

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Low-voltage fuses –

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

Fusibles basse tension –

Partie 2: Exigences supplémentaires pour les fusibles destinés à être utilisés par des personnes habilitées (fusibles pour usages essentiellement industriels) – Exemples de systèmes de fusibles normalisés A à J

WINDOWN



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CONTENTS

FOREWORD.....	14
INTRODUCTION.....	16
1 General scope.....	17
1.2 Normative references	18
Fuse system A – Fuses with fuse-links with blade contacts (NH fuse system)	19
1 General	19
1.1 Scope.....	19
2 Terms and definitions	19
3 Conditions for operation in service.....	19
4 Classification.....	20
5 Characteristics of fuses	20
5.2 Rated voltage	20
5.3.1 Rated current of the fuse-link.....	20
5.3.2 Rated current of the fuse-holder	20
5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	20
5.6 Limits of time-current characteristics.....	21
5.6.1 Time-current characteristics, time-current zones and overload curves	21
5.6.2 Conventional times and currents.....	21
5.6.3 Gates	21
5.7.2 Rated breaking capacity.....	21
6 Marking	22
6.1 Markings of fuse-holders	22
6.2 Markings of fuse-links.....	22
7 Standard conditions for construction	22
7.1 Mechanical design.....	23
7.1.2 Connections, including terminals	23
7.1.3 Fuse-contacts.....	23
7.1.6 Construction of fuse-bases	23
7.1.7 Construction of a fuse-link	24
7.2 Insulating properties.....	24
7.7 I^2t characteristics	24
7.8 Overcurrent discrimination of "gG" fuse-links.....	25
7.9 Protection against electric shock	25
8 Tests	25
8.1.4 Arrangement of the fuse and dimensions	26
8.1.6 Testing of fuse-holders	26
8.2.4 Acceptability of test results.....	27
8.2.5 Resistance to tracking	27
8.3 Verification of temperature rise and power dissipation	27
8.3.1 Arrangement of the fuse	27
8.3.2 Measurement of the temperature rise	28
8.5.8 Acceptability of test results.....	29
8.7.4 Verification of overcurrent discrimination	29

8.9	Verification of resistance to heat	31
8.9.1	Fuse-base	31
8.9.2	Fuse-links with gripping lugs of moulded material or of metal fixed in moulded material	31
8.10	Verification of non-deterioration of contacts and direct terminal clamps	32
8.10.1	Arrangement of the fuse	32
8.10.2	Test method	34
8.10.3	Acceptability of test results	35
8.11	Mechanical and miscellaneous tests	36
Annex AA	(informative) Special test for cable overload protection	58

Fuse system B – Fuses with striker fuse-links with blade contacts (NH fuse system)	59
1 General	59
1.1 Scope	59
2 Terms and definitions	59
3 Conditions for operation in service	59
4 Classification	59
5 Characteristics of fuses	59
5.2 Rated voltage	59
5.3.1 Rated current of the fuse-link	59
5.3.2 Rated current of the fuse-holder	60
5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	60
5.6 Limits of time-current characteristics	60
5.7.2 Rated breaking capacity	60
6 Marking	60
7 Standard conditions for construction	60
7.1 Mechanical design	60
7.1.2 Connections, including terminals	60
7.1.3 Fuse-contacts	60
7.1.7 Construction of a fuse-link	61
7.2 Insulating properties and suitability for insulation	61
7.7 I^2t characteristics	61
7.8 Overcurrent discrimination of "gG" fuse-links	61
7.9 Protection against electric shock	61
8 Tests	61
8.1.6 Testing of fuse-holders	61
8.3 Verification of temperature rise and power dissipation	61
8.7.4 Verification of overcurrent discrimination	62
8.9 Verification of resistance to heat	62
8.9.1 Fuse-base	62

Fuse system C – Fuse-rails (NH fuse system)	71
1 General	71
1.1 Scope	71
2 Terms and definitions	71

3	Conditions for operation in service.....	71
4	Classification.....	71
5	Characteristics of fuses	71
5.2	Rated voltage	71
5.3.2	Rated current	71
5.5.1	Rated acceptable power dissipation.....	71
6	Markings	71
7	Standard conditions for construction.....	72
7.1	Mechanical design.....	72
7.1.2	Connections, including terminals	72
7.2	Insulating properties.....	72
8	Tests	72
8.1.6	Testing of fuse-holders	73
8.3	Verification of temperature rise and power dissipation.....	73
8.3.1	Arrangement of the fuse	73
8.10	Verification of non-deterioration of contacts and direct terminal clamps	74
8.10.1	Arrangement of the fuse	74

Fuse system D – Fuse-bases for busbar mounting (40 mm system) (NH fuse system)

1	General	79
1.1	Scope.....	79
2	Terms and definitions	79
3	Conditions for operation in service.....	79
4	Classification.....	79
5	Characteristics of fuses	79
5.2	Rated voltage.....	79
5.3.2	Rated current	79
5.5.2	Rated acceptable power dissipation of tandem fuse-bases	80
6	Markings	80
7	Standard conditions for construction.....	80
7.1	Mechanical design.....	80
7.1.2	Connections, including terminals	80
7.1.5	Construction of a fuse-base for busbar mounting	80
7.2	Insulating properties and suitability for insulation	81
8	Tests	81
8.3	Verification of temperature rise and power dissipation	81
8.3.1	Arrangement of the fuse	81
8.9.1	Fuse-base	82
8.10	Verification of non-deterioration of contacts and direct terminal clamps	82
8.10.1	Arrangement of the fuse	82
8.10.2	Test method	82
8.11	Mechanical and miscellaneous tests.....	82

Fuse system E – Fuses with fuse-links for bolted connections (BS bolted fuse system)

1	General	91
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1.1	Scope.....	91
2	Terms and definitions	91
3	Conditions for operation in service.....	91
4	Classification.....	91
5	Characteristics of fuses	91
5.3.1	Rated current of the fuse-link.....	91
5.3.2	Rated current of the fuse-holder	91
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	91
5.6	Limits of time-current characteristics	92
5.6.1	Time-current characteristics, time-current zones and overload curves	92
5.6.2	Conventional times and currents.....	92
5.6.3	Gates	92
5.7.2	Rated breaking capacity	92
6	Markings	92
6.1	Markings of fuse-holders	92
6.2	Markings of fuse-links.....	92
7	Standard conditions for construction.....	93
7.1	Mechanical design.....	93
7.1.2	Connections including terminals	93
7.2	Insulating properties and suitability for insulation	93
7.9	Protection against electric shock	93
8	Tests	93
8.3	Verification of temperature rise and power dissipation	93
8.3.1	Arrangement of the fuse	93
8.3.3	Measurement of the power dissipation of the fuse-link.....	93
8.4	Verification of operation	93
8.4.1	Arrangement of the fuse	93
8.5	Verification of breaking capacity.....	93
8.5.1	Arrangement of the fuse	93
8.5.8	Acceptability of test results.....	93
8.9	Verification of resistance to heat	94
8.10	Verification of non-deterioration of contacts.....	94
8.10.1	Arrangement of the fuse	94
8.10.2	Test method	94
8.10.3	Acceptability of the results.....	94
8.11	Mechanical and miscellaneous tests.....	94

Fuse system F – Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)	105
1 General	105
1.1 Scope.....	105
2 Terms and definitions	105
3 Conditions for operation in service.....	105
4 Classification.....	105
5 Characteristics of fuses	105
5.2 Rated voltage	105

5.3.1	Rated current of the fuse-link.....	105
5.3.2	Rated current of the fuse-holder	106
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	106
5.6	Limits of time-current characteristics	107
5.6.1	Time-current characteristics, time-current zones and overload curves	107
5.6.2	Conventional times and currents.....	107
5.6.3	Gates	107
5.7.2	Rated breaking capacity	107
6	Marking	108
6.1	Markings of fuse-holders	108
6.2	Markings of fuse-links.....	108
7	Standard conditions for construction.....	108
7.1	Mechanical design.....	108
7.1.2	Connections including terminals	108
7.2	Insulating properties and suitability for insulation	109
7.7	I^2t characteristics	109
7.8	Overcurrent discrimination of "gG" fuse-links.....	109
7.9	Protection against electric shock	109
8	Tests	110
8.1.6	Testing of fuse-holders.....	110
8.3.1	Arrangement of the fuse	110
8.7.4	Verification of overcurrent discrimination.....	112
8.9	Verification of resistance to heat	113
8.10	Verification of non-deterioration of contacts.....	113
8.10.1	Arrangement of the fuse	113
8.10.2	Test method	114
8.10.3	Acceptability of test results.....	114
Fuse system G – Fuses with fuse-links with offset blade contacts (BS clip-in fuse system)		119
1	General	119
1.1	Scope.....	119
2	Terms and definitions	119
3	Conditions for operation in service.....	119
4	Classification.....	119
5	Characteristics of fuses	119
5.2	Rated voltage	119
5.3.1	Rated current of the fuse-link.....	120
5.3.2	Rated current of the fuse-holder	120
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	120
5.6.1	Time-current characteristics, time-current zones	120
5.6.2	Conventional times and currents.....	120
5.6.3	Gates	120
5.7.2	Rated breaking capacity	120
6	Markings	121
6.1	Markings of fuse-holders	121

6.2	Markings of fuse-links.....	121
7	Standard conditions for construction.....	121
7.1	Mechanical design.....	121
7.1.2	Connections including terminals	121
7.2	Insulating properties and suitability for insulation	121
7.7	I^2t characteristics	121
7.9	Protection against electric shock	122
8	Tests	122
8.3.3	Measurement of the power dissipation of the fuse-link.....	122
8.4.1	Arrangement of the fuse	122
8.5.1	Arrangement of the fuse	122
8.7.4	Verification of overcurrent discrimination	122
8.9	Verification of resistance to heat	123
8.10	Verification of non-deterioration of contacts.....	123
8.10.1	Arrangement of the fuse	123
8.10.2	Test method	123
8.10.3	Acceptability of test results.....	123
8.11	Mechanical and miscellaneous tests.....	123
Fuse system H – Fuses with fuse-links having "gD" and "gN" characteristics (class J, class T, and class L time delay and non time delay fuse types)		129
1	General	129
1.1	Scope.....	129
2	Terms and definitions.....	129
3	Conditions for operation in service.....	129
4	Classification.....	129
5	Characteristics of fuses	129
5.2	Rated voltage	129
5.3.1	Rated current of the fuse-link.....	130
5.3.2	Rated current of the fuse-holder	130
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	130
5.6	Limits of the time-current characteristics	130
5.6.1	Time-current characteristics, time-current zones	130
5.6.2	Conventional times and currents.....	130
5.6.3	Gates	130
5.7.2	Rated breaking capacity	131
6	Markings	131
6.1	Markings of fuse-holders	131
6.2	Markings of fuse-links.....	131
7	Standard conditions for construction.....	131
7.1	Mechanical design.....	131
7.2	Insulating properties and suitability for insulation	131
7.5	Breaking Capacity	131
7.6	Cut-off current characteristics.....	131
7.7	I^2t characteristics	132
7.8	Overcurrent discrimination.....	132
7.9	Protection against electric shock	132

