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PERFORMANCE SPECIFICATION

FUSES, INSTRUMENT, POWER, AND TELEPHONE GENERAL SPECIFICATION FOR

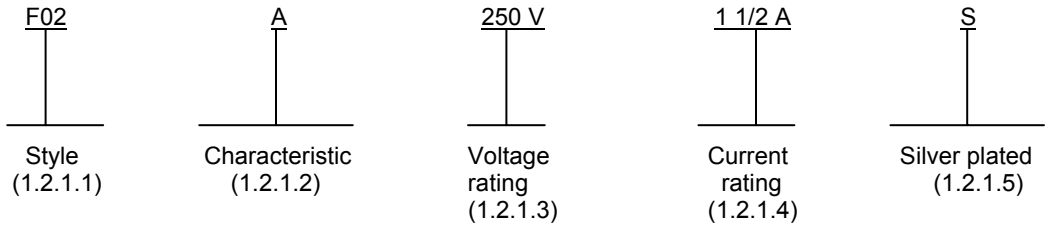
This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for nonrenewable instrument, power, and telephone fuses for the protection of electrical and electronic equipment.

1.2 Classification.

1.2.1 Type designation. The type designation is in the following form and as specified (see 3.1 and 6.2).



1.2.1.1 Style. The style is identified by the letter “F” followed by a two-digit number denoting a fuse of a given interface and physical dimension.

1.2.1.2 Characteristics. The characteristics are identified by a one-letter or two-letter symbol which indicates the relative overload interrupt time (see 6.6) and other special features in accordance with table I.

1.2.1.3 Voltage rating. The voltage rating is the maximum direct current (dc) or alternating current (ac) root mean square (rms) voltage for which a fuse is designed. The voltage rating is identified by a numerical value followed by the letter “V”. The voltage rating is as specified (see 3.1 and 6.2).

1.2.1.4 Current rating. The current rating is the amount of current a fuse will carry indefinitely without interruption. The current rating in amperes is identified by a numerical value followed by the letter “A”. The current rating is as specified (see 3.1 and 6.2).

1.2.1.5 Silver plating. The letter “S” identifies fuses which have silver-plated terminals (see 3.5.4 and 6.2). Identification of other platings is not required.

Comments, suggestions, or questions on this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAT, Post Office Box 3990, Columbus, Ohio 43218-3990 or by email CircuitProtect@dla.mil Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

TABLE I. Relative overload interrupt time.

Symbol	Relative overload interrupt time
A	Normal opening - normal interrupting capacity
B	Time delay - normal interrupting capacity
BR	Time delay - very high interrupting capacity, reject feature
C	Normal opening - very high interrupting capacity

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4 or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

COMMERCIAL ITEM DESCRIPTIONS

A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-19207 - Fuseholders, Extractor Post Type, Blown Fuse, Indicating and Nonindicating, General Specification for.

(See supplement 1 for list of associated specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094).

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

NATIONAL CONFERENCE OF STANDARDS LABORATORIES

NCSL-Z540.1 - Laboratories, Calibration, and Measuring and Test Equipment.

(A Copy of this document is available from the National Conference of Standards Laboratories (NCSL) 2995 Wilderness Place Suite 107, Boulder, Colorado, 80301-5404, United States).

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO 10012-1 - Equipment, Quality Assurance Requirements for Measuring - Part 1: Metrological Confirmation System for Measuring Equipment.

(A Copy of this document is available from http://www.ansi.org/ or the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036-8002).

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Fuses with ratings not covered by a specification sheet. The requirements of this specification shall apply to fuses with other voltage and current ratings, provided the fuse has the same dimensions and falls within the minimum and maximum current and voltage rating of an existing specification sheet, and conforms to all other requirements of that specification sheet. The Qualified Products List (QPL) shall be applicable to these fuses.

3.3 Qualification. Fuses furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable QPL at the time of award of contract (see 4.4 and 6.5).

3.4 Material. The material for each part shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the fuses to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.4.2 Restricted material. Flammable or explosive material, or material which can produce toxic or suffocating fumes when the fuses are in service shall not be used in the construction of fuses.

3.4.3 Case or body.

3.4.3.1 Glass. Glass shall permit the enclosed fuse element to be readily seen.

3.5 Interface and physical dimensions. Fuses shall be of the interface and physical dimensions specified (see 3.1).

3.5.1 Terminal mounting. Terminals shall be secured to the fuse body so that they will not loosen. The fuse wire shall be attached to the terminals so that there shall be no danger of breaking the fuse wire or connections when installing the fuse. Terminals other than ends attached to fusible elements shall be free from solder.

3.5.2 Ferrule alignment. Fuses with ferrule terminals shall pass through a tubular gauge having a length equal to the fuse. The tubular gauge shall have an internal diameter of .010 inch (0.254 mm) greater than the maximum ferrule diameter for fuse lengths up to and including 1.75 inches (44.45 mm). For fuse lengths greater than 1.75 inches (44.45 mm), the tubular gauge shall have an internal diameter of .015 inch (0.381 mm) greater than the maximum ferrule diameter.

3.5.3 Terminal alignment. Fuses with knife blade and lug type terminals shall be aligned or shall be capable of self aligning so that their planes are within 4 degrees of each other.

