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FEDERAL SPECIFICATION

FUSES, CARTRIDGE, HIGH-INTERRUPTING CAPACITY

The General Services Administration has authorized the use of this federal specification by all federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the general requirements and test procedures for current-limiting and noncurrent-limiting, nonrenewable, cartridge fuses with interrupting capacity ratings of 100,000 or 200,000 rms symmetrical amperes (see 3.1 and 6.1).

1.2 Classification. Fuses shall be of the following classes as specified (see 3.1):

Class G	-	Current-limiting, 300 volts, 0-60 amperes
Class J	-	Current-limiting, 600 volts, 0-600 amperes
Class K9	-	Noncurrent-limiting, 250 and 600 volts, 0-600 amperes
Class K5	-	Noncurrent-limiting, 250 and 600 volts, 0-600 amperes
Class K1	-	Noncurrent-limiting, 250 and 600 volts, 0-600 amperes
Class RK5	-	Current-limiting, 250 and 600 volts, 0-600 amperes
Class RK1	-	Current-limiting, 250 and 600 volts, 0-600 amperes
Class L	-	Current-limiting, 600 volts, 601-6000 amperes

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 and 4 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).

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime ATTN: DLA Land and Maritime-VAT, Post Office Box 3990, Columbus, Ohio 43218-3990 or emailed to 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 https://assist.dla.mil.

DEPARTMENT OF DEFENSE STANDARDS

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

(Copies of these documents are available online at https://assist.dla.mil/quicksearch/ or https://assist.dla.mil or from DLA Document Services, Building 4/D, 700 Robbins Avenue, 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).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B16/B16M	-	Standard Specification for Free-Cutting Rod Brass, Bar and Shapes for Use in Screw Machines.
ASTM B36/B36M	-	Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
ASTM B121/B121M	-	Standard Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar.
ASTM B124/B 124M	-	Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.
ASTM B139/B 139M	-	Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
ASTM B152/B152M	-	Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.
ASTM D710	-	Standard Specification for Vulcanized Fibre Sheets, Rods, and Tubes used for Electrical Insulation.
ASTM B700		Standard Specification for Electrodeposited Coatings of Silver for Engineering use.

(Copies of these documents are available online at http://www.astm.org or from the American Society for Testing Materials International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959).

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO 10012 - Measurement, Management Systems - Requirements for Measurement Processes and Measuring Equipment.

(Copies of this document are available online at http://www.iso.org/iso/home.html or from the American National Standards Institute (ANSI), 1899 L Street, NW, 11th Floor, Washington, DC 20036-3804).

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

NCSL Z540.3 - Calibration of Measuring and Test Equipment, Requirements for.

(Copies of this document are available online at http://www.ncsli.org/ or from the National Conference of Standards Laboratories, 2995 Wilderness Place, Suite 107, Boulder, CO 80301-5404.)

UNDERWRITERS LABORATORIES INC. (UL) STANDARDS

UL 248-1	-	UL Standard for Safety for Low-Voltage Fuses - Part 1: General Requirements.
UL 248-5	-	UL Standard for Safety for Low Voltage Fuses - Part 5: Class G Fuses.
UL 248-8	-	UL Standard for Safety for Low Voltage Fuses - Part 8: Class J Fuses.
UL 248-9	-	UL Standard for Safety for Low-Voltage Fuses - Part 9: Class K Fuses.
UL 248-10	-	UL Standard for Safety for Low Voltage Fuses - Part 10: Class L Fuses.
UL 248-12	-	UL Standard for Safety for Low-Voltage Fuses - Part 12: Class R Fuses.
UL 4248-1	-	UL Standard for Safety for Fuseholders - Part 1: General Requirements.

(Copies of these documents are available online at http://www.ul.com or from the Underwriters Laboratories Incorporated, 2600 N. W. Lake Road, Camas, WA 98607-8542).

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.

3.1.1 Fuse ratings not listed in specification sheets. This specification is applicable to other fuse ratings, provided the desired ratings fall within the maximum and minimum current and voltage ratings specified in the applicable specification sheet. Such fuses shall be considered nonstandard items, and no Government part number will be assigned.