8	Tests	133
8.3	Verification of temperature rise and power dissipation	133
8.3.1	Arrangement of the fuse	133
8.4	Verification of operation	133
8.4.1	Arrangement of the fuse	133
8.5.4	Recovery voltage	134
8.6	Verification of cut-off current characteristics	134
8.7	Verification of I^2t characteristics and overcurrent discrimination	134
8.9	Verification of resistance to heat	135
8.10	Verification of non-deterioration of contacts	135
8.10.1	Arrangement of the fuse	135
8.10.2	Test method	135
8.10.3	Acceptability of test results	136
8.11	Mechanical and miscellaneous tests	136
8.11.2	Miscellaneous tests	136
	Fuse system I – gU fuse-links with wedge tightening contacts	151
1	General	151
1.1	Scope	151
2	Terms and definitions	151
3	Conditions for operation in service	151
3.9	Discrimination of fuse-links	151
4	Classification	152
5	Characteristics of fuses	152
5.2	Rated voltage	152
5.3.1	Rated current of the fuse-link	152
5.5	Rated power dissipation of a fuse-link	152
5.6.1	Time-current characteristics, time-current zones	152
5.6.2	Conventional times and currents	152
5.6.3	Gates	152
5.7.2	Rated breaking capacity	153
5.8	Cut-off current and I^2t characteristics	153
6	Markings	153
6.1	Markings of fuse-holders	153
6.2	Markings of fuse-links	153
7	Standard conditions for construction	153
7.1	Mechanical design	153
7.2	Insulating properties and suitability for insulation	153
7.5	Breaking capacity	153
7.7	I^2t characteristics	153
7.8	Overcurrent discrimination of the fuse-links	154
8	Tests	154
8.1.1	Kind of tests	154
8.3.1	Arrangement of the fuse	154
8.3.3	Measurement of the power dissipation of the fuse-link	155
8.4.1	Arrangement of the fuse	155
8.5.1	Arrangement of the fuse	155

8.5.2	Characteristics of the test circuit.....	155
8.5.5	Test method	155
8.5.8	Acceptability of test results	155
8.7.3	Verification of compliance for fuse-links at 0,01 s	156
8.9	Verification of resistance to heat	156
8.11	Mechanical and miscellaneous tests.....	156

Fuse system J – Fuses with fuse-links having "gD class CC" and "gN class CC" characteristics (Class CC time delay and non-time delay fuse types).....

1	General	165
1.1	Scope.....	165
2	Terms and definitions	165
3	Conditions for operation in service.....	165
4	Classification.....	165
5	Characteristics of fuses	165
5.2	Rated voltage	165
5.3.1	Rated current of the fuse-link.....	166
5.3.2	Rated current of the fuse-holder	166
5.5	Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder	166
5.6	Limits of the time-current characteristics	166
5.6.1	Time-current characteristics, time-current zones	166
5.6.2	Conventional times and currents.....	166
5.6.3	Gates	166
5.7.2	Rated breaking capacity.....	166
6	Markings	167
6.1	Markings of fuse-holders.....	167
6.2	Markings of fuse-links.....	167
7	Standard conditions for construction.....	167
7.1	Mechanical design.....	167
7.2	Insulating properties and suitability for insulation	167
7.5	Breaking Capacity	167
7.6	Cut-off current characteristics.....	167
7.7	I^2t characteristics	167
7.8	Overcurrent discrimination.....	168
7.9	Protection against electric shock	168
8	Tests	168
8.3	Verification of temperature rise and power dissipation	168
8.3.1	Arrangement of the fuse	168
8.4	Verification of operation	169
8.4.1	Arrangement of the fuse	169
8.5.4	Recovery voltage.....	169
8.6	Verification of cut-off current characteristics	169
8.7	Verification of I^2t characteristics and overcurrent discrimination	170
8.9	Verification of resistance to heat	170
8.10	Verification of non-deterioration of contacts.....	171
8.10.1	Arrangement of the fuse	171
8.10.2	Test method	171

8.10.3 Acceptability of test results.....	171
8.11 Mechanical and miscellaneous tests.....	171
8.11.2 Miscellaneous tests	172
Bibliography.....	181
Figure 101 – Fuse-links with blade contacts.....	39
Figure 102 – Fuse-bases for fuse-links with blade contacts.....	42
Figure 103 – Replacement handle.....	45
Figure 104 – Time-current zones for "gG" fuse-links	46
Figure 105 – Dummy fuse-link according to 8.3.4.1, 8.9.1 and 8.10	51
Figure 106 – Measuring points according to 8.3.4 of IEC 60269-1, 8.3.4.1, 8.3.4.2 and 8.10.2 of fuse system A	52
Figure 107 – Test knife according to 8.5.5.1.2	52
Figure 108 – Example of a measuring device for determining the withdrawal forces according to 8.9.1 and 8.11.1.2.....	53
Figure 109 – Facility for verifying the mechanical strength of gripping lugs (see 8.11.1.8).....	54
Figure 110 – Measuring points according to 8.10.2.....	55
Figure 111 – Reference fuse-base	56
Figure 112 – Design mark for isolated gripping-lugs.....	57
Figure 201 – Fuse-links with blade contacts with striker.....	64
Figure 202 – Fuse-bases for fuse-links with blade contacts with striker.....	68
Figure 301 – Fuse-rails for fuse-links with blade contacts	75
Figure 302 – Test arrangement for fuse-rails	77
Figure 401 – Busbar mounting bases, 1 pole.....	84
Figure 402 – Busbar mounting bases, 3 pole.....	85
Figure 403 – Busbar mounting base, size 00, 2 × 3 pole (tandem fuse-base).....	86
Figure 404 – Test arrangement for single-pole and triple-pole fuse-bases for busbar-mounting according to 8.3.1.....	87
Figure 405 – Test arrangement for two single-pole and six single-pole fuse-bases in tandem arrangement for busbar-mounting according to 8.3.1.....	88
Figure 406 – Test arrangement for the verification of the peak withstand current	89
Figure 407 – Dummy fuse-link	90
Figure 501 – Fuse-links for bolted connection – Sizes A, B, C and D	96
Figure 502 – Fuse-links for bolted connection – Sizes A and B	97
Figure 503 – Typical fuse-holder.....	98
Figure 504 – Time-current zones for "gG" fuse-link	100
Figure 505 – Time-current zones for "gG" fuse-link	101
Figure 506 – Power dissipation test rig	102
Figure 507 – Breaking capacity test rig for fuse-links for bolted connection.....	103
Figure 601 – Fuse-links with cylindrical caps	115
Figure 602 – Fuse-links with cylindrical contact caps with striker – Additional dimensions for sizes 14 × 51 and 22 × 58 only.....	116
Figure 603 – Base for fuse-links with cylindrical caps	117
Figure 701 – Fuse-links having offset blade contacts, sizes E1, F1, F2 and F3	124

Figure 702 – Typical fuse-holder	125
Figure 703 – Time-current zones for "gG" fuse-links	126
Figure 704 – Time-current zones for "gG" fuse-links	127
Figure 705 – Power dissipation test rig	128
Figure 801 – Class J fuse-links (1 – 600 A).....	137
Figure 802 – Class L fuse-links (700 – 6 000 A).....	138
Figure 803 – Fuse-base and contacts for Class J fuse-links 1 – 600 A	139
Figure 804 – Fuse-base and contacts for Class L fuse-links 700 – 6 000 A	140
Figure 805 – Class T fuse-links (1-1200 A)	141
Figure 806 – Fuse-base and contacts for Class T fuse-links 1-1200 A	142
Figure 807 – Class J Dummy fuse-link dimensions	143
Figure 808 – Class T Dummy fuse-link Dimensions.....	143
Figure 809 – Temperature test arrangement	144
Figure 810 – Time-current zones for "gN" fuse-links	145
Figure 811 – Time-current zones for "gN" fuse-links	146
Figure 812 – Time-current zones for "gN" fuse-links	147
Figure 813 – Time-current zones for "gD" fuse-links	148
Figure 814 – Time-current zones for "gD" fuse-links	149
Figure 815 – Time-current zones for "gD" fuse-links	150
Figure 901 – Time-current zones for current ratings 100 A, 200 A, 355 A and 630 A.....	157
Figure 902 – Time-current zones for current ratings 160 A and 315 A	158
Figure 903 – Time-current zones for current ratings 250 A and 500 A	159
Figure 904 – Time-current zones for current ratings 200 A and 400 A	160
Figure 905 – Dimensions for fuse-links with L type and U type tags	161
Figure 906 – Power dissipation test rig	162
Figure 907 – Breaking capacity test rig	163
Figure 1001 – Class CC Fuse-links (1-30 A)	172
Figure 1002 – Fuse-base and contacts for Class CC fuse-links 1-30 A.....	172
Figure 1003 – Class CC Dummy Fuse-link Dimensions	173
Figure 1004 – Temperature Test arrangement	174
Figure 1005 – Time-current zones for class CC "gN" fuses	175
Figure 1006 – Time-current zones for class CC "gN" fuses	176
Figure 1007 – Time-current zones for class CC "gN" fuses	177
Figure 1008 – Time-current zones for class CC "gD" fuses	178
Figure 1009 – Time-current zones for class CC "gD" fuses	179
Figure 1010 – Time-current zones for class CC "gD" fuses	180
Table 101 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A	21
Table 102 – Gates for specified pre-arcing and operating times of "gG" fuse-links	21
Table 103 – Minimum rated breaking capacities.....	22
Table 104 – Marking of fuse-links	22
Table 105 – Minimum cross-sectional ranges of unprepared conductors	23

Table 106 – Pre-arcing and operating I^2t values at 0,01 s for "gG" fuse-links	24
Table 107 – Maximum operating I^2t values for "aM" fuse-links	25
Table 108 – Pre-arcing I^2t values for discrimination	25
Table 109 – Survey of tests on fuse-holders and number of fuse-holders to be tested	26
Table 110 – Rated impulse withstand voltage	27
Table 111 – Torque to be applied to the terminal screws	28
Table 112 – Test currents	29
Table 113 – Test currents and I^2t limits for discrimination test	30
Table 114 – Torques to be applied when no values are given by the manufacturer	33
Table 115 – Cross-sectional area of aluminium conductors for tests corresponding to 8.10	33
Table 116 – Test sequence for direct terminal clamps.....	35
Table 117 – Permissible changes of the resistance.....	36
Table 118 – Force to withdraw the fuse-link from the fuse-base contacts.....	37
Table 201 – Position and force of the striker	61
Table 301 – Minimum cross-sectional ranges of unprepared conductors for fuse-rails.....	72
Table 302 – Survey of complete tests on fuse-rails and number of fuse-rails to be tested	73
Table 401 – Minimum cross-sectional ranges of unprepared conductors for fuse-bases for busbar mounting.....	80
Table 402 – Torques to be applied to contact making screws.....	81
Table 403 – Test currents	82
Table 404 – Force to withdraw the fuse-link from the fuse-base contacts	83
Table 501 – Conventional time and current for "gG" fuse-links	92
Table 502 – Gates for specified pre-arcing times of "gG" fuse-links	92
Table 601 – Maximum rated current of fuse-links with cylindrical caps	106
Table 602 – Maximum rated current of fuse-holders.....	106
Table 603 – Maximum values of the rated power dissipation of a fuse-link	106
Table 604 – Rated acceptable power dissipation of a fuse-holder	107
Table 605 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A.....	107
Table 606 – Gates for specified pre-arcing and operating times of "gG" fuse-links with rated current lower than 16 A.....	107
Table 607 – Minimum rated breaking capacities.....	108
Table 608 – Colours of marking	108
Table 609 – Minimum range of cross-sections for rigid copper conductors	109
Table 610 – Pre-arcing and operating I^2t values at 0,01 s for "gG" fuse-links	109
Table 611 – Maximum operating I^2t values for "aM" fuse-links	109
Table 612 – Survey of tests on fuse-holders and number of fuse-holders to be tested	110
Table 613 – Torque to be applied to the terminal screws	111
Table 614 – Test currents	112
Table 615 – Test currents and I^2t limits for discrimination test	113
Table 701 – Conventional time and current for "gG" fuse-links	120
Table 702 – Gates for specified pre-arcing times of "gG" fuse-links	120