3.5.4 Terminal finish or plating. Ferrules or other terminals shall be finished (plated, dipped, coated) or shall be natural (no finishing process), as specified (see 3.1). When silver plating is specified (see 1.2.1.5), the letter "S" shall be added as a suffix to the type designation. Additionally, the use of pure tin, as an underplate or final finish, is prohibited externally. Tin content of fuses and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass. Finish shall be optional when not specifically designated. Finishes shall be used which enable the fuses to meet the performance requirements of this specification. For guidance on finishes, see 6.3.

3.6 Continuity. Fuses shall have electrical continuity (see 4.7.1).

3.7 Current-carrying capacity. There shall be no evidence of mechanical damage or failure when fuses are tested as specified (see 4.7.2). Unless otherwise specified on the applicable specification sheet (see 3.1), the temperature of the case, body, and terminals shall not rise above ambient temperature more than shown in table II when using either the thermometer or thermocouple method.

TABLE II. Allowable temperature rise in degrees Celsius (°C).

Casing or body		Terminal	
Thermometer	Thermocouple	Thermometer	Thermocouple
50	90	50	90

3.8 Resistance. Electrical resistance when applicable shall be as specified (see 3.1 and 4.7.3).

3.9 Terminal strength. Fuse terminals shall not loosen or become damaged (see 4.7.4).

3.10 Overload interrupt. Fuses shall open the circuit within the time limits specified (see 3.1) without causing the case or body to char or fracture (see 4.7.5). The fuse shall remain in the energized circuit 1 minute minimum without any indication of the circuit closing again.

3.10.1 Low voltage overload interrupt. The fuses when specified, shall interrupt the overload currents within the time specified (see 3.1, 4.7.5.2, and 6.1.5.1).

3.11 Short circuit interrupt. Fuses shall remain intact and shall open the circuit (see 4.7.6). The fuse shall remain in the energized circuit 30 seconds minimum without any indication of the circuit closing again. The insulation shall not puncture; the ferrules or body shall not rupture or separate, and the terminals shall not be shunted. Fuses shall not emit flame or molten metal sufficient to ignite surgical cotton surrounding the case.

3.12 Vibration. The fuses, when specified (see 3.1), shall not open when subjected to vibration tests (see 4.7.7).

3.13 Shock. The fuses, when specified (see 3.1), shall not open when subjected to shock tests (see 4.7.8).

3.14 Marking. Unless otherwise specified (see 3.1), each fuse shall be marked in accordance with method 1 of MIL-STD-1285, and either 3.14.1 or 3.14.2, or a combination of both.

3.14.1 Ferrule and end cap marking. When fuse ferrules and end caps are marked, the marking shall include the following:

a. Type designation (see 1.2.1).

b. Manufacturer's name, trademark, or code symbol.

3.14.2 Labels. When fuse labels are used, the following shall apply.

3.14.2.1 Material. Label material used shall enable the fuses to meet the performance requirements of this specification and shall show no evidence of peeling, wrinkling, ends lifting, or illegible ink markings (see 4.7.9.1). For guidance on label material, see 6.3.7.

3.14.2.2 Information. Fuse marking shall include the information shown in the following example:

Marking:	Explanation:
Fuse	Component identification.
F02A	Style and characteristic.
250 V	Voltage rating.
1/500 amps	Current rating.
S	Silver-plated (when specified).
Manufacturer's symbol	The manufacturer's identification may be shown on the printed label or may be stamped on the fuse ferrule (or both).

The print size shall be the largest possible which will permit all of the required information to appear on the label.

3.14.2.3 Label size. The width of the label for fuses 2 inches (50.8 mm) in length or less shall almost touch the fuse ferrule on each end of the fuse. For fuses more than 2 inches (50.8 mm) in length, the label shall be large enough so that the markings will be legible. The label shall be centered on the fuse. The label shall completely wrap around the fuse body between the ferrules. Overlapping of the label upon itself is permitted, provided it does not overlap any of the printed information. For fuses not greater than .406 inch (10.3124 mm) diameter, the printed information shall run the length of the fuse body from ferrule to ferrule. For other fuse sizes, the printed information may run perpendicular to the fuse length.

3.14.2.4 Label color. The label color shall be white. Permanent type alcohol-based printing ink shall be used. The color of the printing ink for the various fuses shall be as follows:

Fuse characteristics:	Color:
A	Black
B	Green
BR	Brown
C	Red

3.14.3 Marking of fuses with ratings not covered by specification sheets. Unless otherwise specified (see 6.2), each fuse shall be marked in accordance with method I of MIL-STD-1285 with the following:

a. Style (see 1.2.1.1).

b. Characteristic (see 1.2.1.2).

c. Voltage rating (see 1.2.1.3).

d. Current rating (see 1.2.1.4).

e. Silver plating (see 1.2.1.5) (when required).

f. Manufacturer's name, trademark, or code symbol.

3.15 Soldering. Soldering shall minimize the spattering of solder and flux onto surrounding surfaces. Only noncorrosive fluxes shall be used, unless it can be shown that all corrosive products have been satisfactorily removed or neutralized after soldering. Soldered connections shall be of a character and quality that the bonding between the soldered items may be determined by visual examination. There shall be no evidence of "cold soldering" and the use of excessive amounts of solder will not be permitted.

3.16 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.17 Workmanship. Fuses shall be manufactured and processed in a manner uniform in quality and shall be free from loose terminals, cracked, broken glass, or insulating material, displaced parts, sharp edges, burrs, and other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.4).

b. Verification of qualification (see 4.4.4).

c. Conformance inspection (Group A and group B inspection, see 4.5.1).

d. Periodic inspection (Group C inspection, see 4.5.2).

