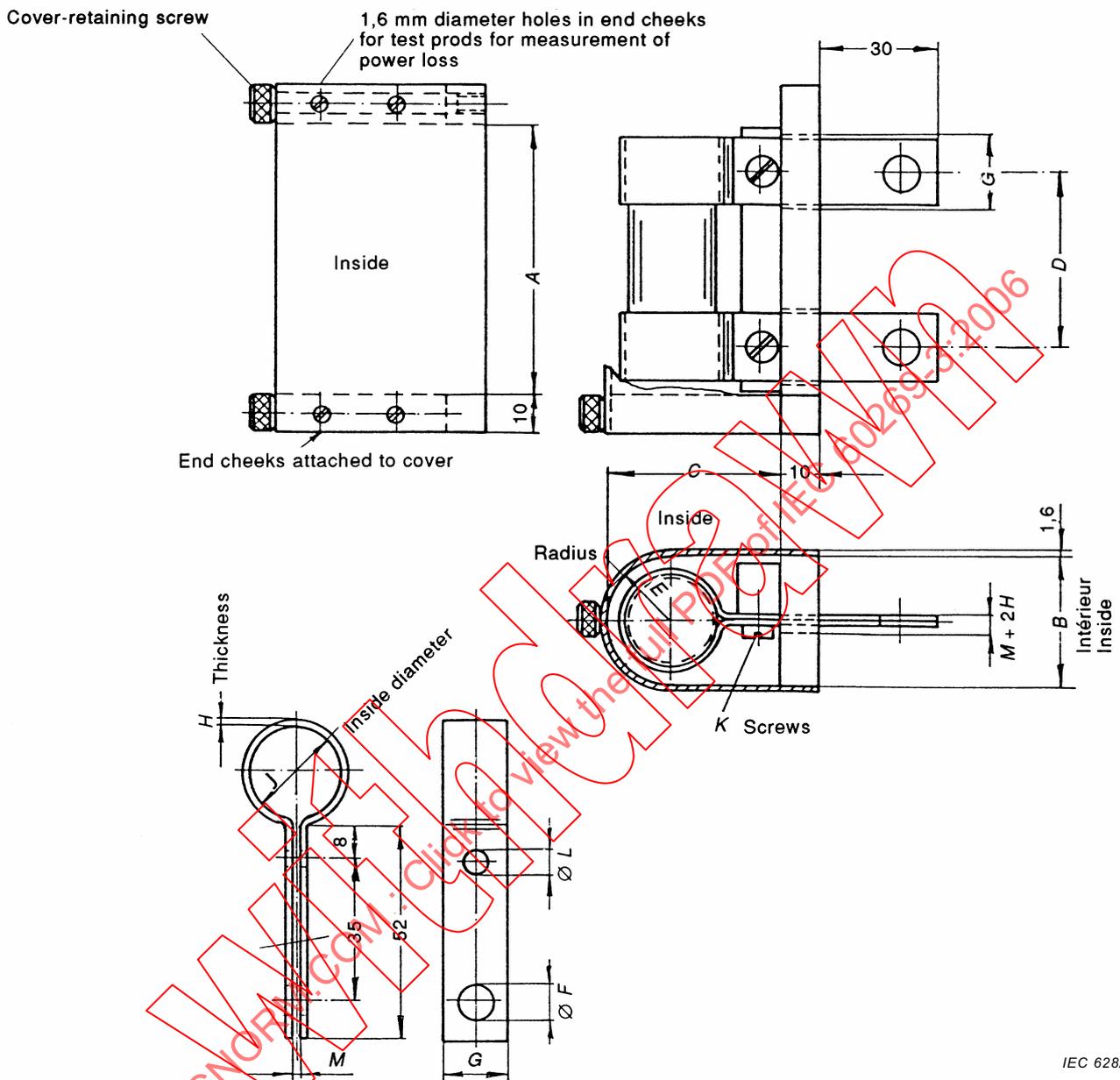


Figure 305 – Time-current zones for "gG" fuse-link

Remark: this figure was previously Figure 20b in IEC 60269-3-1, Section IIB



IEC 628/01

Dimensions in millimetres

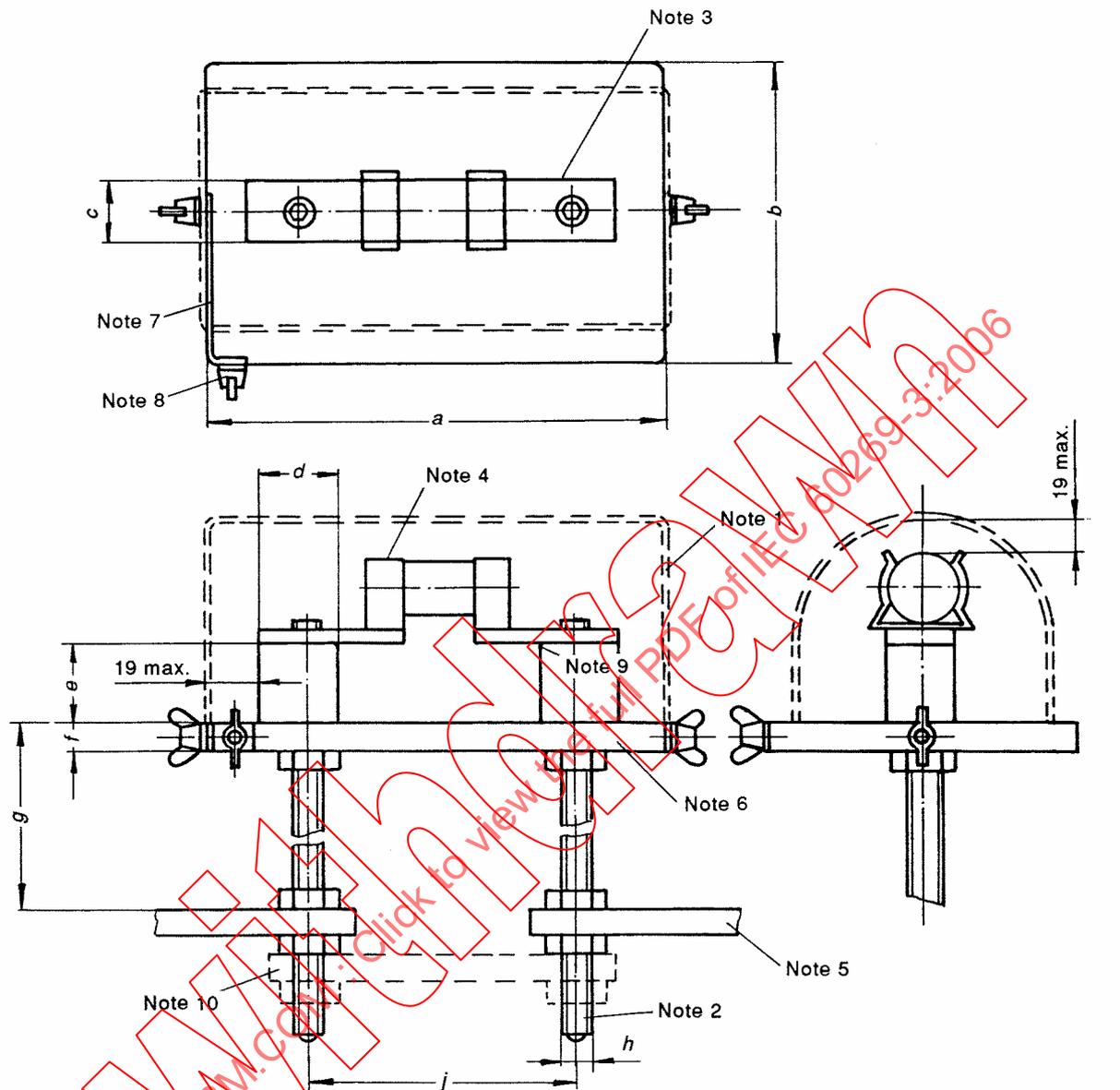
Materials
 Base, end cheeks and cover: insulating material
 Clips: tin-plated