Table 703 – Sizes of copper conductors	121
Table 704 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links	122
Table 801 – Conventional time and current for "gD" and "gN" fuse-links	130
Table 802 – Gates for specified pre-arcing times of "gD" and "gN" fuse-links	131
Table 803 – Pre-arcing I^2t values at 0,01 s for "gD" and "gN" fuse-links	132
Table 804 – Cross-sectional area of copper conductors for tests corresponding to 8.3 and 8.4	133
Table 805 – Maximum cut-off current (I_C) for "gD" and "gN" fuse-links at 200 kA prospective current	134
Table 806 – Maximum operating I^2t values for "gD" and "gN" fuse-links at 200 kA prospective current	135
Table 901 – Maximum power dissipation values	152
Table 902 – Pre-arcing I^2t values for gU fuse-links at 0,01 s	154
Table 903 – Cross-sectional area of conductors for power dissipation and temperature-rise tests	155
Table 1001 – Conventional time and current for "gD class CC " and "gN class CC " fuse-links	166
Table 1002 – Gates for specified pre-arcing times of "gD class CC " and "gN class CC " fuse-links	166
Table 1003 – Pre-arcing I^2t values at 0,01 s for "gD class CC " and "gN class CC " fuse-links	168
Table 1005 – Maximum cut-off current (I_C) for "gD class CC " and "gN class CC " fuse-links at 200 kA prospective current	170
Table 1006 – Maximum operating I^2t values for "gD class CC " and "gN class CC " fuse-links at 200 kA prospective current	170

WITHDRAWN

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE FUSES –

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

FOREWORD

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International Standard IEC 60269-2 has been prepared by subcommittee 32B: Low-voltage fuses, of IEC technical committee 32: Fuses.

This fourth edition of IEC 60269-2 cancels and replaces the third edition published in 2006 and constitutes a minor revision.

This part is to be used in conjunction with IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements* and its Amendment 1 (2009).

This Part 2 supplements or modifies the corresponding clauses or subclauses of Part 1.

Where no change is necessary, this Part 2 indicates that the relevant clause or subclause applies.

Tables and figures which are additional to those in Part 1 are numbered starting from 101. Additional annexes are numbered AA, BB, etc.

The text of this standard is based on following documents:

FDIS	Report on voting
32B/552/FDIS	32B/555/RVD

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

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

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 J

NOTE This edition of IEC 60269-2 is based on Edition 3. Edition 3 was a result of a restructuring of the IEC 60269 series of standards in 2006. Edition 3 included 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).

A list of all parts of the IEC 60269 series, under the general title: Low-voltage fuses, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC 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.

This fourth edition is based on edition 3 of IEC 60269-2. Edition 3 was a result of a restructuring of the IEC 60269 series of standards in 2006. At this time IEC 60269-1, IEC 60269-2, IEC 60269-2-1, 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 authorized persons” are separated from the clauses dealing with “fuses for unskilled 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.

Withdrawn

LOW-VOLTAGE FUSES –

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

1 General scope

Fuses for use by authorized persons are generally designed to be used in installations where the fuse-links are accessible to, and may be replaced by, authorized persons only.

Fuses for use by authorized persons according to the following fuse systems also comply with the requirements of the corresponding subclauses of IEC 60269-1, unless otherwise defined in this standard.

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

- Fuse system A: Fuses with fuse-links with blade contacts (NH fuse system)
- Fuse system B: Fuses with striker fuse-links with blade contacts (NH fuse system)
- Fuse system C: Fuse-rails (NH fuse system)
- Fuse system D: Fuse-bases for busbar mounting (NH fuse system)
- Fuse system E: Fuses with fuse-links for bolted connections (BS bolted fuse system)
- Fuse system F: Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)
- Fuse system G: Fuses with fuse-links with offset blade contacts (BS clip-in fuse system)
- Fuse system H: Fuses with fuse-links having "gD" and "gN" characteristic (Class J and class L time delay and non time delay fuse types)
- Fuse system I: gU fuse-links with wedge tightening contacts
- Fuse system J: Fuses with fuse-links having "gD class CC" and "gN class CC" characteristics (Class CC time delay and non-time delay fuse types)

NOTE The above-mentioned fuse systems are standardized systems in respect to their safety aspects. The National Committees may select from the examples of standardized fuses one or more systems for their own standards.

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 60060-1: *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60112: *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*
Amendment 1 (2009)

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

IEC 60999 (all parts), *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)*

ISO 6988: *Metallic and other non organic coatings – Sulfur dioxide test with general condensation of moisture*

WITNESS

Fuse system A – Fuses with fuse-links with blade contacts (NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuses with fuse-links having blade contacts intended to be replaced by means of a device, for example, replacement handle (see Figure 103), which complies with the dimensions specified in Figures 101 and 102. Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including 1 000 V a.c. or 1 500 V d.c.

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

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60269-1, as well as the following, apply.

2.1.101

gripping-lugs

parts of a fuse-link which are engaged with the replacement handle or fuse-carrier. Gripping-lugs may be made of metal or insulating material. Metal gripping-lugs may be live or not live under service conditions

2.1.102

live gripping-lugs

metal gripping-lugs electrically connected to the blade contacts of the fuse-link. Metal gripping-lugs without electrical contact to the blade contacts are also deemed to be live in case of inadequate creepage distances and clearances according to this standard

2.1.103

isolated gripping-lugs

not-live gripping-lugs made of insulating material or metal. If they are made of metal the required creepage distances and clearances according to the relevant overvoltage category should be met between the gripping-lugs and the blade contacts as well as between the gripping-lugs and the fuse-base contacts

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 voltage are 400 V, 500 V and 690 V. For d.c., the rated voltages are 250 V and 440 V. The standard values of d.c. rated voltage are not related to the standard values of a.c. rated voltage. For example, the following standard combinations are possible: 500 V a.c. – 250 V d.c., 500 V a.c. – 440 V d.c., 500 V a.c., etc.

The rated voltage of fuse-bases according to Figure 102 is 690 V or higher.

5.3.1 Rated current of the fuse-link

For each size the maximum rated currents are given in Figure 101. These values depend upon the utilization categories and rated voltages.

A rated current of 224 A is added to the values as given in 5.3.1 of IEC 60269-1.

5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 102.

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 for the different sizes of fuse-links are specified in Figure 101. The values apply to the maximum rated currents of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 102.

5.6 Limits of time-current characteristics

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

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 Figure 104, including manufacturing tolerances shall be met by all pre-arcing and total times measured at the test voltage according to 8.7.4.

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 101.

Table 101 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A

Rated current I_n A	Conventional time h	Conventional current	
		I_{nt}	I_t
$I_n \leq 4$	1	$1,5 I_n$	$2,1 I_n$
$4 < I_n < 16$	1	$1,5 I_n$	$1,9 I_n$

5.6.3 Gates

For "gG" fuse-links the gates given in Table 102 apply in addition to the gates of IEC 60269-1.

Table 102 – Gates for specified pre-arcing and operating times of "gG" fuse-links

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
8	16,0	35,2	41,6	92,0
10	22,0	46,5	58,0	110,0
12	24,0	55,2	69,6	140,4
224	680	1 450	2 240	3 980

5.7.2 Rated breaking capacity

The minimum rated breaking capacities are specified in Table 103.

Table 103 – Minimum rated breaking capacities

Rated voltage	Minimum rated breaking capacities
≤ 690 V a.c.	50 kA
≤ 750 V d.c.	25 kA

6 Marking

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links and fuse-holders which meet the requirements and tests of fuse system A of this standard may be marked with IEC 60269-2.

6.1 Markings of fuse-holders

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

- size.

The marking of the rated current and the rated voltage shall be discernible from the front when a fuse-link has not been fitted.

6.2 Markings of fuse-links

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

- size or reference;
- rated breaking capacity.

The marking of the rated current and the rated voltage shall be discernible from the front. Furthermore, fuse-links shall be marked as described in Table 104.

Table 104 – Marking of fuse-links

Characteristic	gG		aM	
Colour of marking	Black		Green	
Kind of print	Strip with inverse print	Normal print	Strip with inverse print	Normal print
Voltage				
400 V ^a	X		X	
500 V		X		X
690 V	X		X	
^a For 400 V gG, a blue colour is also permitted.				

Fuse-links with isolated gripping-lugs may be marked in a place easily visible from the front with the graphical symbol of a gripping-lug in a square. If marked, conformity of these fuse-links is verified according to 8.2.

NOTE See Figure 112 for detailed dimensions of the symbol.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 101 and 102.

7.1.2 Connections, including terminals

There are different kinds of terminals. As far as lug terminals are concerned, the range of cross-sections which the terminals shall be capable of accepting results from the following ranges of rated currents of fuse-links of each size.

Terminals designed for unprepared conductors shall be capable of accepting as a minimum three consecutive sizes of conductors within the cross-sectional ranges given in Table 105. In case the terminal is a lug terminal (see IEC 60999 series), the torques which shall be applied are given in Table 111. Torque values for other terminals should be given in the manufacturer's instructions.

Table 105 – Minimum cross-sectional ranges of unprepared conductors

Size	Range of the rated currents of the fuse-links A	Cross-sectional area ranges mm ²	
		Copper	Aluminium
00	6 to 160	6 to 70	25 to 95
0 ^a	6 to 160	6 to 70	25 to 95
1	80 to 250	25 to 120	35 to 150
2	125 to 400	50 to 240	70 to 300
3	315 to 630	No values available	
4	500 to 1 000		
4a	500 to 1 250		

^a Not allowed for new installations except for fuse-links with strikers.

Connections of larger and/or smaller cross-sectional area may be necessary. This can be achieved either by the construction of the terminal or by additional means of connection as recommended by the manufacturer.

Whether the terminals for unprepared conductors are suitable for copper, aluminium or copper and aluminium shall be marked accordingly. Furthermore, the range of cross-sections shall be marked on or near to the clamping saddle or given in the manufacturer's literature.

7.1.3 Fuse-contacts

The contact surfaces of fuse-links and fuse-bases should be silver-plated; otherwise, it shall be verified that contacting is not impaired in normal operation. If the surface plating of the blade contacts of a fuse-link is other than silver, the test according to 8.10 shall be passed with dummies described in 8.10.1.

NOTE If fuse-links are intended to be removed or inserted under load, the construction of the fuse, in particular the fuse-contacts, should be suitable for this purpose.

7.1.6 Construction of fuse-bases

The dynamic short-circuit withstand of the fuse shall – whenever needed – meet the cut-off currents as given in Table 112.

Fuse-bases shall meet the temperature rise test according to 8.3 including all protective covers intended to be used.

7.1.7 Construction of a fuse-link

The preferred construction is as follows; the blade contacts shall be made of solid material. If any other construction of blade contacts is used the manufacturer shall demonstrate that this construction is adequate for the purpose.

With the exception of the attachment for the replacement handle, the endplates are not permitted to protrude radially from the insulation body. For some applications it is preferable to insulate the gripping lugs from live parts.