4.2 Test equipment and inspection facilities. The manufacturer shall establish and maintain a calibration system in accordance with NCSL-Z540.1, ISO 10012-1, or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions. Unless otherwise specified herein, all inspection shall be performed under the following test conditions.

Temperature	-	15°C 35°C (59°F to 95°F).
Relative humidity	-	45 percent to 76 percent.
Air pressure	-	650 mm to 800 mm of mercury.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.5) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. Unless otherwise specified (see 3.1 and 4.4.1), the number of fuses to be subjected to qualification inspection shall be as shown in table III. The numbers shown in the table shall be for each of the maximum and minimum current and voltage ratings of each style and characteristics shown on the specification sheet for which qualification is desired. Four additional samples of each of the above fuses shall be forwarded to the qualifying activity.

4.4.1.1 Samples for fuse label test. Five sample fuses, each of the smallest and largest diameter fuse tubes of each tube material with appropriate labels which the manufacturer proposes to qualify, shall be subjected to the fuse label test (see 4.7.9.1).

TABLE III. Qualification inspection.

Inspection	Requirement	Test method
Group I (all samples)		
Visual and mechanical examination 1/	3.4, 3.5, 3.14, 3.15, 3.16	4.6
Continuity	3.6	4.7.1
Current-carrying capacity	3.7	4.7.2
Group II (eight samples) 2/		
Resistance 3/	3.8	4.7.3
Terminal strength	3.9	4.7.4
Overload interrupt	3.10	4.7.5
Group III (eight samples) 2/		
Short circuit interrupt	3.11	4.7.6
Group IV (four samples) 3/		
Continuity	3.6	4.7.1
Vibration	3.12	4.7.7
Shock	3.13	4.7.8
Group V (four samples) 3/		
Low voltage overload interrupt (when specified)	3.10	4.7.5.2
Group VI (five samples) 3/		
Moisture resistance (fuse labels)	3.14.2.1	4.7.9.1

1/ Physical dimensions need only be measured on four fuses (see 3.1).
2/ Unless otherwise specified (see 3.1).
3/ When applicable (see 3.1).

4.4.2 Inspection routine. Sample units selected in accordance with 4.4.1 shall be subjected to the inspection of table III, group I. Unless otherwise specified (see 3.1), the samples shall then be divided as specified for the remaining groups, excluding group VI, and subjected to the inspection for their particular group in the order shown. The samples of 4.4.1 shall be subjected to the group VI (fuse label) test.

4.4.3 Failures. One or more failures shall be cause for refusal to grant qualification approval. If one or more samples explode or show signs of any missing glass parts, the qualification inspection shall be terminated.

4.4.4 Verification of qualification. To retain qualification, the manufacturer shall provide verification to the qualifying activity for the following items at 36-month intervals:

a. Design of the fuses has not changed.

b. Verification that the conformance inspections have been performed on inspection lots supplied to the requirements of this specification (groups A and B).

c. Verification that the periodic inspection, (group C), has been performed as applicable. If there is an indication of nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to provide verification of the product within 30 days after the end of each 36-month period may result in loss of qualification for the product. The contractor shall immediately notify the qualifying activity at any time during the 36-month period that verification indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, the contractor shall verify to the qualifying activity that the capability to manufacturer and test QPL fuses still exists and that the contractor wants to remain on the QPL. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product of each style, voltage rating, and current rating to testing in accordance with the qualification inspection requirements.

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A and group B inspections (see 4.5.1.2 and 4.5.1.3).

4.5.1.1 Inspection lot. An inspection lot shall consist of all fuses of the same style, current rating, characteristic, and voltage reproduced under essentially the same conditions, and offered for inspection at one time.

4.5.1.2 Group A inspection. Group A inspection shall consist of the inspection and tests specified in table IV.

TABLE IV. Group A inspection.

Inspection	Requirement	Test method
Visual and mechanical examination	3.4, 3.5, 3.14, 3.14.1, 3.15, 3.16	4.6
Continuity 1/	3.6	4.7.1
Resistance 2/	3.8	4.7.3

1/ Not required when resistance is conducted.
2/ When specified (see 3.1).

4.5.1.2.1 Sampling plan. Group A inspection shall be on an inspection lot basis. Samples shall be selected in accordance with table V, based on the inspection lot. If there are one or more failures, the inspection lot shall be considered to have failed.

4.5.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects or 100 percent inspect the lot and remove all defective parts. Reworked lots shall be resubmitted for inspection. Such lots shall be separated from new lots and shall be clearly identified as reinspected lots. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.5.1.2.3 Test routine. All fuses in the sample shall be subjected to the tests specified in table IV.

TABLE V. Group A, zero defect sampling plan. 1/

Lot size	Sample size
1 to 13	100 percent
14 to 150	13
151 to 280	20
281 to 500	29
501 to 1,200	34
1,201 to 3,200	42
3,201 to 10,000	50
10,001 to 35,000	60
35,001 to 150,000	74
150,001 to 500,000	90
500,001 and up	102

1/ At the option of the manufacturer, in-process inspection such as Statistical Process Control, which includes inspection of all the inspections or tests specified in table IV, may be used after approval from the qualifying activity in lieu of the sampling plan specified in table V. All of the in-process control data for these tests shall be made available to the qualifying activity upon request.