3.2 Qualification. Fuses furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before award of contract (see 4.5 and 6.3).

3.3 Terms and definitions. The definitions of all terms used herein shall be as specified in UL 248-1, UL 248-5, UL 248-8, UL 248-9, UL 248-10, and UL 248-12.

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 construction of the fuses.

3.4.3 Enclosure. Fuses shall have a suitable enclosure which shall prevent lint and dust collecting near the fusible link and thus becoming ignited during overload and interrupting capacity rating tests.

3.4.4 Case or body. The tube shall be of hard fiber, ceramic, or melamine-impregnated glass fiber as specified (see 3.1). Other material may be used provided the fuse is capable of meeting the requirements of 3.10.

3.4.4.1 Fiber. Fiber shall conform to grade CH, form T, of ASTM D710.

3.4.4.2 Plastic. Unless otherwise specified (see 3.1), any plastic insulation may be used, except that cotton-base or cotton- or cellulose-filled molding material shall not be used.

3.4.4.3 Epoxy. Epoxy encapsulant compound used shall meet the performance requirements of this specification.

3.4.4.4 Adhesives. An adhesive employed in a fuse shall adequately and reliably secure together the parts that it is intended to secure (see 3.10).

3.4.4.5 Current-carrying parts (except fuse element). Current-carrying parts shall be of brass, copper, phosphor bronze, or copper alloy conforming to ASTM B36/B36M, ASTM B121/B 121M, ASTM B16/B16M, ASTM B124/B 124M, ASTM B152/B152M, ASTM B139/B 139M, respectively.

3.4.4.6 Noncurrent-carrying parts. All metal noncurrent-carrying parts shall be of corrosion resistant material or of material adequately protected against corrosion.

3.5 Design and construction. Fuses shall be of the design, construction, and physical dimensions specified (see 3.1).

3.5.1 Mounting. Unless otherwise specified (see 3.1), the fuse shall be designed for use in fuseholders in accordance with UL 4248-1 and permit convenient insertion and removal from fuseholders without the use of special tools.

3.5.2 Terminals. Terminals shall be secured to the fuse body so that they will not loosen. The fuse element shall be attached to the terminals so that there will be no danger of breaking the fuse element or connections when installing the fuse. Fuses with knife blade terminals shall be aligned so that their planes are within 4 degrees of each other. The alignment shall be insured by means other than friction.

3.5.3 Ferrule alignment. Fuses with ferrule terminals shall pass through a tubular gauge having a length not less than that of the fuse. The tubular gauge shall have an internal diameter 0.005 inch greater than the maximum ferrule diameter for fuse lengths up to and including 1.75 inches. For fuse lengths greater than 1.75 inches, the tubular gauge shall have an internal diameter 0.010 inch greater than the maximum ferrule diameter.

3.5.4 Terminal finish or plating. Ferrules, knife blades, lugs, or other terminals shall be finished (plated, dipped, coated) or shall be natural (no finishing process), as specified (see 3.1). Finish shall be optional when not specified.

3.5.4.1 Silver plating (see 3.1). Silver plating shall be in accordance with ASTM B700 or equivalent as approved by the qualifying activity, and shall be 99.9 percent pure silver, not coin silver. It shall be not less than .00008 inch (0.002 mm) inch thick. When silver plating is specified, the letter "S" shall be added as a suffix to the end of the Government part number.

3.6 Terminal strength. When tested as specified in 4.7.2, fuse terminals shall not loosen or become damaged.

3.7 Current carrying capacity. When tested as specified in 4.7.3, fuses shall carry the specified percentage of current indefinitely (see 3.1). The temperature of the body shall at no point rise more than the amount specified (see 3.1).

3.8 Watts loss (when specified, see 3.1). When fuses are tested as specified in 4.7.4, the watts loss shall be as specified (see 3.1).

3.9 Overload interrupt. When tested as specified in 4.7.5, fuses shall open the circuit within the time specified (see 3.1) without causing the case or body to char, fracture, or otherwise sustain physical damage. Time delay or dual element fuses shall not open the circuit faster than specified (see 3.1).