A (max.)	Size	A	B	C	D	E	F	G	H	J	K	L	M ^{a)}
100	I Ib	63,5	38	47,7	41,3	19	8,7	16	1,2	30,1	M5	5,2	1,6
63	II a	63,5	30	40	41,3	15	8,7	16	1,2	22,2	M5	5,2	1,6
45	I d	42	25	34	25,5	12,5	5	10	0,6	16,7	M3,5	4	1,6
32	I c	42	25	34	25,5	12,5	5	10	0,6	12,7	M3,5	4	1,6
20	I b	29	19	28	19	9,5	4	6,5	0,6	10,3	M3,5	4	1,6
5	I a	29	19	28	19	9,5	4	6,5	0,6	6,3	M3,5	4	0,8

a) These figures are for guidance only. They should be adjusted to give adequate contact pressure between the clips and the fuse endcaps.

Figure 306 – Standard test rig for power-dissipation test

Remark: this figure was previously Figure 20 in IEC 60269-3-1, Section IIB



IEC 629/01

Dimensions in millimetres

Fuse-link reference	a	b	c	d	e	f	g	h	j
Types I, IIa and IIb	187	127	25	36,5	38	12,7	114	M12	111

Figure 307 – Breaking-capacity test rig (figure continued on page 209)

Remark: this figure was previously Figure 22 in IEC 60269-3-1, Section IIB

NOTE 1 Detachable cover fabricated from woven wire cloth, mild steel sheet or perforated mild steel sheet of such thickness as to ensure reasonable rigidity. Individual apertures in the wire cloth or perforated steel sheet shall not exceed 8,5 mm² in area. The cover may differ in section from that shown on the drawings, provided that the clearance of 19 mm between the cover and live metal parts is not exceeded.

NOTE 2 Connecting studs of high conductivity copper.

NOTE 3 Copper adaptor plates of minimum section 25 mm × 6,3 mm length and fixing centres appropriate to the fuse-link under test.

NOTE 4 Fuse clips of a size appropriate to the fuse-links under test. Specific dimensions are pending.

NOTE 5 The arrangement of the test connections beyond the test rig is not specified (the second paragraph of 8.5.1 of IEC 60269-1 does not apply).

NOTE 6 The base shall be made from insulating material and the test rig shall be of sufficient rigidity to withstand the forces encountered without applying external loads to the fuse-link under test.

NOTE 7 Copper strip.

NOTE 8 Fine wire fuse of copper wire approximately 0,1 mm diameter, with a free length of not less than 75 mm, connected between the terminal and one pole of the test supply.

NOTE 9 Chamfer.

NOTE 10 Short-circuiting link required for prospective current test. This may be slotted for easy disconnection. The size of the copper link shall be selected according to the rated breaking capacity.

Figure 307 – (concluded)

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Fuse system D – Cylindrical fuses (Italian cylindrical fuse system)

Remark: previously Section IIC in IEC 60269-3-1

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to “gG” fuses for use by unskilled persons for domestic and similar applications having fuse-links type C of rated currents up to and including 63 A and rated voltages up to and including 400 V a.c., whose dimensions are shown in Figures 401 and 402.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- rated voltage;
- rated power dissipation of the fuse-link and rated acceptable power dissipation of a fuse-holder;
- time-current characteristic;
- gates, I^2t characteristics and conventional times and currents;
- rated breaking capacity;
- marking on the fuse;
- standard conditions for construction;
- tests.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.3.1 Rated current of the fuse-link

The rated currents of the fuse-links, sizes and colours of indicating-devices (if any) are given in Table 401.

Table 401 – Fuse-links: rated currents, sizes and colours of indicating devices (if any)

Remark: this table was previously Table R in IEC 60269-3-1, Section IIC

Fuse size	Rated current										
	A										
	2	4	6	10	16	20	25	32	40	50	63
0	x	x	x	x	x	x					
1	x	x	x	x	x	x	x				
2						x	x	x			
3								x	x	x	
4									x	x	x
Colours of indicating devices	Pink	Brown	Green	Red	Grey	Blue	Yellow	Black	Brass	White	Copper

5.3.2 Rated current of the fuse-holder

The rated currents for the fuse-holders are given in Table 402.

Table 402 – Rated currents of fuse-holders

Remark: this table was previously Table S in IEC 60269-3-1, Section IIC

Size	Rated current of fuse-holders	
	A	
0	20	
1	25	
2	32	
3	50	
4	63	

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of the rated power dissipation of a fuse-link are given in Table 403.

Table 403 – Maximum rated power dissipation of fuse-links

Remark: this table was previously Table T in IEC 60269-3-1, Section IIC

Rated current of fuse-link	A	2	4	6	10	16	20	25	32	40	50	63
		W										
Maximum power dissipation of fuse-link	W	2,5	2,5	2,5	2,6	2,8	3,5	4,0	4,6	5,2	6,5	7

The rated values of acceptable power dissipation of fuse-holders are given in Table 404.

Table 404 – Rated acceptable power dissipation of fuse-holder

Remark: this table was previously Table U in IEC 60269-3-1, Section IIC

Size	Rated acceptable power dissipation of fuse-holders	
	W	
0	3,5	
1	4,0	
2	4,6	
3	6,5	
4	7,0	

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

In addition to the limits of pre-arcing time given by the gates and the conventional currents, the time-current zones are shown in Figures 403 and 404.

5.6.2 Conventional times and currents

The conventional currents for fuse-links having rated currents less than 16 A, in addition to IEC 60269-1, are given in Table 405.

Table 405 – Conventional times and currents for fuse-links of $I_n < 16$ A

Remark: this table refers to Table 2 in IEC 60269-1 and was previously Table II in IEC 60269-3-1, Section IIC

Rated current of the fuse-link A	Conventional time h	Conventional currents	
		I_{nf}	I_f
2 to 4	1	$1,5 I_n$	$2,1 I_n$
6 to 10	1	$1,5 I_n$	$1,9 I_n$

5.6.3 Gates

For fuse-links smaller than 16 A, in addition to the gates of IEC 60269-1, the following gates in Table 406 apply.