4.5.1.3 Group B inspection. Group B inspection shall consist of the tests specified in table VI in the order shown and shall be made on sample units which have passed the group A inspection. Sample units which have been subjected to group B inspection shall not be delivered on the contract or order.

TABLE VI. Group B inspection.

Test 1/	Requirement	Test method
Current-carrying capacity	3.7	4.7.2
Terminal strength	3.9	4.7.4
Overload interrupt 2/	3.10	4.7.5

1/ If the manufacturer can demonstrate that these tests have been performed ten consecutive times with zero failures, the frequency of these tests, with the approval of the qualifying activity, can be performed on a quarterly basis. If the design, material, construction, or processing of the fuse is changed, or if there are any quality problems or failures, the qualifying activity may require resumption of the original test frequency.

2/ Overload interrupt tests shall be conducted at room ambient temperature only.

4.5.1.3.1 Sampling plan. The sampling plan for group B inspection shall be as specified in table VII.

TABLE VII. Group B inspection sampling plan.

Lot size	Sample size	Accept	Reject 1/ 2/ 3/
2 to 15	2	0	1
15 to 25	3	0	1
26 to 90	5	0	1
91 to 150	6	0	1
151 to 280	7	0	1
281 to 500	9	0	1
501 to 1,200	11	0	1
1,201 to 3,200	13	0	1
3,201 to Over	15	0	1

1/ If there are any failures in a sample size, the defective fuses shall be removed from the sample size and the remaining fuses shall be returned to the lot. Defective fuses shall be replaced with new fuses, when available.

2/ This procedure shall be repeated until the sample size conforms to the accept criteria at which time the lot is accepted.

3/ At the option of the manufacturer, in-process inspection such as Statistical Process Control, which includes inspection of all of the inspections or tests specified in table VI, may be used after approval from the qualifying activity in lieu of the sampling plan specified in table VII. All of the in-process control data for these tests shall be made available to the qualifying activity upon request.

4.5.2 Periodic inspection. Qualification verification inspection shall consist of group C. Except where the results of these inspections show nonconformance with the applicable requirements (see 4.5.2.1.4), delivery of products which have passed group A and group B shall not be delayed pending the results of these qualification verification inspections.

4.5.2.1 Group C inspection. Group C inspection shall consist of the tests specified in table VIII in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed the group A and group B inspection, unless the Government considers it more practical to select from current production. A manufacturer's normal quality control tests, production tests and others may be used to fulfill all or part of group C inspections; however, all of group C inspection shall be completed as specified.

4.5.2.1.1 Sampling plan. Unless otherwise specified (see 3.1), the number of fuses to be subjected to group C inspection shall be as shown in table VIII. The number shown in the table shall be for each of the maximum and minimum current and voltage ratings of each style and characteristic shown on the specification sheet for which qualification retention is desired. The tests shall be conducted 36 months after the date of notification of qualification and after each subsequent 36-month period. When production of a particular type of fuse has been suspended for 36 months or more, sample units shall be selected from the first lot of the new production presented for acceptance, and after each subsequent 36-month period.

4.5.2.1.2 Failures. If one or more sample units fail to pass group C inspection, the sample shall be considered to have failed.

TABLE VIII. Group C inspection.

Test	Requirement	Test method
Group I (four samples) 1/		
Short circuit interrupt	3.11	4.7.6
Group II (four samples) 2/ 3/		
Continuity	3.6	4.7.1
Vibration	3.12	4.7.7
Shock	3.13	4.7.8
Group III (four samples) 2/		
Low voltage overload interrupt	3.10.1	4.7.5.2
Group IV (five samples) 2/		
Moisture resistance (labels)	3.14.2.1	4.7.9.1

1/ The short circuit interrupt test may be waived provided sufficient evidence can be provided, to the qualifying activity, that these fuses have passed the UL short circuit.
2/ When applicable (see 3.1).
3/ For group C inspection, shock and vibration may be performed on only the maximum current rating for each characteristic.

4.5.2.1.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract or order.

4.5.2.1.4 Nonconformance. If a sample fails group C inspection, the contractor shall take warranted corrective action on the materials, processes, or both, and on all correctable product units manufactured under similar conditions, with similar materials, processes, and so forth, and subject to similar failure. Product acceptance shall be discontinued until Government accepted corrective action has been taken. Subsequently, group C inspection shall be repeated on additional sample units (either all inspections or the failed original sample inspection at Government discretion). Group A and group B inspection may be reinstituted, however, final acceptance shall be withheld until group C reinspection reveals successful corrective action. In the event of failure after reinspection, failure and relevant corrective action information shall be furnished to the cognizant inspection and qualifying activities.

4.6 Visual and mechanical examination. Fuses shall be examined to verify that the materials, interface, physical dimensions, markings, and workmanship are in accordance with the requirements specified in 3.1 through 3.5 inclusive, 3.14, 3.15, and 3.16.

4.7 Test methods.

4.7.1 Continuity. Continuity of each fuse shall be determined. The equipment used shall limit the current and not cause the fuse to interrupt. (Caution: Insulation testers may provide excessive current on low amperage fuses and cause inadvertent interruption.) Fuses shall meet the requirements specified in 3.6.