Fuse-links shall have an indicator. Electrically conductive parts of indicators shall not be ejected from the fuse-link during operation.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of the fuses and fuse-accessories shall meet the requirements of IEC 60664-1 for overvoltage category III and pollution degree 3. The minimum clearances are also applicable to metal parts which are not permanently live but may be touched. They shall not be diminished during replacement of the fuse-link. The creepage distances between isolated metal gripping lugs and live parts are chosen according to the rated voltage divided by $\sqrt{3}$.

For insulation stressed only for a short time, the creepage distances of isolated metal gripping lugs corresponding to two voltage steps lower may be used.

Insulating parts of the fuse-base supporting live parts have to pass the test at PTI 400 carried out according to IEC 60112 using test solution A.

7.7 I^2t characteristics

For the fuse-links covered by this fuse system, the maximum pre-arcing I^2t values given in Table 7 of IEC 60269-1 apply for the maximum operating I^2t values. Values for rated currents lower than 16 A and for 224 A are given in Table 106.

Table 106 – Pre-arcing and operating I^2t values at 0,01 s for "gG" fuse-links

I_n A	$I^2t_{\min}$ A ² s	$I^2t_{\max}$ A ² s
2	1,00	23,00
4	6,25	90,25
6	24,00	225,00
8	49,00	420,00
10	100,00	576,00
12	160,00	750,00
224	200 000	520 000

The maximum operating I^2t values for “aM” fuse-links are specified in Table 107 on the test-voltage of $1,1 \times U_n$ and the test No. 2 of the largest rated current of each homogeneous series (Table 20 of IEC 60269-1).

Table 107 – Maximum operating I^2t values for “aM” fuse-links

Rated voltage U_n V	I^2t max A^2s
$U_n \leq 400$	$18 I_n^2$
$400 < U_n \leq 500$	$24 I_n^2$
$500 < U_n \leq 690$	$35 I_n^2$

These values apply for the prospective currents corresponding to pre-arcing times less than 0,01 s.

7.8 Overcurrent discrimination of “gG” fuse-links

Fuse-links in series with rated current ratio of 1:1,6 and rated currents 16 A and above have to discriminate up to the values specified in 8.7.4.

With regard to discrimination when circuit-breakers are used, the following I^2t values in Table 108 shall be followed.

Table 108 – Pre-arcing I^2t values for discrimination

I_n A	I^2t_{min} A^2s	at I_p A
16	250	500
20	450	670
25	810	900
32	1 400	1 180
40	2 500	1 580
50	4 000	2 000
63	6 300	2 510
80	10 000	3 160
100	16 000	4 000
125	24 000	4 900
160	42 500	6 520
200	78 000	8 830

7.9 Protection against electric shock

The protection against electric shock can be increased by means of partition walls and covers of the fuse-contacts.

Operation of the fuse-links is considered safe when carried out by authorized persons, instructed in electrical matters, using replacement handles according to this fuse system or linked fuse-carriers. Insulating covers and/or phase separators may be used where applicable.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse and dimensions

The requirements of 7.2 are verified on fuse-bases. The fuse-bases are connected to conductors having the minimum and maximum cross-sections of the range as given in Table 105.

In the case of isolated metal gripping-lugs, the creepage distances and clearances of the fuse-link according to 7.2 are verified. The clearances are also verified on a fuse-link inserted into a model fuse-base according to Figure 111.

8.1.6 Testing of fuse-holders

In addition to the test given in IEC 60269-1, the fuse-holders shall be subjected to the tests according to Table 109.

Table 109 – Survey of tests on fuse-holders and number of fuse-holders to be tested

Test according to subclause		Number of fuse-holders						
		1	1	1	1	1	1	5
8.5.5.1	Verification of the peak withstand current of a fuse-base				X	X		
8.9	Verification of resistance to heat						X	
8.10.1.2	Verification of non-deterioration of direct terminal clamps							X
8.11.1.2	Mechanical strength of the fuse-base	X	X	X				
8.11.2.4	Non-deterioration of insulating parts of fuse-link and fuse-base	X	X	X				

8.2.2.1 Points of application of the test voltage

In addition to IEC 60269-1 the following applies:

- e) between isolated metal gripping-lugs and the terminals of the test fuse-base.

8.2.3.2 Value of test voltage

The insulating properties of isolated metal gripping-lugs may optionally be verified by an impulse withstand voltage test. The relevant rated impulse withstand voltage is given in Table 110 with reference to the rated voltage of the fuse-link.

Table 110 – Rated impulse withstand voltage

Rated voltage V	Rated impulse withstand voltage kV
400	4
500	4
690	6

8.2.3.3 Test method

Five impulses of both polarities and of the shape 1,2/50 μ s according to IEC 60060-1 and at the rated withstand voltage level according to Table 110 are applied to the test object. The minimum period between the impulses shall be 1 s.

NOTE 1 If not otherwise specified, the impedance of the impulse generator should not exceed 500 Ω .

NOTE 2 See IEC 60060-1, IEC 60060-2 and IEC 60060-3 for a detailed description of the test equipment.

8.2.4 Acceptability of test results

8.2.4.3 No flash-over or puncture shall occur during the test. Partial discharges are ignored.

Fuse-links with metal gripping-lugs without electrical contact to the blade contacts which do not comply with the requirements of 7.2 are not considered as isolated in service. They need, however, to fulfil the requirements of 8.9.2 and 8.11.1.8.

8.2.5 Resistance to tracking

The test of insulating parts supporting live parts of the fuse-links (fuse body) and fuse-bases is carried out according to IEC 60112 using test solution A. Five specimens shall be tested and shall pass at PTI 400. Ceramic isolators need not to be tested.

8.3 Verification of temperature rise and power dissipation**8.3.1 Arrangement of the fuse**

If the manufacturer specifies values of torque, they shall be used for the tests of 8.3 and 8.10. If not, the screws or nuts of the terminals shall be fastened in accordance with Table 111.

In case the test arrangement contains more than one fuse, the test specimens are mounted in the conventional service position on a wooden plate at a distance between centre lines of 3 e_2 according to Figure 101.

Copper bars as used for 500 A to 1 250 A test currents are painted mat black.

Table 111 – Torque to be applied to the terminal screws

I_n A	Size	Size of screws	Torque Nm
160	00	M 8	10
160	0 ^a	M 8	10
250	1	M 10	32
400	2	M 10/12	32
630	3	M 10/12	32
1 000	4	M 12	56
1 250	4a	2 × M 12/16	56

^a Not allowed for new installations except for fuse-links with strikers.

8.3.2 Measurement of the temperature rise

Protective covers and fuse-carriers as provided by the manufacturer shall be mounted.

8.3.4.1 Temperature rise of the fuse-holder

The dummy is given in Figure 105. The point at which the temperature rise is measured is marked with E in Figure 106.

8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is measured are marked with S in Figure 106.

8.4.3.1 Verification of conventional non-fusing and fusing current

In the case where the non-fusing current test is also used for the verification of the time current characteristic, a second test specimen shall be used for b).

8.4.3.5 Conventional cable overload protection test (for "gG" fuse-links only)

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

8.5.5.1 Verification of the peak withstand current of a fuse-base

The verification of the peak withstand current of a fuse-base need not be carried out, if this has already been verified during the breaking capacity test of the fuse-links with the highest rating of the size.

8.5.5.1.1 Arrangement of the fuse

The test shall be of the single-phase type. The test set-up for the fuse-base shall be in line with 8.5.1 of IEC 60269-1.

The current shall be limited by a fuse-link of the highest rating for the particular size. The peak values of the test currents attained shall lie in the ranges shown in Table 112.

Table 112 – Test currents

Size	Cut-off current kA
00	22...24
0	22...24
1	34...37
2	44...48
3	65...70

The maximum values may be exceeded as long as the requirements stated under 8.5.5.1.3 are met.

If the cut-off current range cannot be attained with the highest rating of the size, correspondingly higher series connected fuse shall be used. In this case the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimensions given in Figure 101.

8.5.5.1.2 Test method

The test shall be performed on two fuse-bases. In the case of fuse-base No. 1, a hardened and polished test knife of steel, shown in Figure 107, shall be inserted by hand in order to open up the contacts to a certain extent. The purpose of this test is to ensure that the resilient spring travel is limited to the elastic range. The contacts shall be opened up three times. This test will be dispensed with if a mechanical stop limits the gap to less than 7 mm so that the test blade cannot be correctly fitted by hand. Fuse-base No. 2 is tested in accordance with 8.11.1.2. The values of F_{max} according to Table 118 shall be adhered to. After these pre-tests the above-mentioned current test shall be performed.

8.5.5.1.3 Acceptability of test results

The fuse-links shall not be ejected. There shall be no signs of arcing or welding or other damage likely to prevent further use of the fuse-bases. Pitting marks on the contacts are permissible.

8.5.8 Acceptability of test results

The fuse or circuit-breaker for protection of the source shall not operate during this test.

8.7.4 Verification of overcurrent discrimination

The overcurrent discrimination for fuses with rated current up to 12 A and the overcurrent discrimination ratio of 1:1,6 for fuses with rated currents higher than 12 A is verified by the I^2t values evaluated from the recorded test results.

The samples are arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1 regarding the test circuit and tolerance of current.

Four samples are tested, two samples are tested at the r.m.s. prospective test current I , corresponding to the minimum pre-arcing I^2t values, the other samples at the r.m.s. prospective test current I , corresponding to the operating I^2t values.

The test voltage for 690 V fuses is $1,05 \times \frac{U_n}{\sqrt{3}}$.

The test voltage for all other fuses is $1,1 \times \frac{U_n}{\sqrt{3}}$.

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

I_n A	Minimum pre-arcing I^2t		Maximum operating I^2t		Discrimination ratio
	Prospective I r.m.s. kA	I^2t A ² s	Prospective I r.m.s. kA	I^2t A ² s	
2	0,013	0,67	0,064	16,4	Can be calculated
4	0,035	4,90	0,130	67,6	
6	0,064	16,40	0,220	193,6	
8	0,100	40,00	0,310	390,0	
10	0,130	67,60	0,400	640,0	
12	0,180	130,00	0,450	820,0	
16	0,270	291,00	0,550	1 210,0	1:1,6
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	
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	
125	3,000	36 000,00	5,100	104 000,0	
160	4,000	64 000,00	6,800	185 000,0	
200	5,100	104 000,00	8,700	302 000,0	
224	5,900	139 000,00	10,200	412 000,0	
250	6,800	185 000,00	11,800	557 000,0	
315	8,700	302 000,00	15,000	900 000,0	
400	11,800	557 000,00	20,000	1 600 000,0	
500	15,000	900 000,00	26,000	2 700 000,0	
630	20,000	1 600 000,00	37,000	5 470 000,0	
800	26,000	2 700 000,00	50,000	10 000 000,0	
1 000	37,000	5 470 000,00	66,000	17 400 000,0	
1 250	50,000	10 000 000,00	90,000	33 100 000,0	

The evaluated I^2t values shall lie within the corresponding I^2t limits specified in Table 113.

8.9 Verification of resistance to heat

These tests apply to fuse-links and fuse-bases.

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the acceptable power dissipation of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5 .

8.9.1 Fuse-base

The test given below should be applied if it is not obvious that the components are not affected adversely by the given temperature and withdrawal forces.

8.9.1.1 Test arrangement

A dummy fuse-link according to Figure 105 is fitted into a fuse-base and also suspended from a measuring device as shown, for example, in Figure 108. The manner in which the dummy is fitted and secured (for example, by locking pins), in fuse-bases shall ensure that heat dissipation is not seriously affected. The conductor cross-section depends upon the rated current (see IEC 60269-1, Table 17), and the connections outside the heating chamber shall be at least 1 m long. The test set-up is installed in such a heating chamber or below a heatable cowl of at least 50 l capacity, care being taken to see that the bushings etc. for the measuring facility and connections are suitably sealed. The heaters shall be such as to ensure that during the test sequence described below a temperature of $(80^{+5}_0)^\circ\text{C}$ is maintained with or without the test current, the temperature being measured at a horizontal distance of 150 mm from the dummy centre point.