Table 406 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents lower than 16 A

Remark: this table refers to Table 3 in IEC 60269-1 and was previously Table III in IEC 60269-3-1, Section IIC

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,7	8,5	6	23
4	8,0	18	14	45
6	12	26	28	75
10	22	38	50	85

5.7.2 Rated breaking capacity

The minimum breaking capacities are specified in Table 407.

Table 407 – Minimum rated breaking capacities

Remark: this table was previously Table A in IEC 60269-3, Edition 2

Rated voltage V	Minimum rated breaking capacity kA
230	6
400	20

6 Markings

IEC 60269-1 applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Fuse-links and fuse-bases shall be in accordance with Figures 401 and 402.

7.1.2 Connections including terminals

The terminals shall be capable of accepting the cross-sectional areas of the conductors specified in Table 408.

Table 408 – Cross-sectional areas

Remark: this table was previously Table W in IEC 60269-3-1, Section IIC

Size	Cross-sectional areas of rigid conductors mm ²	Cross-sectional areas of flexible conductors mm ²
0	1,0 to 4	0,75 to 2,5
1	1,0 to 6	0,75 to 4
2	2,5 to 10	1,5 to 6
3	4,0 to 16	2,5 to 10
4	6,0 to 25	4,0 to 16

7.1.6 Construction of a fuse-carrier

A fuse-carrier shall be provided with means for retaining the fuse-link in position whether the fuse-carrier is fitted in the fuse-base or not.

A fuse-carrier for fuse-links for which an indicating device is required shall be provided with an appropriate opening for observing the indicator. The opening shall be closed with a securely fixed window of suitable transparent material or other suitable means of protection against material, which could be ejected from the indicator.

7.1.7 Construction of a fuse-link

A fuse-link shall be so constructed that it is not possible to remove or to replace parts ensuring non-interchangeability.

In the case where the fuse has an indicating device, the indication shall be visible when the fuse-link is inserted in the fuse-holder or fuse-carrier.

7.1.8 Non-interchangeability

Fuses shall be so designed that a fuse-link cannot be replaced inadvertently by another rated current exceeding a pre-determined value.

7.1.9 Construction of a fuse-base

A fuse-base shall be so designed that it can be securely fixed in such a way that its unintentional removal is not possible.

A fuse-base intended for use with gauge pieces shall be provided with suitable means for retaining the gauge pieces in positions and allowing their removal only by the aid of a suitable tool.

Covers of fuse-bases providing protection against access of live parts shall withstand the mechanical stresses occurring during fixing and shall be firmly fixed in such a manner that they can be removed only by the aid of a tool or deliberate action when mounted.

The terminals shall be suitable for accepting conductors with the appropriate cross-sectional areas.

7.2 Insulating properties

The values of clearances and creepage distances shall not be less than those shown in Table 409.

Table 409 – Creepage distances and clearances

Remark: this table was previously Table K in IEC 60269-3-1, Section IIA

	mm
Minimum creepage distances and clearances	
1 Between live parts of the same polarity separated during breaking operation:	3
2 Between live parts of different polarities:	3
3 Between live parts and:	3
a) metallic accessible parts not listed in Clause 5, decorative parts and metallic covers, parts of mechanism, if these are isolated from live parts;	
b) screws of fixing means for surface-mounting base of devices;	3
c) screws or fixing means for the base of devices in flush-mounting housings;	
d) screws of covers or cover sheets;	3
e) conduits entering the apparatus:	
4 Between metallic parts of the mechanism and the accessible metallic parts, including frame-works used as support to flush-mounting device bases if an insulation is required:	4
5 Between live parts other than terminals for one part, and for the other part, metallic enclosures, or cases as well as the supporting surface of the bases:	6
6 Between terminals and the metallic enclosures or bases, as well as the supporting surface of the bases:	3
Shortest distance	
7 Between live parts covered by minimum 2 mm of sealing compound and the supporting surface of the bases:	
NOTE The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width. Any air gap less than 1 mm is ignored in computing the total clearance.	

7.3 Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder

Instead of Table 5 of IEC 60269-1, the following Table 410 applies.

Table 410 – Temperature-rise limits for terminals

Remark: this table refers to Table 5 in IEC 60269-1 and was previously Table IV in IEC 60269-3-1, Edition 2

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3.4.2 of IEC 60269-1, for the corresponding rated current of the fuse-base shall not exceed	65K
---	-----

7.7 I^2t characteristics

7.7.1 Minimum pre-arcing I^2t values at 0,01 s

The values are given in Table 411.

Table 411 – Minimum pre-arcing I^2t values at 0,01 s

Remark: this table was previously Table Y in IEC 60269-3-1, Section IIC

I_n	A	2	4	6	10
I^2t_{\min}	A ² s	1	6,2	24	100

7.7.2 Maximum operating I^2t values at 0,01 s

The values are given in Table 412.

Table 412 – Maximum operating I^2t values at 0,01 s

Remark: this table was previously Table Z in IEC 60269-3-1, Section IIC

I_n	A	2	4	6	10	16	20	25	32	40	50	63
I^2t_{\max}	A ² s	30	80	330	400	1 000	1 800	3 000	5 000	9 000	16 000	27 000

7.9 Protection against electric shock

A fuse shall be so designed that live parts are not accessible when the fuse-base is installed and wired as in normal use with gauge-piece(s), if any, fuse-link and fuse-carrier in position. Where fuse-bases have exposed live parts which are intended to be covered, when installed, by shields not forming a part of the fuse, these live parts are considered to be not accessible.

The degree of protection shall be at least IP2X when the fuse is under normal service conditions. When replacing the fuse-link, the degree of protection may temporarily be reduced to IP1X (see Annex C).

Where a fuse-carrier is used, it shall retain the fuse-link during insertion in, and removal from, the fuse-base.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of the fuse holder

In addition to Table 14 of IEC 60269-1, Table 413 applies.

Table 413 – Survey of the complete tests on fuse-holders and number of fuse-holders to be tested

Remark: this table refers to Table 14 in IEC 60269-1 and was previously Table VIII in IEC 60269-3-1, Section IIC

Test according to subclause		Number of fuse-holder tests			
		1	1	1	1
8.9.1	Test in heating cabinet	x			
8.9.2.1	Ball-pressure test at 125 °C				x
8.9.2.2	Ball-pressure test at 70 °C or $T + 40$ K			x	
8.11.1.6.1	Impact test		x		
8.11.1.6.2	Construction of the fuse-carrier		x		
8.11.1.6.3	Mechanical strength of the screw-type fuse-holder			x	

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The screws of screw terminals shall be tightened with a torque of two-thirds of the torque specified in Table 416.

8.3.3 Measurement of the power dissipation of the fuse-link

The power dissipation shall be measured between the end caps of the fuse-link.

This verification shall be carried out in the test rig shown in Figure 405.

The contact forces for this test are specified in Table 414.

Table 414 – Contact forces of the test rig

Remark: this table was previously Table AA in IEC 60269-3-1, Section NC

Test rig	Fuse-link size	Contact force N
A	0	15 ± 10 %
	1	20 ± 10 %
	2	25 ± 10 %
B	3	40 ± 10 %
	4	50 ± 10 %

8.3.4.1 Temperature rise of the fuse-holder

This test shall be carried out with the dummy fuse-link shown in Figure 406.