4.7.2 Current-carrying capacity. Unless otherwise specified (see 3.1), fuses shall be subjected to an ac or dc current of 110 percent of rated current at any convenient voltage within the rating of the fuse. The current shall be maintained for not less than 30 minutes after the temperature of each fuse has stabilized. Stabilization shall be considered to have occurred when no individual fuse temperature rise reading of 4 consecutive readings taken at 5 minute intervals exceeds the average reading of these 4 readings by more than 2° C and no indication of increasing temperature rise is observed. This average temperature rise reading shall be deemed to be the temperature rise of the fuse. The temperature of the fuse case or body and of the terminals shall be measured by thermocouples (wire size 28 AWG to 32 AWG) or by using the thermometer method. Each fuse shall be mounted in a standard single pole, open-type fuseholder having a corresponding electrical rating. Fuseholders and fuseclips may be selected from MIL-PRF-19207. When two or more fuses are tested in series, the fuseholders shall be located so that there will be a spacing of not less than 6 inches between any two fuses under test. The wire connecting the fuseholders, ammeter, and the source of supply shall be in accordance with A-A-59544. The wire length and size shall be as shown in table IX . Fuses shall meet the requirements specified in 3.7.

TABLE IX. Size of test leads.

Fuse rating amperes	Wire		Circular-mil size
	Length (ft)	AWG size	
0 - 30	2	8	
31 - 60	2	4	
61 - 100	2	1	
101 - 200	2		200,000
201 - 400	4		500,000
401 - 600	4		1,000,000

4.7.3 Resistance. Resistance shall be calculated from the voltage drop measured between the terminals of the fuse at 10 percent or less of rated current using a high impedance voltmeter, a double Kelvin Bridge, Wheatstone Bridge, or other measuring means. Fuses shall meet the requirements specified in 3.8.

4.7.4 Terminal strength. Unless otherwise specified (see 3.1), terminals shall be tested in accordance with method 211 of MIL-STD-202, as applicable. Forces shall be as specified (see 3.1), and shall be applied to individual terminals as follows.

a. Pin type terminals: Test condition A.

   (1) Along terminal axis.

   (2) Perpendicular to terminal axis.

b. Ferrule and knife blade type terminals: Test condition E.

   (1) Torque.

Fuse terminals shall meet the requirements specified in 3.9.

4.7.5 Overload interrupt. Fuses shall be subjected to the percentage of rated alternating current and voltage specified (see 3.1). Unless otherwise specified for qualification, and group B inspection, this test shall be performed at standard ambient conditions only. Opening time measurements shall be made with an oscillograph for periods shorter than 1 second; a synchronous timer may be used for measurements longer than 1 second and a stop watch is suitable for measurements of longer than 10 seconds. Unless otherwise specified (see 3.1), the number of fuses shall be divided evenly for various overloads and temperature conditions. For rated voltage test, the fuses shall be left in the energized circuit for 1 minute minimum after interruption without any indication of reclosing. Fuses shall meet the requirements specified in 3.10.

4.7.5.1 Overload test voltage. For qualification, group C, and first article tests, half of the test samples shall be tested with a power supply having an open circuit voltage within 5 percent of the specified voltage rating for the fuse under test. No times shall be recorded but the fuses shall be examined to determine that they have opened the circuit. The power supply voltage of the other half of the samples and for group B tests may be of any value which is not less than 6 volts.

4.7.5.2 Overload test currents.

4.7.5.2.1 135 percent tests. For 135 percent rated current tests at either rated or reduced voltage, the current tolerance shall be zero to plus 10 percent.

4.7.5.2.2 150, 200, and 300 percent tests. For fuses not greater than .406 inch (10.3124 mm) diameter, when tested at either rated or reduced voltage, the current tolerance shall be plus or minus 3 percent. For fuses greater than .406 inch (10.3124 mm) diameter, when tested at either rated or reduced voltage, the test shall be conducted on a preset circuit or the current may be adjusted to the required test current at a uniform rate not exceeding 3 seconds.

4.7.5.2.3 500 percent tests. For 500 percent rated current tests at rated voltage, the current tolerance shall be zero to minus 5 percent; for reduced voltage tests, the test shall be conducted on a preset circuit adjusted to the required test current using a copper bar in the circuit. The copper bar shall then be replaced with the test fuse, the circuit turning on and readjusted to the required test current at a uniform rate not exceeding 3 seconds.

4.7.6 Short circuit interrupt. Fuses shall meet the requirements specified in 3.11.

4.7.6.1 AC tests. Fuses shall be subjected to ac short circuit tests at the current and voltage specified (see 3.1). The tolerance on the short circuit current shall be zero to plus 20 percent. The tolerance on the voltage shall be zero to plus 10 percent. The ac tests shall be conducted using a supply of adequate capacity such as an ac generator and transformer bank, and shall be on a single phase basis. The current shall be applied within plus or minus 10 degrees of the voltage wave zero point. For characteristic A fuses tested at 450 volts, for characteristic BR fuses and for characteristic C fuses, the power factor shall be as specified (see 3.1). For other fuses, the power factor shall be 0.45 to 0.50 for current ratings not less than 100 amperes, or 0.85 to 0.95 power factor for current ratings not greater than 100 amperes. Fuses shall remain in the energized circuit for not less than 30 seconds after interruption without any indication of reclosing. Short circuit currents shall be determined by means of an oscillograph. Test circuits shall be calibrated for the specified current with the fuseholder short circuited.