3.9.1 Opening at rated voltage. When tested as specified in 4.7.5.1 classes G, J, K, and R fuses shall open the circuit without causing the case or body to char, fracture, or otherwise sustain physical damage.

3.10 Interrupting capacity rating. When fuses are tested as specified in 4.7.6 the interrupting capacity shall be not less than specified (see 3.1). The fuse shall remain intact and permanently open the circuit and shall not ignite cotton, emit molten solder, or permit movement or deformation of either or both end-caps.

3.11 Threshold ratio (when specified, see 3.1). When tested as specified in 4.7.7, the fuses shall clear the circuit in the first half cycle after the circuit is closed. The maximum threshold ratio for the fuse shall be as specified (see 3.1).

3.12 Peak let-thru current. When fuses are tested as specified in 4.7.8 , the peak let-thru current shall not exceed the limit specified (see 3.1).

3.13 Maximum clearing I^2T. When fuses are tested as specified in 4.7.9, the amount of ampere-squared seconds passed by the fuse during melting, arcing, and clearing shall not exceed the value specified (see 3.1).

3.14 Marking. Fuses shall be marked in a manner which will be plainly visible after the fuse has been installed in a standard fuseholder. All markings shall be legible. The marking shall include the following:

a. Classes G, J, K1, K5, K9, RK1, RK5, or L as specified (see 3.1).

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

c. Current rating in amperes.

d. Classes G, J, R, and L fuses shall be identified as "Current Limiting". (Classes K1, K5, and K9 shall not be identified as current limiting.)

e. The interrupting rating (see 3.1).

f. Time delay fuses (see 3.1) shall be identified with a letter "D" or the words "Time Delay".

3.14.1 Government part number. The Government part number (see 3.1) may be marked on the item at the option of the manufacturer.

3.14.2 Underwriters Listed (UL Listed) mark. Fuses which conform to UL 248-1, UL 248-5, UL 248-8, UL 248-9, UL 248-10, or UL 248-12 (see 4.5b), shall have the UL Listed mark on each fuse.

3.15 Soldering. Soldering shall be such as to 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 such a manner as to be uniform in quality and shall be free from loose terminals, cracked or displaced parts, sharp edges, burrs, and other defects that will affect life, serviceability, or appearance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government. Compliance with the requirements of NCSL Z540.3, ISO 10012 or equivalent system as approved by the qualifying activity.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

a. Qualification inspection (see 4.5.1).

b. Conformance inspection (see 4.6).

4.3 Inspection of materials and components. In accordance with 4.1, the contractor is responsible for insuring that materials and components used were manufactured, tested, and inspected in accordance with the requirements of

this specification and of referenced subsidiary specifications and standards to the extent specified, or if none, in accordance with this specification (see 3.4).

4.4 Inspection conditions. All inspections, examinations, and tests shall be performed in accordance with the applicable conditions specified in UL 248-1, and UL 248-5, UL 248-8, UL 248-10 for classes G, J, and L fuses; UL 248-9 for classes K1, K5, and K9 fuses; and, and UL 248-12 for classes RK1 and RK5 fuses.

4.5 Qualification inspection. Qualification shall be obtained by either of the following:

a. By testing the fuses in accordance with 4.5.1. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

b. By having UL Listed marking on fuses. Manufacturers electing this option shall submit a letter of certification to the qualifying activity listing the UL file number, the Government part number, and the manufacturer's part number for each fuse rating for which qualification is desired. The manufacturer shall also certify that he will notify the qualifying activity of any problem which threatens the loss of the UL Listed mark within 30 days after recognition of the problem.

4.5.1 Inspection routine (applicable to 4.5a. only). Fuses shall be subjected to the inspections specified in table I, in the order shown. Sample size, character of failures, and number of failures permitted shall be as specified in UL 248-1, and UL 248-5, UL 248-8, and UL 248-10 for classes G, J, and L fuses; as specified in UL 248-9 for classes K1, K5, and K9 fuses; and as specified in UL 248-12 for RK1 and RK5 fuses.

TABLE I. Qualification inspection.