For screw-type fuse-holders, the relevant fuse-carrier shall be tightened with a torque equal to two-thirds the torque specified in Table 415.

Table 415 – Torque to be applied to the screw-type fuse-carrier

Remark: this table was previously Table BB in IEC 60269-3-1, Section IIC

Size	Torque Nm
0	1,0
1	1,2
2	1,4
3	1,8
4	3,0

8.4 Verification of operation

8.4.1 Arrangement of the fuse

In addition to IEC 60269-1, the following applies.

The fuse-links are tested in test rigs as specified in Figure 405. The fuse-link is placed under a housing of polyacryl resin according to Figure 407.

The fuse shall be tested in a horizontal position. Before each test, it is necessary to verify the correct state of contact piece surfaces of the test rig.

8.5 Verification of the breaking capacity

8.5.1 Arrangement of the fuse

In addition to IEC 60269-1, the following applies.

The fuse-links are tested in test rig according to Figure 405. The contact forces to be applied are given in Table 414. Before each test, it is necessary to verify the correct state of the contact piece surfaces of the test rigs.

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1, tests in accordance with Table 20 of IEC 60269-1 shall be made. An alternative test to tests Nos. 1 and 2 of Table 20 is given in Annex B.

8.5.8 Acceptability of test results

Small blisters, localized bumps and small holes on the contact pieces may be neglected.

8.7.4 Verification of discrimination

To verify the requirements specified in 7.7.1 and 7.7.2 of this fuse system, the samples are arranged as for breaking capacity tests according to 8.5 of IEC 60269-1. The test voltage to verify the operating I^2t values shall be:

$$\frac{1,1 \times 380 \text{ V a.c.}}{\sqrt{3}}$$

8.9 Verification of resistance to heat

8.9.1 Test in heating cabinet

The following test applies to fuse-holders.

The fuse-holder is kept for 1 h in a heating cabinet at a temperature of $100 \text{ °C} \pm 2 \text{ °C}$.

During the test, it shall not undergo any change impairing its further use, and sealing compound, if any, shall not flow to such an extent that live parts are exposed.

After the test, and after the fuse-holder has been allowed to cool down to approximately room temperature, there shall be no access to live parts which are normally non-accessible when the fuse-holder is mounted as in normal use, even if the standard test finger (see Figure 9 of IEC 60898) is applied with a force not exceeding 5 N.

After the test, markings shall still be legible. Discoloration, blisters or a slight displacement of the sealing compound may be disregarded, provided that safety is not impaired within the meaning of this standard.

8.9.2 Ball-pressure test

The following test applies to fuse-holders.

8.9.2.1 Parts made of insulating material, necessary to retain current-carrying parts in position, are subjected to a ball-pressure test by means of the apparatus as specified in 8.14.2 of IEC 60898.

A protective conductor is not considered as a current-carrying part. The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface with a force of 20 N.

The test is made in a heating cabinet at a temperature of $125^{\circ}\text{C} \pm 2^{\circ}\text{C}$. After 1 h, the ball is removed from the sample, which is then cooled down within 10 s to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

8.9.2.2 Parts of insulating material, not necessary to retain current-carrying parts in position even though they are in contact with them, and parts in contact with parts of the protective circuit, if any, are subjected to a ball-pressure test as specified above, but the test is made at a temperature of $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$, or $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ plus the highest temperature rise T determined for the relevant part during the test of 8.3 of this fuse system, whichever is the higher. The test is not made on parts of ceramic material.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

A dummy fuse-link, with its maximum power dissipation and its dimensions, is given in Figure 406 of this standard. Subclause 8.3.4.1 of this fuse system applies.

Torques to be applied to the screws of the terminals are specified in 8.3.1 of this fuse system.

8.10.2 Test method

The load period is 75 % of the conventional time.

The no-load period is 25 % of the conventional time.

The test-current is the non-fusing current.

The conventional time, as well as the non-fusing current, are stated in Table 2 of IEC 60269-1. A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature-rise values of terminals shall not exceed the temperature rise measured at the beginning of the test (1st cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature-rise values of terminals shall not exceed the values measured at the beginning of the test (1st cycle) by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1.4 Mechanical strength of screw thread

For screws which are operated during the installation of the fuse, including screws of terminals and screws for fixing covers – but not screws for fixing the fuse base to the supporting surface – the following test is performed.

The screws are tightened and loosened five times in the case of metallic thread and 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 416.

For testing terminal screws, a conductor of the largest cross-sectional area specified by the manufacturer or in IEC 60269-1 shall be placed in the terminal. The conductor shall be moved after each operation to present a new surface to the terminal screw.

Table 416 – Mechanical strength of screw-thread

Remark: this table was previously Table C in IEC 60269-3, Edition 2

Nominal diameter of thread mm	Torque Nm
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 10,0	7,5

During the test, no change impairing the further use of the screwed connection shall occur.

8.11.1.6 Mechanical strength of the fuse-holder

Fuse-holders shall have adequate mechanical behaviour so as to withstand stresses imposed during installation and use.

Compliance is checked by the tests specified in 8.11.1.6.1, 8.11.1.6.2 and 8.11.1.6.3 of this fuse system.

8.11.1.6.1 Impact test

This test is performed on the fuse-holder fitted with its enclosure or cover-plate mounted as in normal use. The sample is subjected to impact by means of the test apparatus as shown in Figures 10, 11 and 12 of IEC 60898.

The striking element has a hemispherical face of 10 mm radius, made of polyamide having a Rockwell hardness of HR100, and has a mass of $150 \text{ g} \pm 1 \text{ g}$.

It is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and a wall thickness of 0,5 mm, which is pivoted at its upper end in such a way that it swings only in a vertical plane.

The axis of the pivot is $1\,000 \text{ mm} \pm 1 \text{ mm}$ above the axis of a striking element.

The Rockwell hardness of the polyamide striking element is determined by using a ball having a diameter of $12,700 \text{ mm} \pm 0,0025 \text{ mm}$, with the initial load $500 \text{ N} \pm 2,5 \text{ N}$ and the extra load $100 \text{ N} \pm 2 \text{ N}$.

Additional information concerning the determination of the Rockwell hardness of plastics is given in ASTM D 785-89¹⁾.

The design of the apparatus is such that a force between 1,9 N and 2,0 N has to be applied to the face of the striking element to maintain the tube in a horizontal position.

The sample is mounted on a sheet of plywood, 8 mm thick and 175 mm square, secured at its top and bottom edge to a rigid bracket, which is part of the mounting support.

The mounting support shall have a mass of $10 \text{ kg} \pm 1 \text{ kg}$ and shall be mounted on a rigid frame by means of pivots. The frame is fixed to a solid wall.

The design of the mounting is such that

- the sample can be so placed that the point of impact lies in the vertical plane through the axis of the pivot;
- the sample can be removed horizontally and turned about an axis perpendicular to the surface of the plywood;
- the plywood can be turned around a vertical axis.