4.7.6.2 DC tests. Fuses shall be subjected to dc short circuit tests when specified (see 3.1). The current and voltage shall be as specified (see 3.1). The tolerance on the short circuit current shall be zero to plus 20 percent. The tolerance on the voltage shall be as follows.

1 volt dc to 100 volts dc; zero to plus 15 percent.

Over 100 volts dc, zero to plus 5 percent.

The dc test shall be made using a source of power with the rate of current rise for the test circuit adjusted for not less than 2.92×10^6 amperes per second. The current rate of rise may be lower if the test station limitations preclude obtaining the stated value. Fuses shall remain in the energized circuit for not less than 30 seconds after interruption without any indication of reclosing. Short circuit currents shall be determined by means of an oscillograph. Test circuits shall be calibrated for the specified current with the fuseholder short circuited.

4.7.7 Vibration. Fuses shall be subjected to vibration tests in accordance with MIL-STD-202 using the method specified (see 3.1). The following details and exceptions shall apply:

a. Mounting: Fuses shall be mounted in appropriate fuseholders in accordance with MIL-PRF-19207, or other approved fuseholders.

b. Test method as specified (see 3.1).

(1) Method 201 or

(2) Method 204: Test condition A (except 5g peak).

c. One-half of the sample units shall be tested while carrying 80 percent of rated current and the remainder tested with no current. All fuses shall be tested for continuity as specified in 4.7.1 at the end of the test.

The fuse shall meet the requirements of 3.12.

4.7.8 Shock. When specified, fuses shall be subjected to shock tests in accordance with method 213 of MIL-STD-202, test condition I or method 207 of MIL-STD-202. The following details shall apply.

a. Fuses shall be mounted in appropriate fuseholders in accordance with MIL-PRF-19207 or other approved fuseholders.

b. One-half of the sample units shall be tested while carrying 80 percent of rated current and the remainder tested with no current. All fuses shall be tested for continuity as specified in 4.7.1 at the end of the test.

The fuse shall meet the requirements of 3.13.

4.7.9 Fuse label. Fuse labels shall meet the requirements specified in 3.14.2 and 3.14.3.

4.7.9.1 Moisture resistance (labels). Fuses with attached labels shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply.

a. Initial measurement: Labels shall be inspected for lifting of ends, wrinkles, peeling, and legibility of ink.

b. Step 7b: Vibration is not required.

c. Final measurement: After each cycle, labels shall be examined for lifting of ends, wrinkles, peeling, legibility of ink, and any change from initial measurement.

4.7.9.2 Label conditions. Results of fuse label conditions shall be made available to the qualifying activity upon request.

4.8 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing, and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified herein.

EFFECT OF AMBIENT TEMPERATURE ON THE CURRENT CARRYING CAPACITY OF NORMAL (CHARACTERISTIC A AND C) FUSES

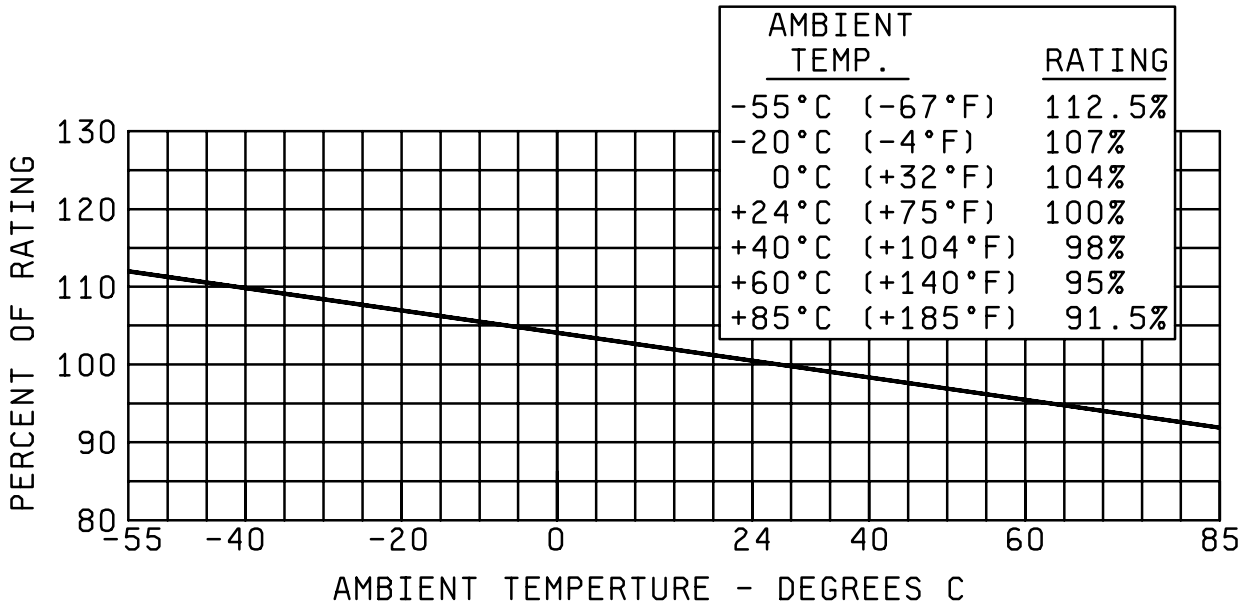


FIGURE 1. (FOR REFERENCE ONLY) - Effect of ambient temperature on the current carrying capacity of normal fuses (characteristic A and characteristic C).