Inspection	Applicability (class)	Requirement paragraph	Method paragraph
Visual and mechanical examination- - - - - - - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L	3.1 through 3.5.3, 3.14 and 3.15	4.7.1
Terminal strength - - - - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L	3.6	4.7.2
Current carrying capacity - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L	3.7	4.7.3
Watts loss - - - - - - - - - - - - - - - - - -	G	3.8	4.7.4
Overload interrupt		3.9	4.7.5
135 percent - - - - - - - - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5		
150 percent - - - - - - - - - - - - - - - -	L		
200 percent - - - - - - - - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5		
500 percent - - - - - - - - - - - - - - - -	K1, K5, K9, RK1, RK5		
Opening at rated voltage - - - - - - -	G, J, K1, K5, K9, RK1, RK5	3.9.1	4.7.5.1
Interrupting capacity rating		3.10	4.7.6
Interrupting ability - - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L		
Maximum energy - - - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L		
Intermediate interrupting ability - - - - - - - - - - - - - - - - - -	G, K1, K5, K9, RK1, RK5		
Low interrupting ability - - - - - - -	G, K1, K5, K9, RK1, RK5		
Threshold ratio - - - - - - - - - - - - - -	G, J, RK1, RK5, L	3.11	4.7.7
Peak let-thru current - - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L	3.12	4.7.8
Maximum clearing I^2T - - - - - - - - -	G, J, K1, K5, K9, RK1, RK5, L	3.13	4.7.9

4.5.2 Retention of qualification. To retain qualification, the contractor shall provide verification to the qualifying activity for the following items every 12 months:

a. Verification that the conformance inspections have been performed on inspection lots supplied to the requirements of this specification. If test results indicate 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 QPL.

b. Those contractors that used the UL Listed mark to obtain qualification shall submit certification that the qualified fuses retain the UL Listed Mark, at 12-month intervals, to the qualifying activity. The letter of certification shall include the UL file number, the Government part number, and the manufacturer's part number for each fuse rating that is qualified. The manufacturer shall also certify that they will notify the qualifying activity of any problem which threatens loss of the UL Listed Mark within 30 days after recognition of the problem. The initial reporting date shall be established by the qualifying activity. Failure to submit the certification within 30 days after the end of each 12-month period may result in loss of qualification for the product.

In the event that no production has occurred in this period, the contractor shall still verify to the qualifying activity that the capacity to manufacture and test QPL fuses still exists and that the contractor wants to remain on the QPL.

4.6 Quality conformance inspection. Quality conformance inspection shall consist of groups A, B, and C inspections as specified herein, for fuses which qualified in accordance with 4.5a. For fuses which qualified in accordance with 4.5b. the UL Listed Mark shall be evidence of compliance.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections.

4.6.1.1 Inspection lot. An inspection lot shall consist of all fuses of the same class and current rating produced under essentially the same conditions, and offered for inspection at one time.

4.6.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table II.

TABLE II. Group A inspection.

Inspection	Requirement paragraph	Method paragraph
Visual and mechanical examination - - - - - - - - - - - - - - - - -	3.1 through 3.5.3, 3.14, and 3.15	4.7.1
Terminal strength - - - - - - - - - - - - - - -	3.6	4.7.2

4.6.1.2.1 Sampling plan. A sample of parts shall be randomly selected in accordance with table III. If one or more defects are found, the lot shall be rescreened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with table III. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE III. Group A and group B, zero defect sampling plan.

Lot size	Sample size		
	Group A		Group B
	Major	Minor	
2 to 8	100 percent	3 1/	5 1/
9 to 25	13 1/	3	5
26 to 50	13	5	5
51 to 90	13	6	7
91 to 150	13	7	11
151 to 280	20	10	13
281 to 500	29	11	16
501 to 1,200	34	15	19
1,201 to 3,200	42	18	23
3,201 to 10,000	50	22	29

1/ If sample size equals or exceeds lot size, 100 percent inspection is required.