8.9.1.2 Test method

The temperature in the heating chamber is raised to $(80^{+5}_0)^\circ\text{C}$, and maintained for 2 h. The dummy is then loaded with approximately 160 % rated current with a tolerance of $\pm 2\%$ for 2 h. The test may be carried out at reduced voltage.

After loading and 3 min after switching off, a tensile force $F_{\max}$ (see Table 118) is applied smoothly to the dummy. The force $F_{\max}$ is exerted for a period of 15 s.

8.9.1.3 Acceptability of test results

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After pulling out of the dummy the dimensions of Figure 102 are to be considered. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

8.9.2 Fuse-links with gripping lugs of moulded material or of metal fixed in moulded material

8.9.2.1 Test arrangement

A fuse-link of the highest rating for a size is fitted into a fuse-base; it shall be arrested there and also suspended from a measuring device as shown in Figure 108.

8.9.2.2 Test method

The temperature in the heating chamber is raised to (80^{+5}_0) °C and maintained for 2 h. The fuse-link is then loaded with 150 % rated current until it operates, but the test is restricted to the conventional time. A reduced test voltage may be used. Three minutes after the fuse-link has operated or the conventional testing time has expired, a tensile force $F_{\max}$ (see Table 118) is applied smoothly to the gripping lugs. The force is exerted for a period of about 15 s.

8.9.2.3 Acceptability of test results

The gripping lugs shall remain fully operational, and the length of the neck $(2,5^{+0,5}_0)$ mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions d of Figure 101. The same applies to the maximum values of dimension c_2 .

8.10 Verification of non-deterioration of contacts and direct terminal clamps

8.10.1 Arrangement of the fuse

The dummy fuse-link is given in Figure 105. The dummy fuse-link shown with silver-plated blade contacts is representative for fuse-links with silver-plated blade contacts. If the non-deterioration test proves that a surface plating of the blade contacts of a fuse-link other than silver fulfils the requirements, then the surface of the blade contacts of the dummy fuse-link shall be plated accordingly.

For lug terminals, the torques are given in Table 111.

Subclause 8.10.1 of IEC 60269-1 applies with the following modification:

The insulation of the conductors shall be removed over the whole length. All covers of contacts and terminals shall be removed for this test only.

8.10.1.1 Contacts

Subclause 8.10.1 of IEC 60269-1 applies.

8.10.1.2 Direct terminal clamps

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

The test shall be performed on 10 direct terminal clamps of five fuse-bases.

The test arrangement shall be as follows: the fuse-bases shall be mounted in a vertical position, side by side with a distance between the fuse-base centres of at least three times e_2 , shown in Figure 101. The test of direct terminal clamps which can be used for copper as well as aluminium conductors shall be made with aluminium conductors.

If there is no information given by the manufacturer, the screws of the direct terminal clamps shall be tightened with a torque according to Table 114.

NOTE 1 The torques are based on a friction coefficient of $\mu = 0,12$ for thread and head of the screw and a maximum elongation of $R_{p0,2}$ according to ISO 898-1. The shaft of the screws will be stressed up to 90 % of these values during tightening. The torques are based on class 5.6 screws.

NOTE 2 Torques for lug terminals are given in Table 111.

Table 114 – Torques to be applied when no values are given by the manufacturer

Thread	Torque Nm
M5	2,6
M6	4,5
M8	11
M10	21
M12	38

Direct terminal clamps only for copper conductors are tested like direct terminal clamps for aluminium with the exception that cleaning and storage are not necessary. Furthermore, for copper clamps, the test can be part of the test of contacts. If the requirements for the contacts after 250 cycles (see 8.10.2.1) are met, the clamps for copper have satisfied this requirement.

The conductor cross-section depends upon the rated current (for copper conductors see Table 17 of IEC 60269-1).

The relevant cross-sections for aluminium conductors are given in Table 115.

Table 115 – Cross-sectional area of aluminium conductors for tests corresponding to 8.10

Rated current A	Cross-sectional area mm ²
40	25
50	25
63	35
80	50
100	70
125	95
160	95
200	150
250	185
315	240
400	300

In case of insulation piercing clamping units, only the insulation outside the clamping area will be removed.

The contact area of six conductors shall be prepared as follows.

The conductors shall be cleaned with a suitable abrasive and connected within a time not greater than 5 min.

The remaining four conductors, after removing only the insulation and the grease, shall be stored indoors for 14 days. These uncleaned conductors shall not be treated before being connected.

The bolts of the clamps shall be fixed as stated by the manufacturer. A readjustment of the bolts during the tests is not allowed.

For stranded aluminium conductors, it shall be ensured that the test current goes into the cross-section as equally as possible. This can be achieved by welding or compressing the conductor in the middle of its length.

8.10.2 Test method

A test cycle consists of a load period and a no-load period referred to as the conventional time. The test currents for the load period and the no-load period are specified as follows.

Test current: conventional non-fusing current I_{nf}

Load period: 25 % of the conventional time see Table 2 of IEC 60269-1

No-load period: 10 % of the conventional time

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 temperature rise is measured in accordance with 8.10.2 of IEC 60269-1 at rated current.

The voltage drop shall be measured after 50 cycles and 250 cycles and, if necessary, after 500 cycles and 750 cycles.

Subclause 8.10.2 of IEC 60269-1 applies with the following modifications.

The voltage drop is measured at direct current of $I_m = (0,05 \text{ to } 0,20) I_{nf}$. However, the current I_m shall be chosen so as to give a voltage drop of at least 100 µV. If it is necessary, the upper limit of I_m may be increased to $0,30 I_{nf}$.

The tolerance of I_m during the measurement shall not be greater than $^{+1}_0$ %.

The voltage drop shall be changed into the resistance of the contacts. Before measurement, the sample shall be cooled down to room temperature. If the room temperature T during the measurement deviates from 20 °C, the following formula may be applied:

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

The relevant coefficient α_{20} according to the conductor material (aluminium or copper) shall be used.

8.10.2.1 Contacts

The points between which the voltage drop is measured are marked as A and B in Figure 106.

At the conclusion of the test after 250 cycles and 750 cycles, the withdrawal forces are measured. For this purpose a hardened and polished steel test knife as shown in Figure 107 shall be inserted in order, if possible, to open the contacts up, to a certain extent (see 8.5.5.1.2).

Afterwards, the withdrawal forces are measured with a test link made of hardened steel as described in 8.11.1.2. The test link is inserted three times in the fuse-base. The withdrawal forces shall be within the limits of Table 118. If the measured values are too low, the dynamic test in accordance with 8.5.5.1 shall be performed.

8.10.2.2 Direct terminal clamps

The points between which the voltage drop ΔU of the test sample is measured are given in Figure 110. The point of measurement on the conductor F shall be a centre punch point where solid conductors are concerned or a bare wire wrapped around stranded conductors. For aluminium conductors, special precautions shall be implemented by use, for example, of a welded equalizer (the aluminium cable is cut; the conductors of each part are welded together, then the two parts are welded and the measure can be carried out in a hole drilled in a welded part).

Additionally, for aluminium conductors the voltage drop before starting the cycle test shall be measured. In any case for aluminium conductors, the test shall be performed for 750 cycles.

The test sequence for all types of conductors (aluminium and copper) is given in Table 116.

Table 116 – Test sequence for direct terminal clamps

Verification of temperature rise at I_n
Measurement of $R_{cl\ 0}$
50 cycles
Measurement of $R_{cl\ 50}$
200 cycles
Measurement of $R_{cl\ 250}$
Verification of temperature rise at I_n
250 cycles
Measurement of $R_{cl\ 500}$
250 cycles
Measurement of $R_{cl\ 750}$
Verification of temperature rise at I_n

At the end of the cycle test, the verification of the temperature rise shall be performed in accordance with 8.3.4.1. The conductor with removed insulation used for the cycle test remains fastened. The point F at which the temperature rise is measured on the conductor is at a distance of 10 mm from the clamp (see Figure 110).

8.10.3 Acceptability of test results

The permissible changes given are based on laboratory experience. The final criterion shall be met; it is not the summation of the intermediate criteria.

8.10.3.1 Contacts

If at the end of the 250th cycle the measured values do not exceed the following limit, the fuse-base is considered to have passed the test and the test may be stopped:

$$\frac{R_{250} - R_{50}}{R_{50}} \leq 15\%$$

If at the end of the 250th cycle the above limit is exceeded, the test is continued. After 500 cycles the following limit shall not be exceeded:

$$\frac{R_{500} - R_{250}}{R_{250}} \leq 30\%$$

If the limit is exceeded, the test is not satisfied. If the limit is not exceeded, the test is continued up to 750 cycles. At the end of the 750th cycle the following limit shall not be exceeded:

$$\frac{R_{750} - R_{50}}{R_{50}} \leq 40\%$$

The difference of the temperature rise between the last and the first measurement shall be less than 20 K.

8.10.3.2 Direct terminal clamps

The permissible tolerance for the resistance $R_{cl 0}$ for test samples with cleaned aluminium conductors is the following:

$$R_{cl 0 \max} \leq 2 R_{cl 0 \min}$$

The changes of the resistance from $R_{cl 50}$ to $R_{cl 750}$ shall meet the following values in Table 117.

Table 117 – Permissible changes of the resistance

	Permissible changes	
	Copper conductors or cleaned aluminium conductors	Uncleaned aluminium conductors
$\frac{R_{cl 250} - R_{cl 50}}{R_{cl 50}} \times 100$	15	30
$\frac{R_{cl 500} - R_{cl 250}}{R_{cl 250}} \times 100$	20	40
$\frac{R_{cl 750} - R_{cl 500}}{R_{cl 500}} \times 100$	15	30
$\frac{R_{cl 750} - R_{cl 50}}{R_{cl 50}} \times 100$	40	80

The temperature rise measured at test spot F shall be lower than 75 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a dummy fuse-link of Figure 105 or fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature rise test at rated current.

At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature-rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is

greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

8.11.1.2 Mechanical strength of the fuse-base

The mechanical strength of the fuse-bases and their components is verified by the following tests.

The test to verify the contact force of fuse-bases is performed with three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions according to Figure 101.

When pulling steadily by means of suitable test equipment, the withdrawal force F measured (see Figure 108) shall be found to lie within the limits as specified in Table 118.

Table 118 – Force to withdraw the fuse-link from the fuse-base contacts

Size	Withdrawal force	
	$F_{\min}$ N	$F_{\max}$ N
00	60	250
0	80	300
1	110	350
2	150	400
3	210	400

In order to verify that the fuse-base contacts are firmly seated, steel screws (class 8.8) are fastened at the terminals. They are fastened three times by applying a torque of 1,2 times the value specified by the manufacturer or, where no value is specified, 1,2 times the value of Table 111. For flat connections requiring a nut, steps shall be taken to prevent, by suitable means, the nut from turning round.

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

8.11.1.8 Impact resistance of gripping-lugs of moulded material or of metal fixed in moulded material

8.11.1.8.1 Test arrangement

The facility to verify impact resistance is given in Figure 109. The weight of the drop hammer is 300 g, the height of fall between the impact-mandrel and the gripping-lug is 300 mm.