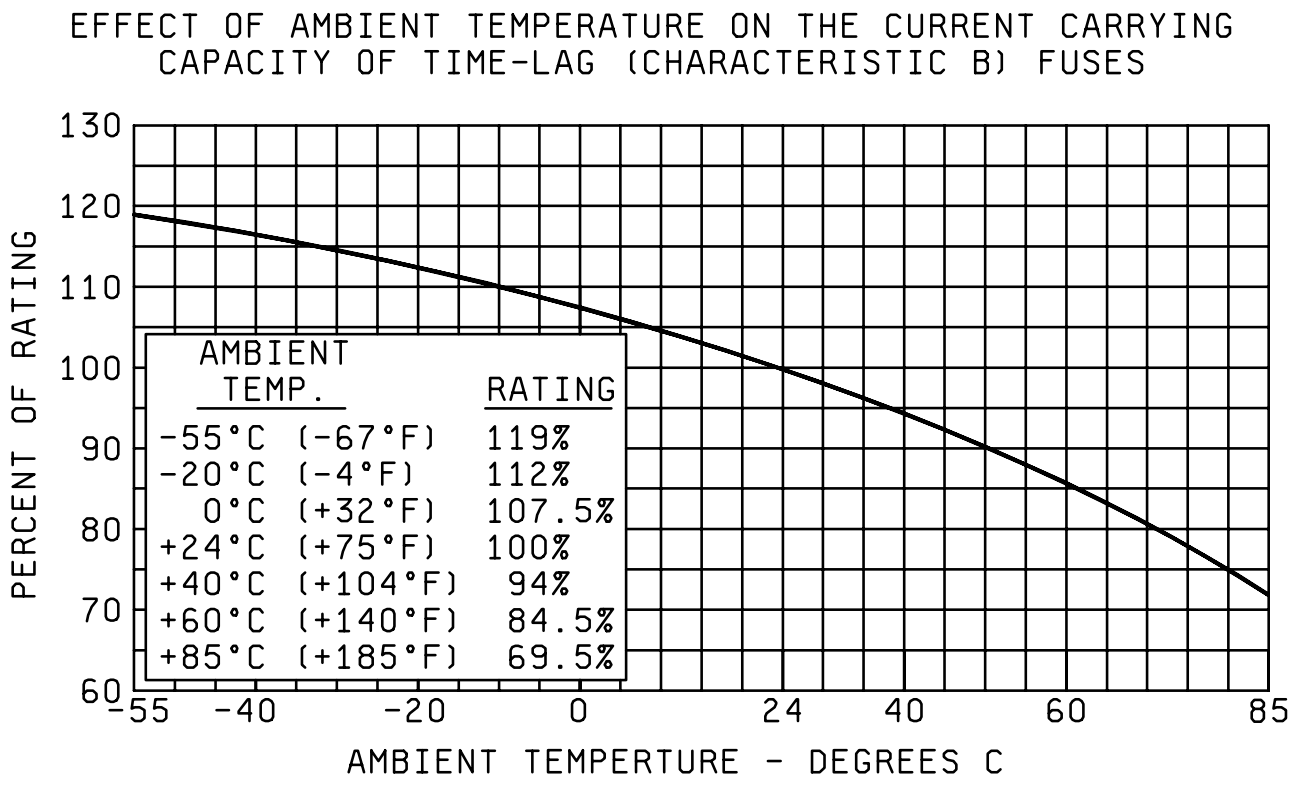


FIGURE 2. (FOR REFERENCE ONLY) - Effect of ambient temperature on the current carrying capacity of time-delay fuses (characteristic B).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Fuses covered by this specification are intended for the protection of electrical and electronic equipment. The fuses are unique due to the fact that these devices must be able to operate satisfactorily under the following demanding conditions: Vibration, 100 g's of shock, and 500 percent rated current tests. In addition, these requirements are verified under a qualification system.

6.1.1 Characteristic A fuses. Normal opening characteristic A fuses are intended for general circuit protection when only nominal short circuit currents are available. Where higher interrupting capacity is desirable, use characteristic C fuses.

6.1.2 Characteristic C fuses. Normal opening characteristic C fuses are intended for general circuit protection where there is a possibility of extremely high short circuit currents. Characteristic C fuses can be substituted for characteristic A fuses; however, the reverse is not true.

6.1.3 Characteristic B fuses. Time delay characteristic B fuses are intended for use in circuits containing motors and other circuits where provision must be made for momentary surges. The fuses should be used only when nominal short circuit currents are available. Consideration should be given to using characteristic BR fuses in lieu of characteristic B fuses wherever possible. Characteristic B fuses cannot be used in rejection type fuseclips intended for characteristic BR fuses.

6.1.4 Characteristic BR fuses. Time delay characteristic BR fuses are intended for use in circuits containing motors and in other circuits where provision must be made for momentary surges. These fuses are capable of interrupting extremely high short circuit currents. They have a "rejection" feature which when used with "rejection" type fuseclips will prevent fuses such as the characteristic A, B, or C from being substituted. Characteristic BR fuses can be substituted for characteristic B fuses in all applications even when standard fuseclips are used.