4.6.1.2.1.1 Classification of defects. The classification of defects for group A inspection shall be as follows:

Categories	Defects
Major	
1	Material not as specified (see 3.4).
2	Terminal mounting not as specified (see 3.5.1).
3	Fuses will not pass through gauge as specified (see 3.5.3).
4	Terminal alignment not as specified (see 3.5.2 and 3.5.3).
5	Terminal strength not as specified (see 3.6).
6	Broken insulating material (see 3.4.4).
7	Marking - Incorrect class designation (see 3.14).
Minor	
8	Illegible or improperly located markings (see 3.14).
9	Minor cuts, scratches, burrs and nicks not impairing function.
10	Dimensions out of tolerance not affecting interchangeability, assembly, or operation.
11	Insulation damage not causing possible mechanical or electrical failure.
12	Incomplete removal of soldering flux residue.
13	Other evidence of poor workmanship not affecting the function of the fuse.

4.6.1.3 Group B inspection. Group B inspection shall consist of the inspections specified in table IV, in the order shown, and shall be made on sample units which have been subjected to and have passed group A inspection.

TABLE IV. Group B inspection.

Inspection	Requirement paragraph	Method paragraph
Current-carrying capacity	3.7	4.7.3
Watts loss	3.8	4.7.4
Overload interrupt	3.9	4.7.5

4.6.1.3.1 Sampling plan. A sample of parts shall be randomly selected in accordance with table III.. If one or more defects are found, the lot shall be rescreened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with table III. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.3.2 Disposition of sample units. Sample units subjected to group B inspection shall not be delivered on the contract or purchase order.

4.6.2 Qualification verification inspection. Qualification verification inspection shall consist of group C. Except where the results of this inspection show noncompliance with the applicable requirement (see 4.6.2.1.4), delivery of products which have passed groups A and B shall not be delayed pending the results of this qualification.

4.6.2.1 Group C inspection. Group C inspection shall consist of the interrupting capacity rating test (see 3.10 and 4.7.6). Group C inspection shall be made on sample units selected from lots which have passed groups A and Binspections, unless the Government considers it more practical to select a sample from current production. A manufacturer's normal quality control and production tests may be used to fulfill group C inspection.

4.6.2.1.1 Sampling plan. Samples shall be selected at random. Fifteen each of the maximum and minimum ratings shall be selected from those covered on a single specification sheet, 12 months after the date of notification of qualification and after each subsequent 12-month period.

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

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

4.6.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action acceptable to the qualifying activity has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all tests and examinations, or the test which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination. Fuses shall be examined to verify that the material, design and construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1 through 3.5.3, 3.14, and 3.15).

4.7.2 Terminal strength (see 3.6). Terminals shall be tested in accordance with method 211 of MIL-STD-202, test condition E. Torque shall be as specified (see 3.1).

4.7.3 Current carrying capacity (see 3.7). Fuses shall be subjected to an alternating current, of any convenient voltage, at the specified percentage of rated current (see 3.1). Each fuse shall be mounted in such a position that its major axis is horizontal. The current shall be maintained until the temperature has stabilized.

4.7.3.1 Classes G, J, R, and K fuses. It may be assumed that the temperature has stabilized when three successive temperature readings, taken at 5-minute intervals, indicate no increased rise above the temperature of the ambient air. The temperature of the fuse case, or body, and of the terminals shall be measured using a standard all-glass mercury thermometer. The thermometer shall be supported so that the angle of its stem and the vertical shall not exceed 60 degrees. Contact between the bulb and the fuse will be insured by completely covering the bulb with glazing putty. The test shall be conducted in still air with the ambient temperature within 18°C to 32°C (65°F to 90°F) provided the air temperature does not vary more than 5°C (9°F) during the test. 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. The wire connecting the fuseholders, ammeter, and the source of supply shall be in accordance with A-A-59544 and shall be of the size specified in table V. For fuses rated at more than 60 amperes, C clamps or suitable clip clamps shall be used to insure adequate contact. C clamps shall be of iron or steel, weighing not more than 3 ounces and neither face of the clamp in contact with the fuseholder terminals shall have an area exceeding 1/2 square inch. For fuses rated at 60 amperes or less, a pressure-type fuseholder shall be used to insure adequate contact between the clips and the ferrules of the fuse.

TABLE V. Wire test leads.

Fuse rating in amperes	Wire	
	Minimum length in feet 1/	Size 2/
0-30	2	8 AWG
31-60	2	4 AWG
61-100	2	1 AWG
101-200	2	4/0 AWG
201-400	4	500 MCM
401-600	4	1,000 MCM

1/ Any connection to the source of supply shall be not less than 4 feet.
2/ Connections larger than 8 AWG shall employ a suitable soldering lug or pressure wire connector.