8.11.1.8.2 Test method

One fuse-link is exposed to $(150 \pm 5) ^\circ\text{C}$ for 168 h and another one to $-15 ^\circ\text{C}$ for 72 h. The fuse-link exposed to heat is to be cooled off to room temperature before being subjected to the dynamic stress. For the sample exposed to cooling, the time interval between the taking out and the dynamic stress shall not be longer than 1 min.

The samples are placed in the test facility of Figure 109 in such a way that the direction of the stroke is parallel to the longitudinal axis of the fuse-link. Each of the gripping-lugs is only once exposed to stress at which the place of impact shall be the middle of the gripping-lug-

neck. It shall be guaranteed that each time only the upper gripping-lug is stressed by the impact.

8.11.1.8.3 Acceptability of test results

The gripping-lugs shall show no damage capable of hindering their further use. Each of the gripping-lugs shall not be bent out by more than 3 mm measured before and after the impact; furthermore, the coupling with a handle according to Figure 103, shall not be hindered.

8.11.2.3 Verification of resistance to rusting

8.11.2.3.1 The test shall be carried out according to ISO 6988 with cyclic moist atmosphere containing 0,2 % SO₂ (SFW 0,2 S); number of cycles: 1.

For reasons of test economy this test may be carried out on the test samples used for the non-deterioration test of contacts according to 8.10 after completion of the test.

8.11.2.3.2 The following test is an optional test to be agreed between manufacturer and customer. It considers severe environmental conditions.

Fuse-links and fuse-bases intended to be used in an environment of pollution degree ≥ 3 according to IEC 60664-1 shall be tested with SFW 2,0 S for 5 cycles. They shall be marked accordingly.

8.11.2.4 Non-deterioration of insulating parts of fuse-link and fuse-base

8.11.2.4.1 Test method

Three fuse-links and three fuse-bases to be tested shall be exposed to the following temperatures:

For a period of 168 h

(150 ± 5) °C for fuse-links and fuse-bases comprising moulded elements intended to support live parts,

(100 ± 5) °C for covers,

for a period greater than 1 h

(150 ± 5) °C over 1 h for sealing compounds; stability of the marking.

After cooling to ambient temperature the following shall be tested.

Fuse-links: verification of the breaking capacity with I_1 and I_2 in accordance with 8.5 of IEC 60269-1.

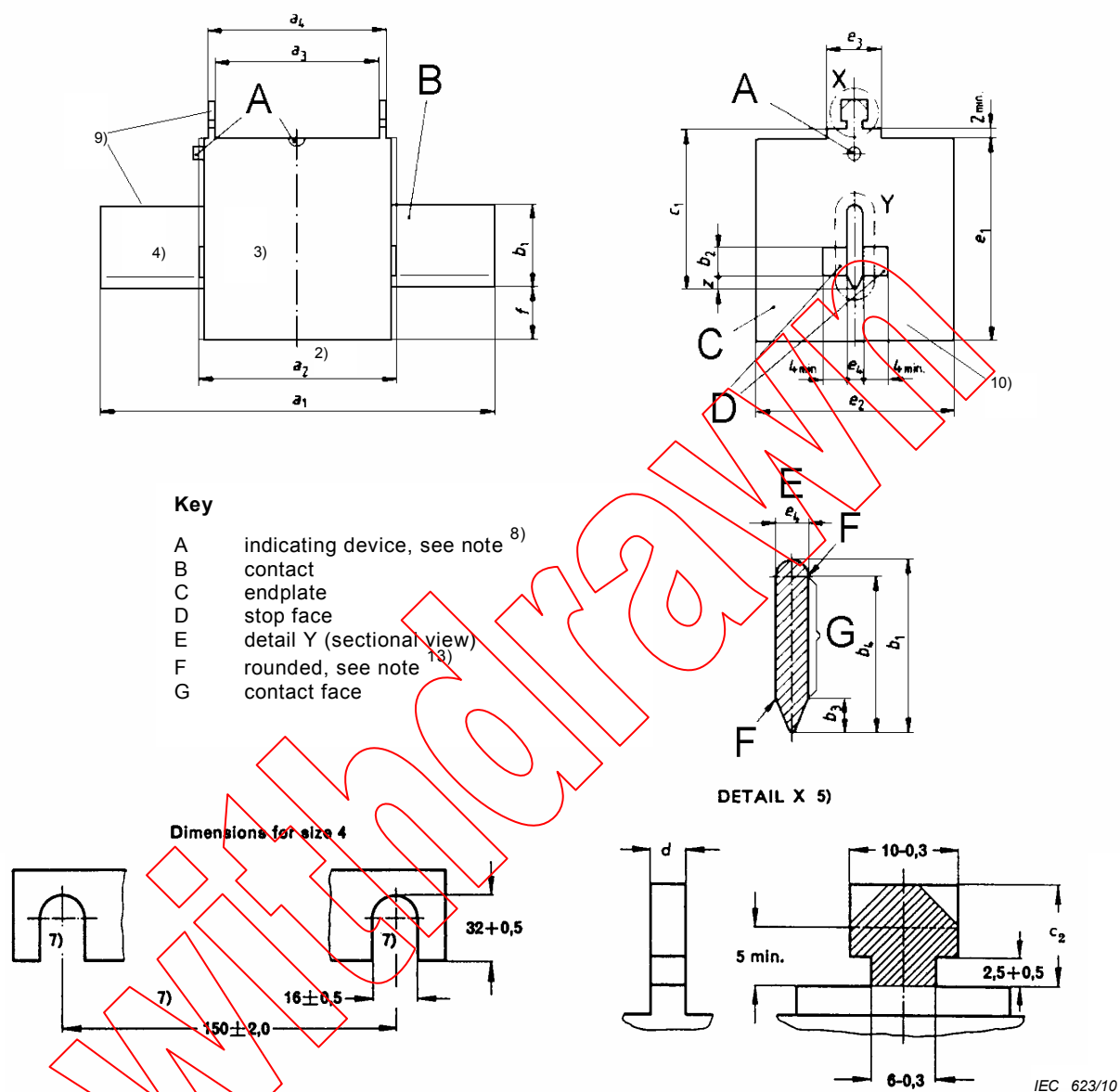
Fuse-base: verification of the mechanical strength in accordance with 8.11.1.2.

8.11.2.4.2 Acceptability of test results

The positions of the fuse-base contacts taking the fuse-link shall not have changed in a manner likely to affect its correct functioning. The insulating body on which the terminals are fixed shall neither fracture nor show any signs of a fracture. The mechanical strength of cemented joints shall not have been impaired. Sealing compounds shall not have shifted to an extent permitting live parts to be exposed. The fuse-links shall operate correctly.

The marking shall be durable and easily legible.

Dimensions in millimetres



The drawings are not intended to govern the design except as regards the notes and dimensions shown.

Figure 101 – Fuse-links with blade contacts

(figure continued on the next page)

Maximum values of the rated power dissipation P_n

Size	gG						aM			
	400 V a.c.		500 V a.c.		690 V a.c.		400 and 500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
000	100 160	6 10	100 125	7,5 9	63	12	100	7,5	80	12
00	160	12	160	12	100	12	100 160	7,5 12	160	12
0	160	12	160	16	100	25	160	16	100	25
1	250	18	250	23	200	32	250	23	250	32
2	400	28	400	34	315	45	400	34	400	45
3	630	40	630	48	500	60	630	48	630	60
4	-	-	1 000	90	800	90	1 000	90	1 000	90
4a	1 250	90	1 250	110	1 000	110	1 250	110	1 250	110

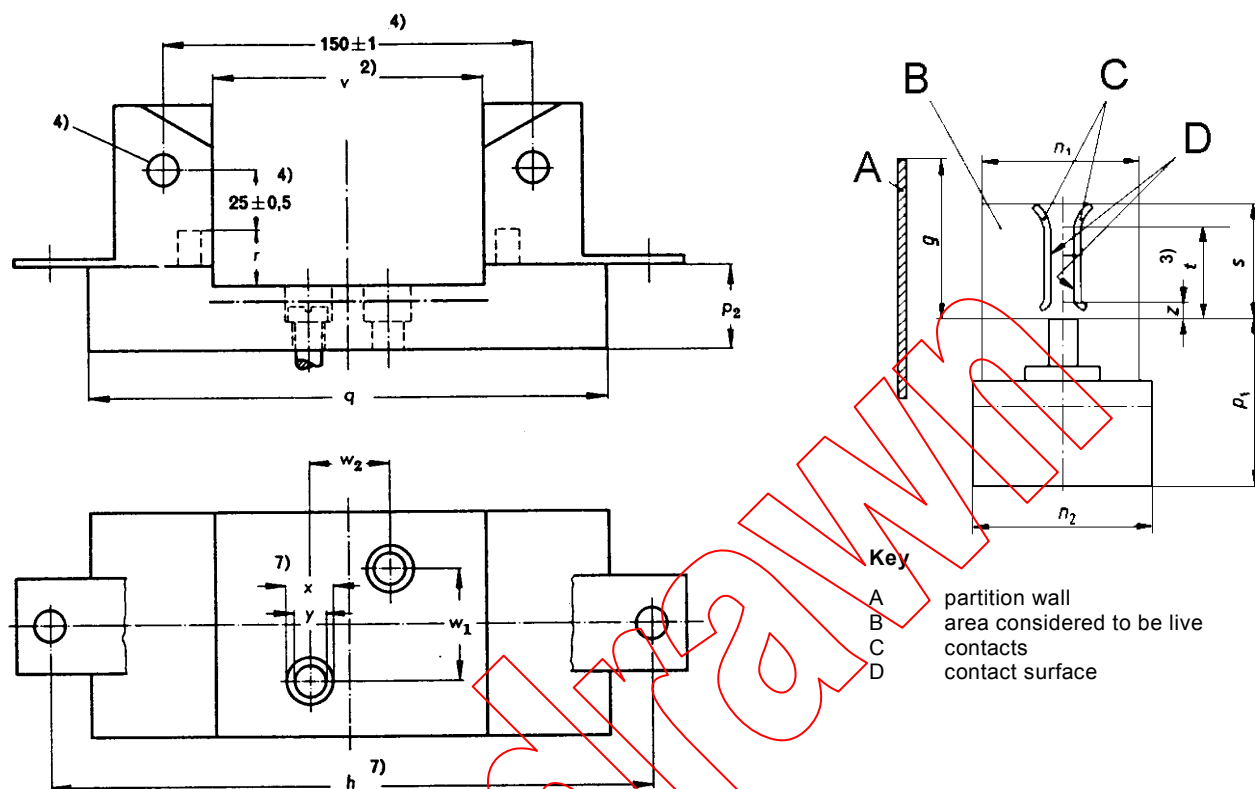
Figure 101 (continued)