6.1.5 Fuse selection. The following steps should apply in the selection of a fuse for any application:

a. Step 1. Select a fuse with a voltage rating equal to or in excess of the circuit voltage (see 6.1.5.1).

b. Step 2. The short circuit interrupting rating of the fuse should be checked to determine that it is adequate to protect against the short circuit currents that the particular equipment or circuit can be exposed to.

c. Step 3. The ambient temperature in which the fuse is to be used should be compared to the curves shown on figure 1 or figure 2 to determine the effect the ambient will have on the current rating. For example, if a characteristic A fuse is to be used in a 60°C ambient, it will only carry 95 percent of its normal rating; a fuse which is used in a minus 20°C ambient will carry 107 percent of its nominal rating.

d. Step 4. A fuse rating should be selected on the basis of equipment ampere load with compensation made for ambient temperature (see figure 1 and figure 2). Characteristics A and C fuses should not be loaded to more than 80 percent of the fuse rating (or 80 percent of the adjusted rating based on ambient temperature consideration) to avoid nuisance openings caused by inrush currents and other harmless overloads. Time delay (characteristic B or BR) fuses can be loaded to a higher level because of the ability to override harmless overloads, transients, and inrush currents of short duration.

6.1.5.1 Low voltage applications. Problems can arise when fuses are used at voltages considerably lower than their rated voltage. Due to the increase of the voltage drop when the element of a fuse approaches its melting point, care should be taken to ensure that there is sufficient circuit voltage available to cause the fuse to interrupt the current when an electrical fault occurs. Furthermore, fuses of the same type and rating may, due to difference in design or element material, have different voltage drops and may therefore not be interchangeable in practice when used in applications with low circuit voltages. A minimum low voltage test (3.10.1) is specified (see 3.1) for those fuses which are most likely to be effected when used in very low voltage circuits. However, caution should be used in applying a fuse in any circuit with a voltage considerably lower than the fuse voltage rating.

6.1.5.2 Selected items. Equipment designers should refer to SAE-ARP1199 for possible selection of fuse types preferred for use in new equipment design.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).

c. Title, number, and date of the applicable specification sheet or detail specification with the fuse type designations (see 1.2.1 and 3.1).

d. Style (see 1.2.1.1).

e. Characteristic (see 1.2.1.2).

f. Voltage rating (see 1.2.1.3).

g. Current rating (see 1.2.1.4).

h. When silver plating is required (see 1.2.1.5).

i. Whether first article inspection is required (see 3.3).

j. Requirements for packaging (see 5.1).

k. Special marking, if required (see 3.14.3).

6.3 Finishes and material.

6.3.1 Tin-plated finish. Pure tin plating is prohibited (see 3.5.4) since it may result in tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over the top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have been shown to inhibit the growth of tin whiskers. For additional information on tin finish, refer to ASTM-B545 (Standard Specification for Electrodeposited Coatings of Tin), or for tin plating see ASTM-B545 and ASTM-B339.

6.3.2 Silver-plated finish. Users may consult ASTM-B700 for further information on silver plating.

6.3.3 Gold plated finish. Users may consult SAE-AMS2422 for further information on gold plating. Based on past experience, gold plating of 99.0 percent gold, 0.00005 inch (0.00127 mm) minimum thick, with Knoop hardness ≥ 91, has been used successfully to meet the performance requirements of this specification.

6.3.4 Nickel plated finish. Based on past experience, nickel plating in accordance with SAE-AMS-QQ-N-290, .00008 inch (0.0020 mm) thick over brass and .0002 inch (0.0051 mm) thick over copper, has been used successfully to meet the performance requirements of this specification.

6.3.5 Bright alloy plated finish. Based on past experience, bright alloy plating .00008 inch (0.0020 mm) thick for brass terminals and .0002 inch (0.0051 mm) thick for copper terminals with the following compositions, has been used successfully to meet the performance requirements of this specification:

Copper - 50 to 60 percent
Tin - 25 to 28 percent
Zinc - 14 to 18 percent

6.3.6 Bright dip. When bright dip is used (see 3.1), the metal parts are to be treated and washed to remove tarnish before assembly. Plating is not required.

6.3.7 Label material. Based on past experience, a pressure sensitive polyester tape, Permacel, EE-6951 or equivalent has been used successfully to meet the performance requirements of this specification.

6.4 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs. table X lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. If any of these hazardous materials are required, it is recommended that it be used only when other materials cannot meet performance requirements.

TABLE X. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachoride	Mercury and Compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyle Ketone	Trichloroethyene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.5 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Defense Supply Center Columbus (DSCC-VQP), 3990 East Broad Street, Columbus, Ohio 43218-3990, http://www.dscc.dla.mil/offices/sourcing_and_qualification/default.asp.(see 6.5.1).

6.5.1 Provisions Governing Qualification SD-6. Copies of "Provisions Governing Qualification", SD-6, may be obtained at http://assist.daps.dla.mil/quicksearch/basic_profile.cfm?ident_number=108148 or upon application to the Defense Automated Printing Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.6 Definitions. The term "relative overload interrupt time" refers to relative opening time, and "overload interrupt" refers to overload opening.

6.7 Subcontracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.8 Subject term (key word) listing.

Nonrenewable fuse
Normal opening fuse
Overload interrupt
Power surge
Short circuit
Time delay fuse

6.9 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - SH
Air Force - 11
DLA - CC

Review activities:
Army - AR, AT, CR4, MI
Navy - AS, CG, MC, OS, YD
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5920-2005-004)

NOTE: the activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.