For flush-type fuses, the sample is mounted in a suitable recess provided in a block of plywood or similar material, which is fixed to a sheet of plywood, and not in its relevant mounting box. If wood is used for the block, the direction of the wood-fibres shall be perpendicular to the direction of the impact. Flush-type fixing fuses shall be fixed by means of screws to lugs recessed in the plywood block.

Flush-type claw-fixing fuses shall be fixed to the block by means of the claws.

The sample is mounted so that the point of impact lies in the vertical plane through the axis of the pivot. The striking element is allowed to fall from a height of 10 cm.

The height of fall is the vertical distance between the position of a checking point, when the pendulum is released, and the position of that point at the moment of impact. The checking point is marked on the surface of the striking element where the line through the point of intersection of the axes of the steel tube of the pendulum and the striking element, and perpendicular to the plane through both axes, meets the surface.

¹⁾ The American Society for Testing and Materials Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.

Theoretically, the centre of gravity of the striking element should be the checking point. As the centre of gravity in practice is difficult to determine, the checking point is chosen as described above.

The sample is subjected to 10 blows, which are evenly distributed over the sample.

In general, five blows are applied as follows.

- For flush-type fuses, one blow on the fuse-carrier; the other blows shall be distributed on the external surface as follows:
 - one at each extremity of the area over the recess in the block; and
 - the other two approximately midway between the previous blows, preferably on the ridge, if any, the sample being moved horizontally.
- For other fuses, one blow on the fuse-carrier, the other blows shall be distributed on the external surface as follows:
 - one on each side of the sample after it has been turned as far as possible, but not through more than 60°, about a vertical axis; and
 - the other two approximately midway between the previous blows, preferably on the ridge, if any.

The remaining blows are then applied in the same way, after the sample has been turned through 90° around its axis perpendicular to the plywood.

Cover-plates and other covers of multiple fuses are tested as though they were the corresponding number of separate covers, but only one blow is applied to any point.

After the test, the sample shall show no damage within the meaning of this standard. In particular, live parts shall not become accessible.

In case of doubt, it shall be verified that it is possible to remove and to replace external parts, such as boxes, enclosures, covers and cover-plates, without these parts or their insulating lining being broken.

If, however, a cover-plate, backed by an inner cover, is broken, the test is repeated on the inner cover, which shall remain unbroken.

Damage to the finish, small dents which do not reduce creepage distances or clearances below the value specified in 7.2 of this fuse system and small chips which do not adversely affect the protection against electric shock may be neglected.

Cracks not visible to the naked eye and surface cracks in fibre-reinforced mouldings and the like may be ignored. Cracks or holes in the outer surface of any part of the fuse-holder may be ignored if the fuse-holder complies with this fuse system, even if this part is omitted.

If a decorative cover is backed by an inner cover, fracture of the decorative cover may be neglected if the inner cover withstands the test after removal of the decorative cover.

8.11.1.6.2 Construction of the fuse-carrier

All fuse-carriers shall comprise a device intended to maintain the fuse-link in place during the withdrawal of the fuse-carrier from the fuse-base.

The efficiency of this device is verified by using a fuse-base corresponding to the fuse-carrier under test. The fuse-carrier is equipped with a gauge, having contact dimensions corresponding to the maximum contact dimensions of the relevant fuse-link specified in Figure 401 for the rated current of the fuse considered and fitted together with the fuse-base as in normal use.

The fuse-carrier is then withdrawn from the fuse-base and the gauge is replaced by a new gauge, having contact dimensions corresponding to the minimum contact dimensions specified in Figure 402.

The fuse-carrier is then kept in its most unfavourable position during about 10 s. The gauge shall not fall out from the fuse-carrier under the effect of its own weight.

The weight of the gauge used for this test should be as near as possible to the weight of the relevant fuse-link; moreover, the contact surfaces shall be made of polished steel.

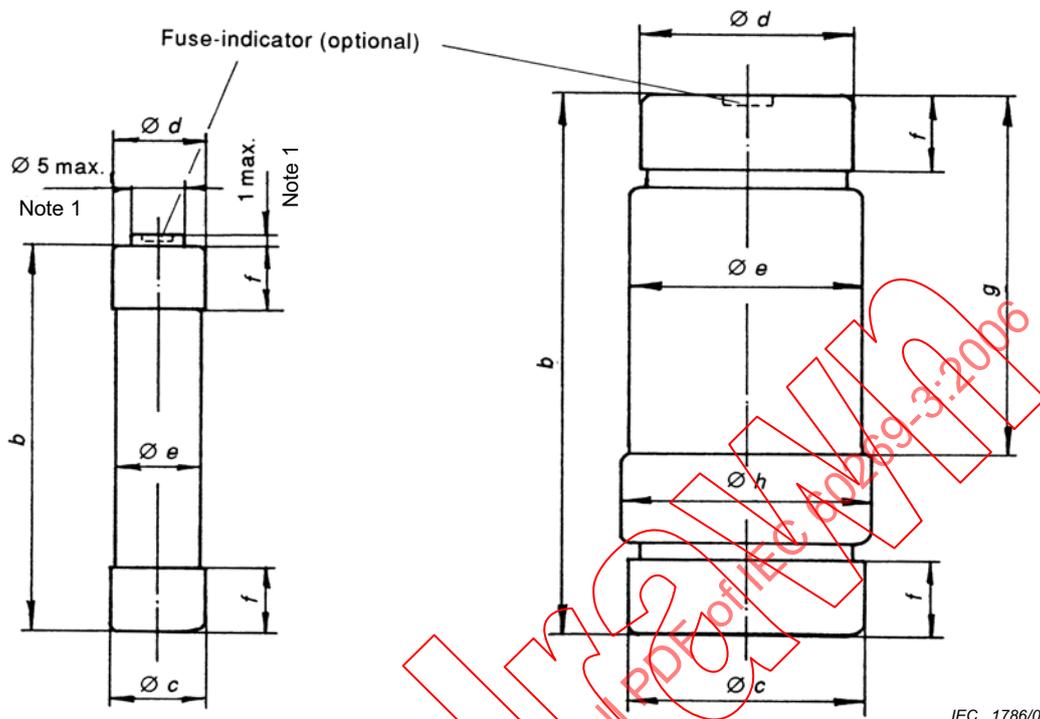
8.11.1.6.3 Mechanical strength of the screw-type fuse-holder

This test applies only to screw-type fuses.

The fuse-carrier, with a relevant fuse-link complying with Figure 401, is screwed and unscrewed five times into the fuse-base by applying a torque as given in Table 415. After this test, the sample shall not show any change impairing its further use.

8.11.2.6 Dimensions and non-interchangeability

Compliance with 8.1.4 of 60269-1 and 7.1.8. of this standard shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.