Withd

Size	a_1 1)	a_2 2)	a_3 1)	a_4 1)	b_1 min. 12)	b_2 min. 12)	b_3 max. 12)	b_4 min. 12)	c_1 $\pm 0,8$	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 $\pm 0,2$	f max.	z max.
000	78,5 $\pm 1,5$	54 -6	45 $\pm 1,5$	49 $\pm 1,5$	15	4,5	5	12	35	10 -1	2 +1 -0,5	41	21	16 +5 -2	6	8	3
00	78,5 $\pm 1,5$	54 -6	45 $\pm 1,5$	49 $\pm 1,5$	15	4,5	5	12	35	10 -1	2 +1 -0,5	48	30	20 ± 5	6	15	3
0	125 $\pm 2,5$	68 -8	62 +3 -1,5	68 +1,5 -3	15	4,5	5	12	35	11 -2	2 +1,5 -0,5	48	40	20 ± 5	6	15	3
1	135 $\pm 2,5$	75 -10	62 $\pm 2,5$	68 $\pm 2,5$	20	5	6	17	40	11 -2	2,5 +1,5 -0,5	53	52	20 +5 -2	6	15	5
2	150 $\pm 2,5$	75 -10	62 $\pm 2,5$	68 $\pm 2,5$	25	8	6	22	48	11 -2	2,5 +1,5 -0,5	61	60	20 +5 -2	6	15	5
3	150 $\pm 2,5$	75 -10	62 $\pm 2,5$	68 $\pm 2,5$	32	11	6	29	60	11 -2	2,5 +1,5 -0,5	76	75	20 +5 -2	6	18	5
4 ⁷⁾	200 ± 3	90 max.	62 $\pm 2,5$	68 $\pm 2,5$	49	19,5	8	45	87	11 -2	2,5 +1,5 -0,5	110	105	20 +5 -2	8	25	5
4a ¹¹⁾	200 ± 3	100 max.	84 ± 3	90 ± 3	49	-	8	45	84 ± 3	11 -2	2,5 +1,5 -0,5	110	102	30 ± 10	6	30	-

- 1) The centres of the dimensions a_1 , a_3 and a_4 shall not deviate from the centre of a_2 by more than 1,5 mm.
- 2) The dimension a_2 shall be observed within the total area of the stop faces ($b_2 \times 4$ min.) on both sides of the blades. Outside of these areas the maximum dimension a_2 applies.
- 3) Insulating material.
- 4) The blade contacts shall be axially aligned and contact surfaces shall be plane.
- 5) Attachment for replacement handle (detail X).
- 6) Maximum dimensions of the enclosure of the fuse-link. Within these limits, the fuse-links may be of any form, for example, square, rectangular, circular, oval, polygonal, etc.
- 7) The slots are mandatory for size 4 fuse-links.
- 8) Indicating device. Position of the indicating device as chosen by the manufacturer.
- 9) Live parts, gripping-lugs can be insulated.
- 10) With the exception of the attachment for the replacement handle (detail X), the endplates are not permitted to protrude radially from the insulation body.
- 11) Only to be used with a swivel unit having an interlocking device.
- 12) As far as overlapping of rated currents exists within the sizes 0, 1, 2 and 3 the dimension of the smaller size is permitted.
- 13) All corners shall be rounded to prevent damage to the contact surface of the base contacts.

Figure 101 (concluded)



IEC 1812/06

Dimensions in millimetres

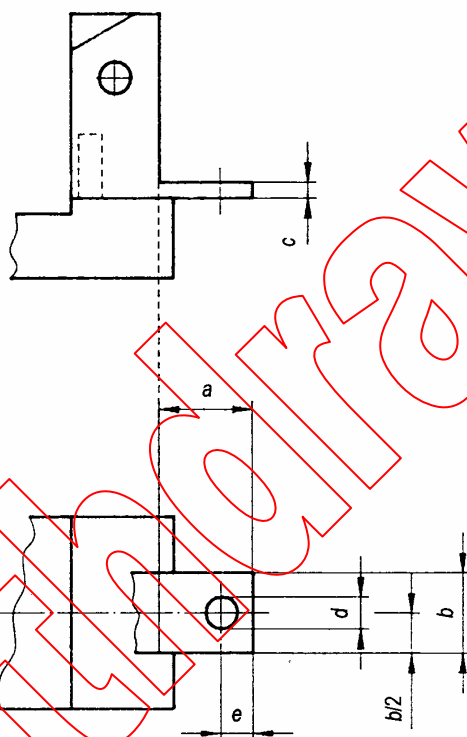
The drawings are not intended to govern the design except as regards the notes and dimensions shown.

Size	g ± 1 8)	h $\pm 1,5$ 7)	n_1 max.	n_2 max.	p_1 max.	p_2 $\pm 1,5$	r min.	s max.	t min.	v	w_1 7)	w_2 7)	x min. 7)	y $\pm 0,5$ 7)	z max.
00 ¹⁴⁾	47	100	30	38	40	–	17	21	15	$56,5 \pm 1,5$	$0 \pm 0,7$	$25 \pm 0,7$	14	7,5	3
0 ¹³⁾	52	150	40	48	48	–	17	25	15	74 ± 3	$0 \pm 0,7$	$25 \pm 0,7$	14	7,5	3
1	53	175	52	60	55	35	17	38	21	80 ± 3	$30 \pm 0,7$	$25 \pm 0,7$	20	10,5	5
2	61	200	60	68	60	35	17	46	27	80 ± 3	$30 \pm 0,7$	$25 \pm 0,7$	20	10,5	5
3	73	210	75	83	68	35	20	58	33	80 ± 3	$30 \pm 0,7$	$25 \pm 0,7$	20	10,5	5
4	100	–	–	–	–	–	27	84	50	97 min.	–	–	–	–	5
4a ⁶⁾	100	270	102	115	–	40	32	84	50	110 ± 15	$45 \pm 0,7$	$30 \pm 0,7$	36	14	6

Figure 102 – Fuse-bases for fuse-links with blade contacts

(figure continued on the next page)

Size	Rated current A	Rated acceptable power dissipation W
00 ¹⁴⁾	160	12
0 ¹³⁾	160	25
1	250	32
2	400	45
3	630	60
4	1 000	90
4a	1 250	110



IEC 147/96

Dimensions in millimetres

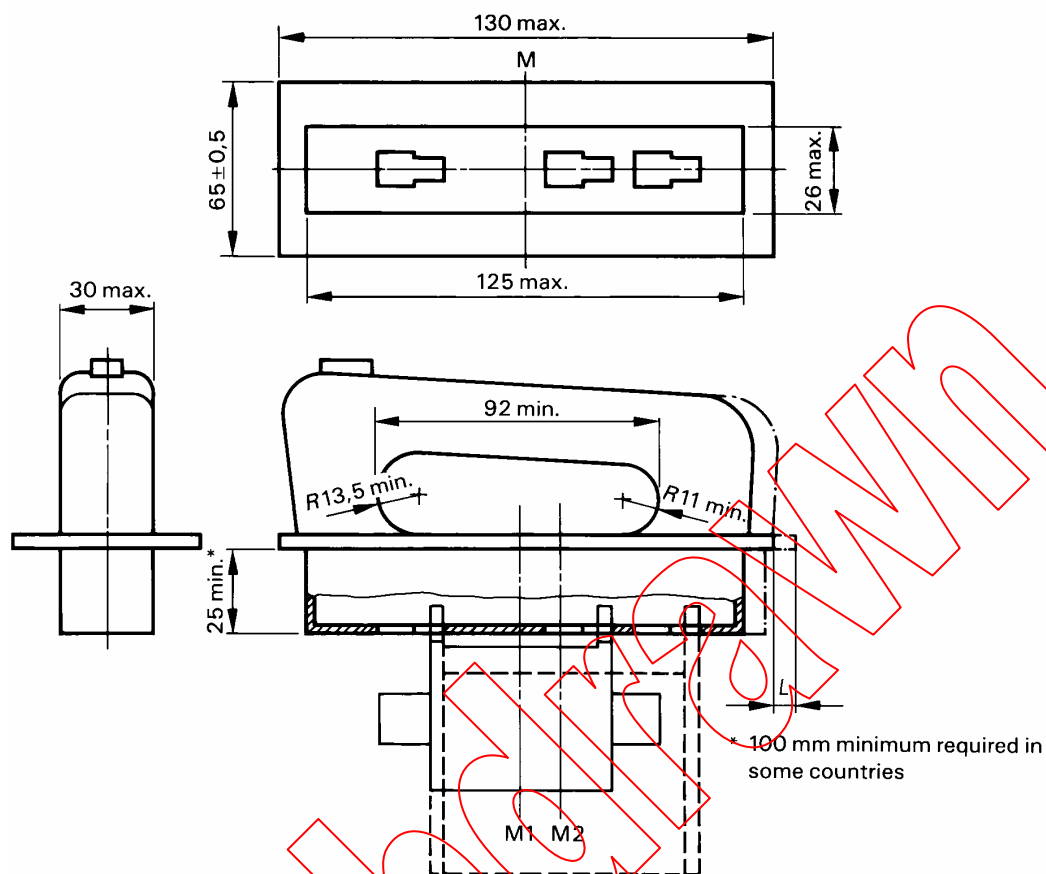
Size	$a^{9)12)}$ min.	$b^{9)}$ min.	$c^{11)}$ min.	$d \pm 0,25$		$e \pm 0,5$
				Hole diameter	Thread	
00 ¹⁴⁾	20	20	3	9	M8	10
0 ¹³⁾	23	20	3	9	M8	10
1	24	25	4	11	M10	12,5
2	28	25	4	11 ¹⁰⁾	M10 ¹⁰⁾	12,5
3	35	30	5	11 ¹⁰⁾	M10 ¹⁰⁾	15
4	45	40	8	14	M12	20
4a	45	40	10	18	M16	20

Figure 102 (continued)

- 1) This area is considered to be live.
- 2) The maximum value of dimension v is intended to define a point of contact. It shall at least be observed at one point of contact within the two areas $b_2 \times 4$ min. of the fuse-link. Dimension v may also be met by means of insulating contact covers.
- 3) Height of contact surface. It shall also be possible to insert fuse-links with blade contacts according to Figure 101, even if the contact surface is not smooth but grooved or divided.
- 4) Dimensions for size 4. Fixing bolts are mandatory for size 4; M12 when threaded.
- 5) Resilient contact surface, except for size 4. Contact force by auxiliary means.
- 6) Only to be used with a swivel unit having an interlocking device.
- 7) These values are only mandatory if interchangeability of fuse-bases is required.
- 8) When constructing multipole or assemblies of single-pole fuse-bases, it is necessary, for reasons of safety, to fit insulating barriers (for example, partition walls with recommended dimension g) compatible with the maximum dimension prescribed for n_1 .
- 9) Greater dimensions for "a" and "b" or deviating shapes, for example, rounded or circular, observing the dimensions "d" and "e" are permitted in relation to the peculiarity of the construction.
- 10) M12 with through hole 14 permitted.
- 11) Dimension "c" may be lower provided the mechanical stress when connecting the conductors can be withstood without deformation of the connection. Types with thread shall comply with test-torque requirements.
- 12) Dimension "a" shall be measured on the top side of the connection.
- 13) Not allowed for new installations except for fuse-links with strikers.
- 14) Fuse-bases of size 00 shall be used for fuse-links of size 000 and size 00.

Figure 102 (concluded)

The drawings are not intended to govern the design of the handle except as regards the notes and dimensions shown.



IEC 407/98
Dimensions in millimetres

Size	L mm	Distance	
		M – M1 mm	M – M2 mm
000/00	14	0 ± 3	
0 ... 3	16		9 ± 5

The basic position of the fuse-link for measurement of the handle is defined by the manufacturer.