4.7.3.2 Class L fuses. It may be assumed that the temperature has stabilized when three successive readings taken at intervals of 10 percent of the previous elapsed duration of the test, but not less than 10-minute or more than 20-minute intervals, indicate no change. The temperature during the test shall be made with iron and constantan thermocouples using 30 AWG wires. Attachment shall be in the center of the fuse terminal approximately .250 inch (6.35 mm) from the outer edge of the fuse body on the side opposite the terminal bus-bar connection. The fuse under test shall be bolted to a silver plated copper bus-bar with a rectangular cross-sectional area as specified in table VI. The bus-bar shall be at least as wide as the terminal or blade of the fuse being tested. The test current shall be as specified in table VI. The equipment shall be calibrated using a dummy fuse substituted for the fuse to be tested. The dummy fuse shall be a rectangular silver plated copper bus-bar approximately the same length as the fuse to be tested. The dummy fuse may be one piece or laminated, without space between the laminations. The temperature rise of the dummy fuse shall be within the limits specified in table VI. The thermocouples shall be attached to the dummy fuse at the approximate center and on the side opposite the terminal bus-bar connections.

TABLE VI. Bus-bar cross-section and dummy fuse temperature rise.

Ampere rating	Test current (amperes)	Maximum bus-bar cross-section (square inches)	Dummy fuse temperature rise	
			Maximum	Minimum
800	880	.75	35°C (63°F)	20°C (36°F)
1,000	1,100	1	35°C (63°F)	20°C (36°F)
1,200	1,320	1	35°C (63°F)	20°C (36°F)
1,600	1,760	2	35°C (63°F)	20°C (36°F)
2,000	2,200	3	35°C (63°F)	20°C (36°F)
2,500	2,750	4	35°C (63°F)	20°C (36°F)
3,000	3,300	4.5	45°C (81°F)	30°C (54°F)
4,000	4,400	6	60°C (108°F)	40°C (72°F)
5,000	5,500	9	70°C (126°F)	50°C (90°F)
6,000	6,600	9	85°C (153°F)	65°C (117°F)

4.7.4 Watts loss (see 3.8). Fuses shall be mounted in suitable open clip type fuseholders and shall be subjected to rated current until the temperature is stabilized (see 4.7.3.1). The voltage drop shall be taken across the geometric

centers of the ends of the terminals. The average watts loss is calculated as follows:

a. Five fuses are subjected to test.

b. The results of the highest and lowest voltage drops are to be disregarded.

c. The voltage drop for each of the remaining fuses shall be multiplied by the rated current of the fuse. The sum of the product of these three fuses shall be divided by 3 which shall be the average watts loss.

4.7.5 Overload interrupt (see 3.9). Fuses shall be subjected to the overloads as specified (see 3.1), using a power supply of any convenient voltage. The fuse shall open the circuit as specified (see 3.1). Fuses shall be tested singularly. Overload tests shall start at an ambient room temperature of 25°C (77°F) with the following allowable tolerances:

a. Classes G, J, and L - ±5°C (±9°F)

b. Classes K1, K5, K9, RK1, and RK5 - ±7°C (±13°F)

The ambient temperature shall not vary more than 5°C (9°F) during the test.

4.7.5.1 Opening at rated voltage (see 3.9.1). Classes G, J, K1, K5, K9, RK1, and RK5 fuses shall be subjected to an overload of 200 percent of rated current (-0, +10 percent) with a power factor of 80 percent or less (see UL 248-1, UL 248-5, or UL 248-8, UL 248-9, UL 248-10, and UL 248-12). The open circuit voltage shall be not less than the rated voltage at a frequency of 48 to 60 hertz. The fuse may be preconditioned in an air oven having an average temperature of 90°C (194°F) for at least 24 hours prior to testing. Class G fuses shall also be subjected to currents of 5,000, 2,000, 1,000, 500, and 250 rms symmetrical (±10 percent) amperes at 480 volts and a frequency of 48 to 60 hertz. The closing angle shall be at random.