Size	b	c	d	e (max.)	f (min.)	g	h
0	$31,5 \pm 0,5$	$8,8 \pm 0,2$	$8,3 \pm 0,2$	8	4	–	–
1	$36 \pm 0,8$	$9 \pm 0,4$	$8,5 \pm 0,4$	8,2	5	–	–
2	$38 \pm 0,8$	$10,2 \pm 0,4$	$9,8 \pm 0,4$	9,5	5	–	–
3	50 ± 1	$13,7 \begin{smallmatrix} +0,6 \\ 0 \end{smallmatrix}$	$12,5 \begin{smallmatrix} +0,6 \\ 0 \end{smallmatrix}$	13,5	5	33 ± 2	$14 \begin{smallmatrix} +1 \\ 0 \end{smallmatrix}$
4	50 ± 1	$22 \begin{smallmatrix} +0,8 \\ 0 \end{smallmatrix}$	$20 \begin{smallmatrix} +0,8 \\ 0 \end{smallmatrix}$	22	6	33 ± 2	$23,5 \begin{smallmatrix} +1 \\ 0 \end{smallmatrix}$

Current-carrying parts are of copper or copper alloys.

NOTE 1 Only for fuse-link having a fuse-indicator.

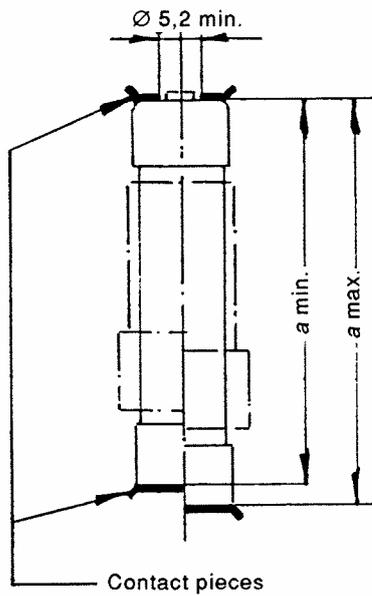
Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

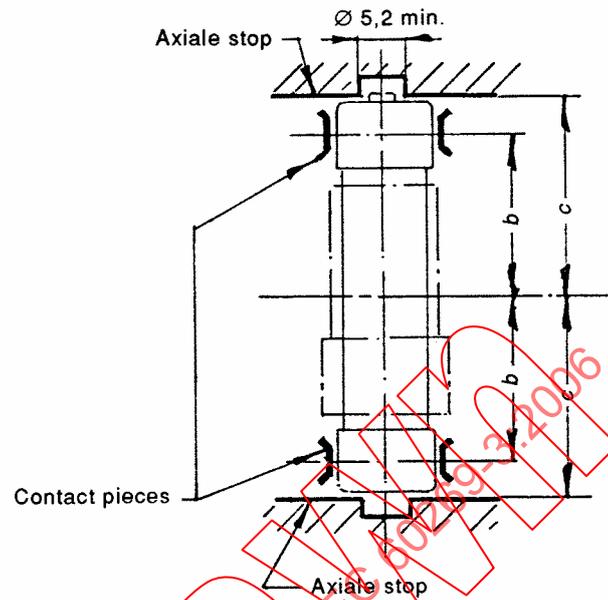
Figure 401 – Cylindrical fuse-link type C

Remark: this figure was previously Figure 23 in IEC 60269-3-1, Section IIC

Contacts on fuse-link end surfaces



Contacts on fuse-link cylindrical surfaces



IEC 631/01

The contacts shall be ensured within dimensions: a min. and a max.

Axial stops and contact pieces shall be so constructed as not to interfere with the indicating devices, if any.

Bases having one contact on fuse-link end surface and the other on fuse-link cylindrical surface are allowed.

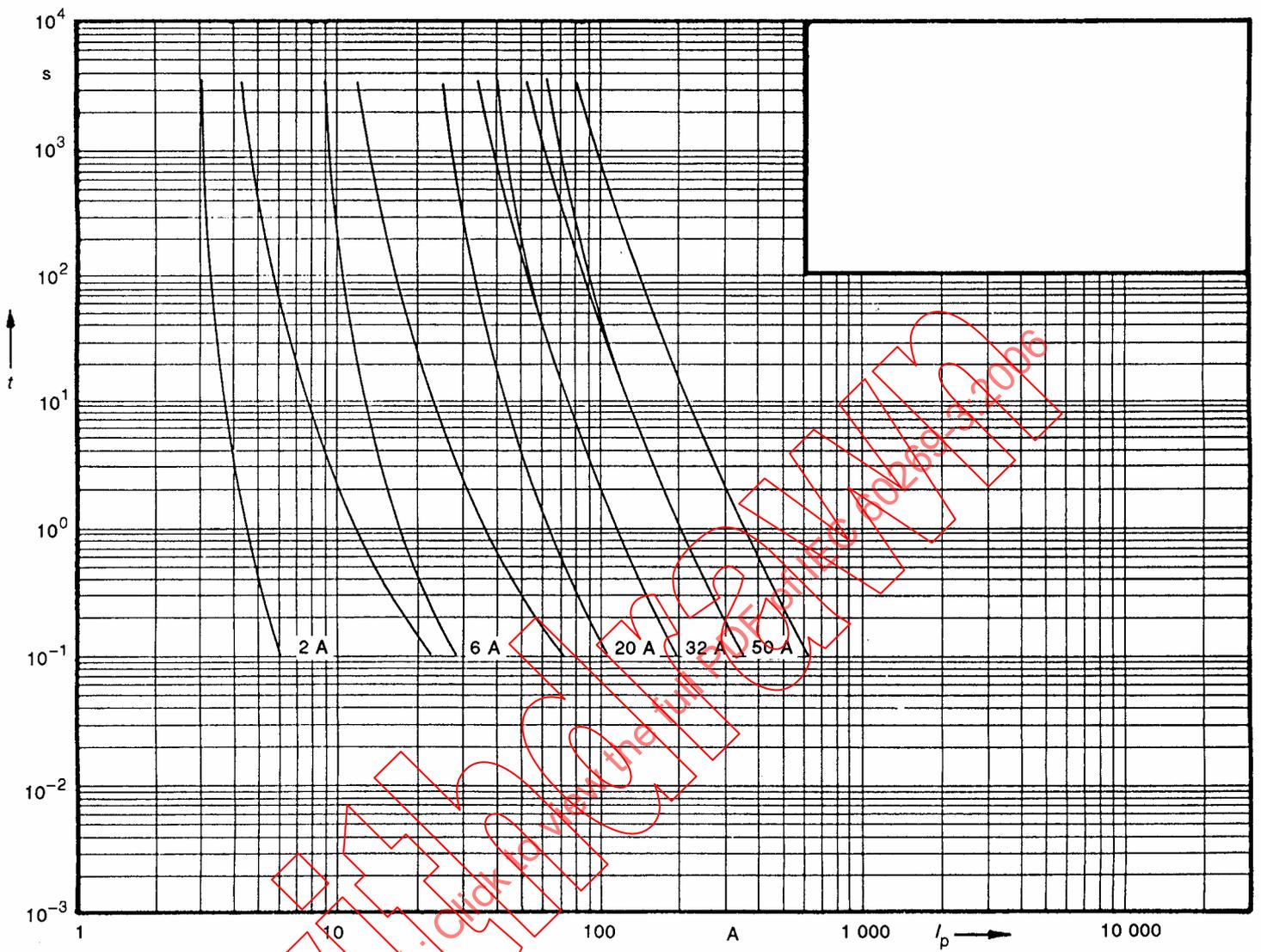
Size	Contacts on end surfaces		Contacts on cylindrical surfaces	
	a min.	a max.	$b \begin{smallmatrix} +0,3 \\ 0 \end{smallmatrix}$	$c \begin{smallmatrix} 0 \\ -0,3 \end{smallmatrix}$
0	30,8	32,2	13	16,5
1	35	37	14,5	18,9
2	37	39	15,5	19,9
3	49,8	51,2	21,5	25,5
4	49,8	51,2	21	25,5