Centre of the set-in and blocked-up fuse-link:

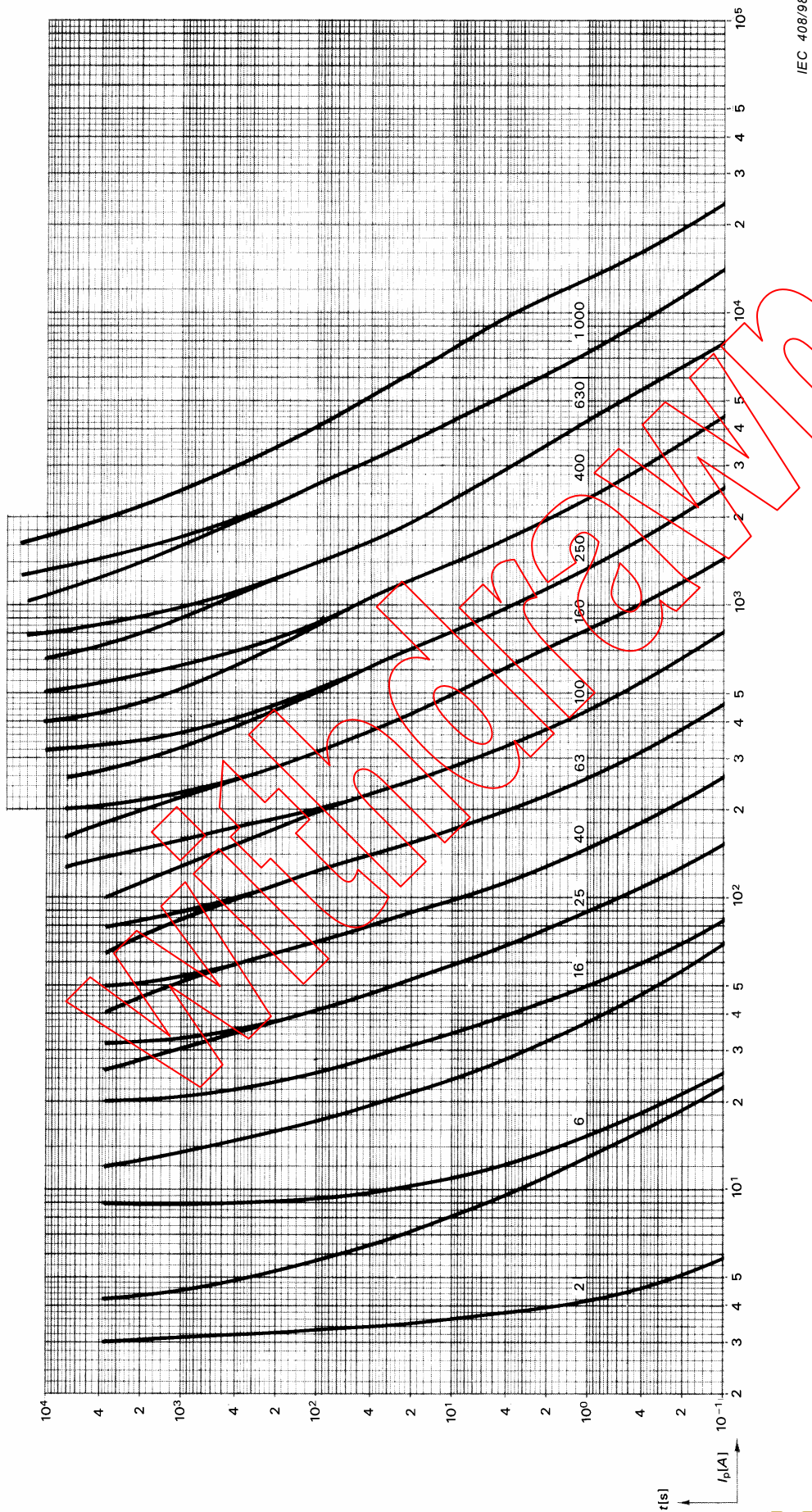
M1 for sizes 000/00

M2 for the sizes 0...3

M = Centre of the coupling

L = Permitted lift for setting in and taking out of the fuse-link

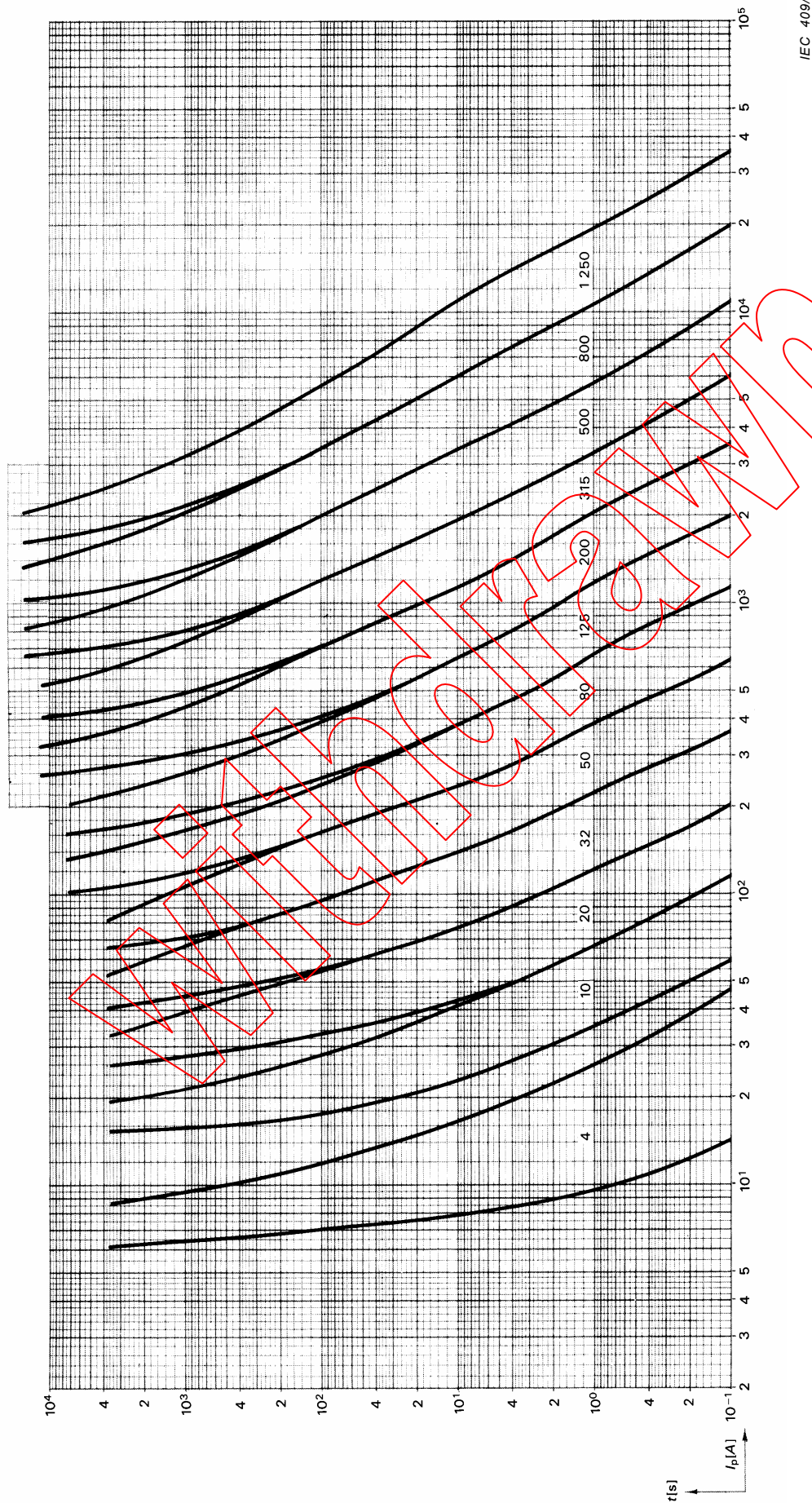
Figure 103 – Replacement handle



IEC 408/98

Figure 104 – Time-current zones for "gG" fuse-links

(figure continued on the next page)



IEC 409/98

Figure 104 (continued)

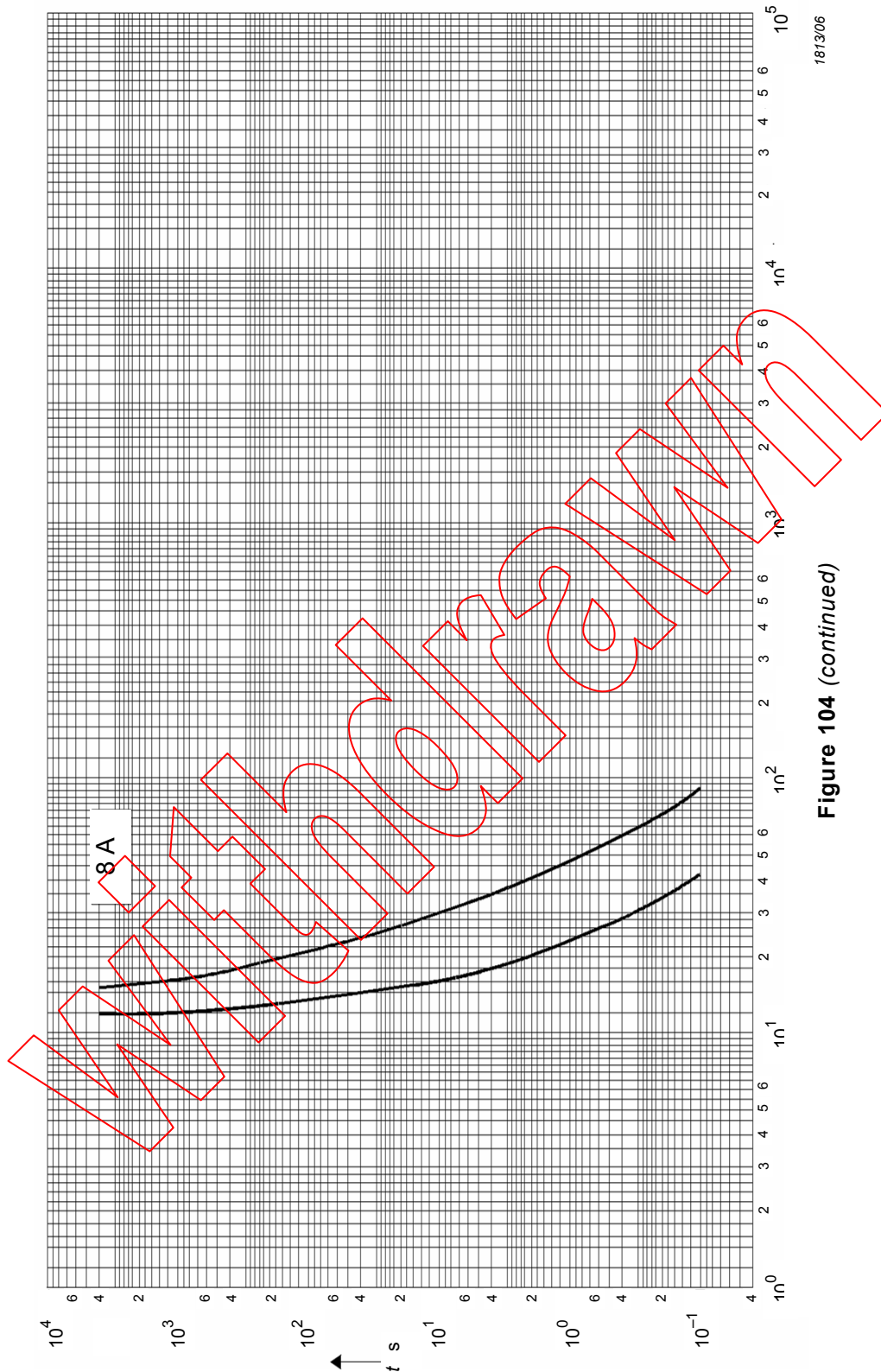


Figure 104 (continued)