4.7.6 Interrupting capacity rating (see 3.10). Fuses shall be tested as described herein in accordance with the applicability as shown in TABLE I. For additional information on the calculation and determination of power factors, circuit calibration, restrike, and instrumentation, the provisions and applicable portions of UL 248-1, UL 248-5, UL 248-8, UL248-9, UL 248-10, and UL 248-12 shall apply. All tests shall be supported with photographic oscillographic records and may be enlarged to enable accurate measurement.

4.7.6.1 Interrupting ability. Fuses shall be tested on a circuit having an available rms symmetrical current not less than 100 percent or greater than 120 percent of the interrupting capacity rating (see 3.1), and shall be rated frequency (see 3.1). The closing angle shall be essentially at the zero of the voltage wave (maximum offset) or later, to produce start of arcing within 30 electrical degrees prior to system peak voltage. The fuse shall be entirely surrounded by and in intimate contact with untreated surgical cotton. Fuses shall be tested within 1 hour of removal from a 90°C (194°F) oven after at least 24 hours conditioning.

4.7.6.2 Maximum energy. Fuses shall be subjected to an rms symmetrical current (if not greater than the interrupting capacity rating of the fuse) such that the fuse permits a peak current let-thru of 70 to 100 percent of the peak value of the symmetrical component of the alternating current of the circuit at a power factor of 20 percent or less. The voltage shall be not less than rated voltage (see 3.1), and at rated frequency (see 3.1). The closing angle shall produce start of arcing within 30 electrical degrees prior to system peak voltage. The fuse shall be entirely surrounded by and in intimate contact with untreated surgical cotton. Fuses are to be tested within 1 hour of removal from a humidity chamber after conditioning at room temperature and 90 to 100 percent relative humidity for 5 days. This test shall be conducted whether or not the let-thru current for the interrupting ability test falls between 70 and 100 percent of the available current, since different pretesting conditions are imposed on the fuse.

4.7.6.3 Intermediate interrupting ability. Fuses shall be subjected to an rms symmetrical current below the interrupting capacity rating of the fuse - 100,000 amperes (±10 percent), 50,000 amperes (±10 percent), and 25,000 amperes (±10 percent), at a power factor of 20 percent or less. The voltage shall be not less than specified (see 3.1), and at rated frequency (see 3.1). The closing angle shall be adjusted to cause start of arcing within 30 electrical degrees prior to system peak voltage. The fuse shall be entirely surrounded by and in intimate contact with untreated surgical cotton and shall be tested within 1 hour of removal from a 90°C (194°F) oven after at least 24 hours conditioning.

4.7.6.4 Low interrupting ability. Fuses shall be subjected to an rms symmetrical current of not less than 10,000 amperes nor more than 11,000 amperes at a power factor of 50 percent or less. The voltage shall be not less than rated voltage (see 3.1), and at rated frequency (see 3.1). The instant of closure shall be at random with reference to the phase of the voltage wave. Oscillographic records are not required.

4.7.7 Threshold ratio (see 3.11). Fuses shall be subjected to an available rms symmetrical current of not more than the product of the fuse current rating and the threshold ratio (see 3.1), for the fuse being tested. The voltage shall be not less than rated voltage (see 3.1), and the frequency shall be as specified (see 3.1). Oscillographic records shall be used to determine that the circuit was cleared as specified (see 3.11).

4.7.8 Peak let-thru current (see 3.12). Fuses shall be subjected to rms symmetrical currents of 25,000 amperes (if not below threshold), 100,000 amperes, and 200,000 amperes (if not above the interrupting capacity rating). Tolerance on currents is +20, -0 percent. The power factor shall be 20 percent or less. The closing angle shall be essentially at zero of the voltage wave (maximum offset) or later, so as to produce start of arcing within 30 electrical degrees prior to system peak voltage. The peak let-thru current shall not exceed the value specified (see 3.1) when tested on circuits between threshold current and the interrupting capacity rating of the fuse. The test voltage shall be not less than rated voltage (see 3.1). The maximum peak voltage occurring during the interruption shall be not more than 3000 volts. This voltage shall be measured with an instrument having a frequency response that is linear from 50 to 3000 hertz.