Dimensions in millimetres

The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 402 – Fuse-base

Remark: this figure was previously Figure 24 in IEC 60269-3-1, Section IIC



IEC 632/01

Figure 403 – Time-current zones

Remark: this figure was previously Figure 25a in IEC 60269-3-1, Section IIC

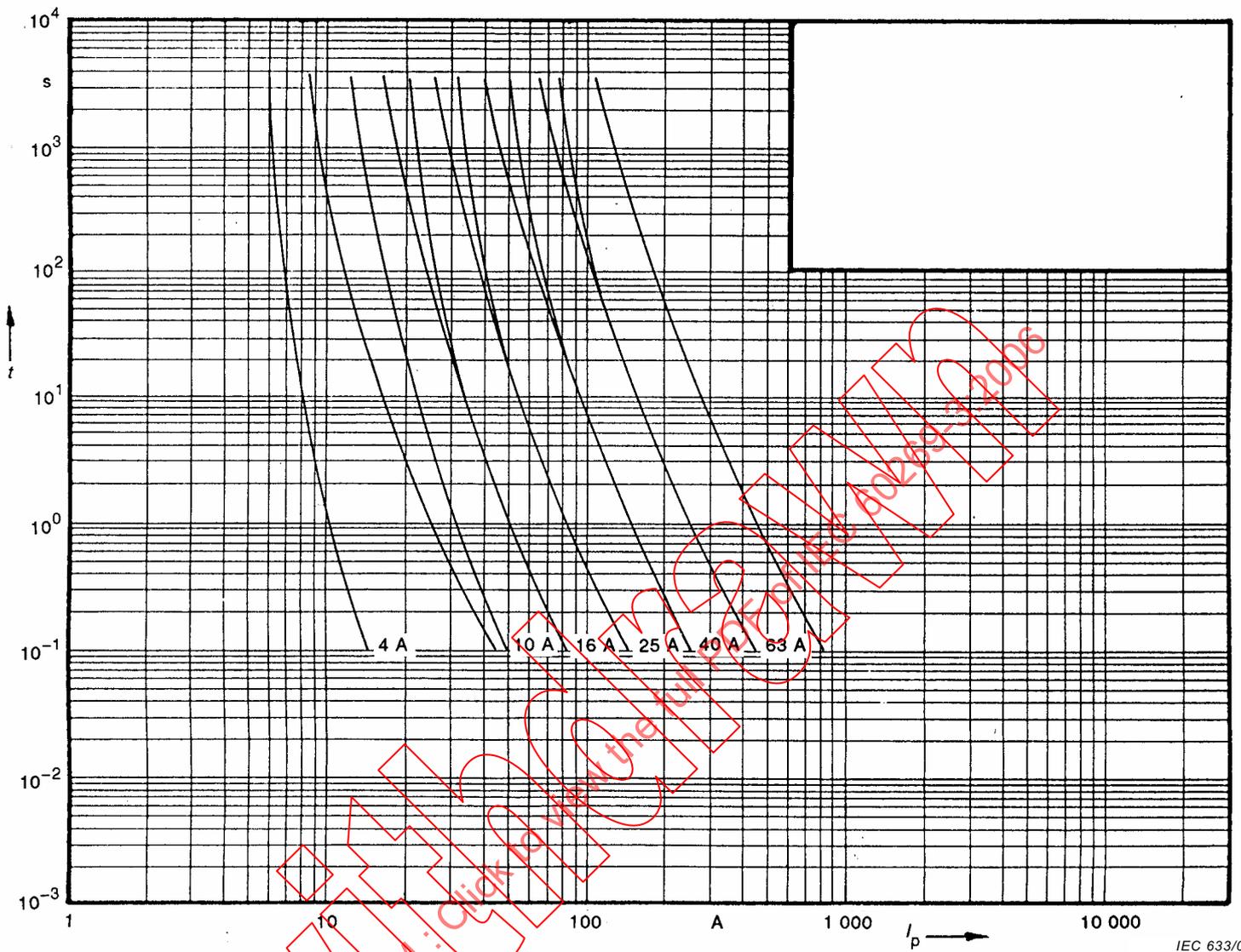
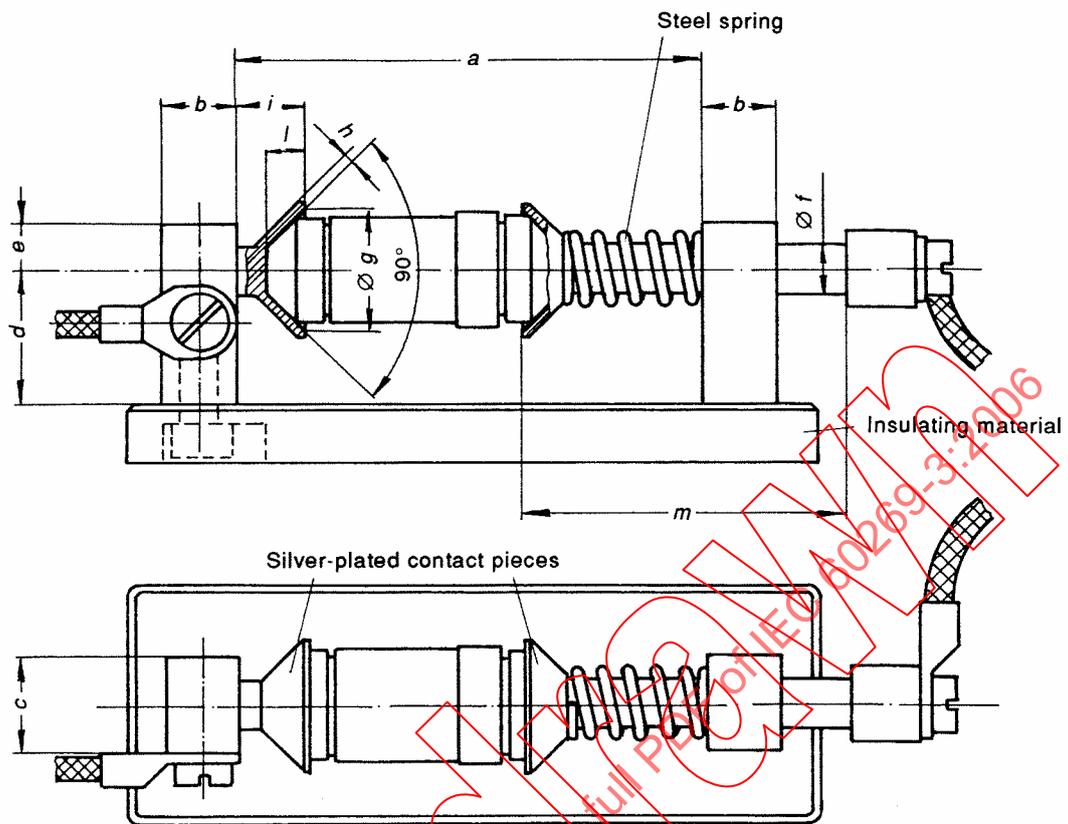