4.7.9 Maximum clearing I^2T (see 3.13). The maximum clearing I^2T shall be determined from an oscillogramshowing the current trace obtained in 4.7.8 . The determination shall be made by application of Simpson's rule or the use of an integrating planimeter as shown in UL 248-1, UL 248-5, or UL 248-8, UL 248-9, UL 248-10, and UL 248-12.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military service’s system commands. 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

INFORMATION FOR GUIDANCE ONLY. (This section contains information of a general or explanatory nature that is helpful, but is not mandatory).

6.1 Intended use. Fuses furnished to this specification and listed by Underwriters Laboratories Inc. are intended for use in accordance with the National Electrical Code (NFPA 70). These fuses are designed for use on circuits which may be subjected to high short circuit currents, and these fuses are capable of limiting the peak let-thru current and maximum clearing I^2T (see 3.1 and 3.3).

6.1.1 Class G fuses. These fuses provide safe protection for circuits in homes, commercial buildings, and industrial plants of 120/208, 120/240, and 277/480 volts (not to exceed 300 volts line to ground).

6.1.2 Class J fuses. These fuses provide safe protection on circuits of 600 volts or less that have available short circuit currents up to 200,000 amperes. These fuses are fast (no time delay) and are current limiting.

6.1.3 Class K fuses. These fuses have the same National Electrical Code dimensions as class H fuses but differ from class H in that they have a high interrupting rating. The class K fuses have varying degrees of current limiting ability but may not be designated as current limiting. Class K fuses are divided into subclasses as follows:

a. K1 - Highest degree of current limitation characteristics; interrupting capability up to 200,000 amperes.

b. K5 - Medium degree of current limitation characteristic. Time delay - shall not open in less than 10 seconds at 500 percent of rated current, interrupting capability up to 200,000 amperes.

c. K9 - The lowest degree of current limitation characteristic. Same time delay as the K5, but an interrupting capability up to 100,000 amperes.

6.1.4 Class R fuses. These fuses have the same overall National Electrical Code dimensions as classes H and K fuses but differ by possession of a "rejection feature" which prevents them from being used in a fuseholder for a class H or K fuse. These fuses are current limiting and are divided into subclasses as follows:

a. RK1 - Highest degree of current limiting characteristic; interrupting capability up to 200,000 amperes.

b. RK5 - Medium degree of current limiting characteristic; interrupting capability up to 200,000 amperes.

6.1.5 Class L fuses. These fuses consist of the larger current ratings (600 to 6000 amperes) and are used on circuits of 600 volts or less that have available short circuit currents up to 200,000 amperes. These fuses provide safe current limiting protection when properly bolted to bus bars. They have no intentional time delay.

6.1.6 Interchangeability of classes H, K, and R fuses. Fuses which have the same amperage, voltage, and time delay ratings are one-way interchangeable between classes as follows:

a. RK1 may be used in lieu of RK5, K1, K5, K9, and H.

b. RK5 may be used in lieu of K5, K9, and H.

c. K1 may be used in lieu of K5, K9, and H.

d. K5 may be used in lieu of K9 and H.

e. K9 may be used in lieu of H.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Title, number, and date of the applicable specification sheet.

c. Government part number (see 3.1).

d. Fuse ratings not listed in applicable specification sheets (see 3.1).

e. Levels of preservation-packaging and packing required (see 5.1).

f. Quantity of fuses per unit package.

g. Special or other identification marking, if required (see 5.1).

6.3 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 DLA Land and Maritime, ATTN: DLA Land and Maritime-VQH, 3990 E. Broad Street, Columbus, OH 43218-3990, or by e-mail: VQWebTeam@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at http://www.landandmaritime.dla.mil/programs/qmlqpl/.

6.4 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmentally Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at http://www.epa.gov/osw/hazard/wastemin/priority.htm. Included in the list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

6.5 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes (additions, modifications, corrections, deletions) 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
Air Force - 85
DLA - CC

Review activities:
Army - AR, CR4
Air Force - 99
NSA - NS

Preparing activity:
DLA - CC

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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 https://assist.dla.mil.