Figure 404 – Time-current zones

Remark: this figure was previously Figure 25b in IEC 60269-3-1, Section IIC



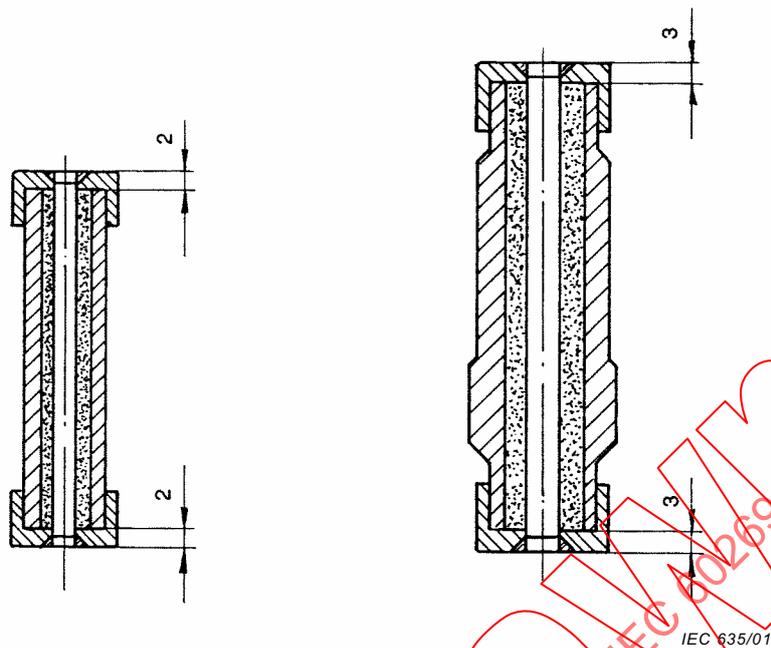
IEC 634/01

Test rig	Fuse-link size	Dimensions											
		mm											
		a	b	c	d	e	f	g	h	i	l	m	
A	0	70											
	1	73	12	15	19	7	6	13	3	10	5	53	
	2	74											
B	3	90	16	20	28	10	10	25	3	14	9	67	
	4	95											

NOTE Current-carrying parts, other than springs, are of brass with copper contents from 58 % to 70 %.

Figure 405 – Test rig

Remark: this figure was previously Figure 26 in IEC 60269-3-1, Section IIC



NOTE The end caps are made of copper tin alloy, nickel-plated. The body is made of ceramic material. The fuse element is made of an alloy of 56 % copper and 44 % nickel or of an equivalent material with similar values of specific resistance and temperature coefficient (for example, constantan), hard-soldered to the end caps. The arc-extinguishing medium and the filling are the same as those of the normal fuse-links. The other dimensions are those specified in Figure 401.

The values of power dissipation are specified in Table 403.

Figure 406 – Dummy fuse-link

Remark: this figure was previously Figure 27 in IEC 60269-3-1, Section IIC

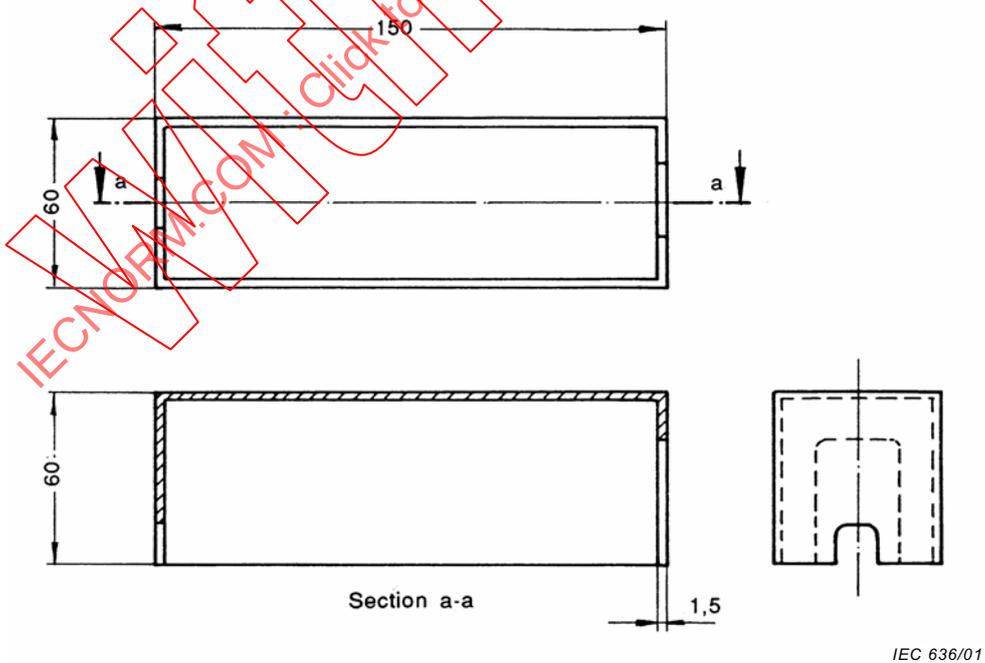


Figure 407 – Housing for verification of operation of the fuse-links

Remark: this figure was previously Figure 28 in IEC 60269-3-1, Section IIC

Fuse system E – Pin-type fuses

Remark: previously Section III in IEC 60269-3-1

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to “gG” pin-type fuses for use by unskilled persons for domestic and similar applications according to Figures 501, 502 and 503.

These fuses have rated currents up to and including 50 A and a rated voltage of 230 V a.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1.

- rated voltage;
- rated power dissipation of the fuse-link and rated acceptable power dissipation of a fuse-holder;
- time-current characteristic;
- gates, I^2t characteristics and conventional times and currents;
- rated breaking capacity;
- marking on the fuse;
- standard conditions for construction;
- tests.

2 Terms and definitions

IEC 60269-1 applies with the following supplementary requirements.

2.3 Characteristic quantities

2.3.501

Remark: previously 2.3.25 in IEC 60269-3-1, Section III

equivalent section of a fuse-base

minimum section of the copper wire to be protected when the fuse-base is fitted with a fuse-link of the maximum current rating which the fuse-base can accommodate

2.3.502

Remark: previously 2.3.26 in IEC 60269-3-1, Section III

size of the fuse-base

conventional roman figure by which the type of the fuse-base is defined with regard both to its equivalent section and to the maximum rated current of the fuse-link the fuse-base can accommodate