INCH-POUND
MIL-DTL-27715C
17 April 2014
SUPERSEDING
MIL-DTL-27715B
09 May 2008

DETAIL SPECIFICATION

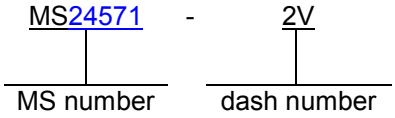
CIRCUIT BREAKER, TRIP-FREE, HIGH TEMPERATURE, AIRCRAFT GENERAL SPECIFICATION FOR

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 of push-pull type single pole, trip-free circuit breakers for use in protecting circuits with a rating of 118/200 volts at 400 Hz alternating current and 28 volts direct current, in ambient temperatures to 121.1°C (250°F).

1.2 Part or Identifying Number (PIN). The PIN will consist of the following (see 3.1 for details):



2. APPLICABLE DOCUMENTS

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-7742	-	Screw Threads, Standard, Optimum Selected Series: General Specification for.
MIL-I-24768/1	-	Insulation, Plastic, Laminated, Thermosetting, Glass Cloth, Melamine-Resin (GME).
MIL-I-24768/17	-	Insulation, Plastic, Laminated, Thermosetting, Glass Cloth, Silicone Resin (GSG).

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 by email 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/.

MS24571 - Circuit Breakers, Aircraft, Trip-free, 2 1/2 to 50 Amperes, 121.1°C Ambient.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130 - Identification Marking of U. S. Military Property.
MIL-STD-202 - Test Method Standard, Electronic and Electrical Component Parts.
MIL-STD-704 - Electric Power Characteristics, Aircraft.
MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-31000 - Technical Data Packages.

(Copies of these documents are available online at http://quicksearch.dla.mil 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).

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

NASM25027 - Nut, Self-Locking, 250 Degrees F, 450 Degrees F, and 800 Degrees F.

(Copies of this document are available from http://www.aia-aerospace.org or from the Aerospace Industries Association of America, Inc., 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, 703-358-1000).

AMERICAN SOCIETY FOR QUALITY

ASQ Z1.4 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of this document are available from http://www.asq.org/ or from the American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203-2914).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D5948 - Standard Specification for Molding Compounds, Thermosetting.

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

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

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

ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories.

(Copies of these documents 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 20036-3801).

SOCIETY OF AUTOMOTIVE ENGINEERS

SAE-AS50861	-	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy.
SAE-AS20659	-	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class 1 for 175°C Total Conductor Temperature.
SAE-AS25036	-	Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, Bell-Mouthed, Type II, Class 1 (for 105ºC Total Conductor Temperature).

(Copies of these documents are available online at http://www.sae.org/ or from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 Qualification. The circuit breakers furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award.

3.3 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected to meet the requirements of this specification, except as specified in 3.3.1 and 3.3.2.

3.3.1 Commercial parts. Commercial parts having suitable properties may be used where, on the date of invitation for bids, there are no suitable standard parts. In any case, commercial utility parts such as screws, bolts, nuts, and cotter pins having suitable properties may be used provided:

a. They can be replaced by the standard military parts without alteration.

b. The corresponding standard part numbers are referenced in the parts list and on the contractor's drawings.

3.3.2 Standard parts. With the exception specified in 3.4.1, standard military parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.4 Materials. Materials shall conform to applicable specifications and shall be as specified herein. Materials not covered by applicable specifications or not specifically described herein shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended. Materials shall be inherently fungus resistant.

3.4.1 Metals. Metals shall be corrosion-resistant or suitably treated to resist corrosion due to fuels, salt atmosphere, or atmospheric conditions that may be encountered in storage or normal service.

3.4.1.1 Dissimilar metals. Unless otherwise suitable protected, dissimilar metals, such as brass, copper, or steel, shall not be used in intimate contact with magnesium, aluminum, or their alloys. Where contact between dissimilar metals is unavoidable, the metals shall be protected against electrolytic corrosion. When thermostatic bimetals and trimetals are used, corrosion resulting from tests specified herein shall not adversely affect the performance of the breaker.

3.4.2 Plastics. Plastic materials used in the housing, insulator base, and any internal parts exposed to arcing or surface creepage shall conform to Specification MIL-I-24768/17, MIL-I-24768/1, or ASTM-D5948. Other types of plastic materials may be used provided the manufacturer submits satisfactory evidence to the activity responsible for qualification that the materials are suitable for the purpose intended. The plastic materials used shall neither support combustion nor give off noxious gas when subjected to arcs, such as those caused by interrupting heavy short-circuit currents, or explosions of gaseous vapors to which the materials may be subjected in service. Plastic materials with cellulose fillers shall not be permitted in parts that may be subjected to arcing or surface creepage.

3.4.2.1 Color. The color of the plastic case for the circuit breaker shall be optional.

3.4.3 Protective treatment. When materials are used in the construction of the circuit breaker that are subject to corrosion in salt air or other atmospheric conditions likely to occur during service usage, they shall be protected against such corrosion in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip or scale with age or extremes of atmospheric conditions shall be avoided.

3.5 Design and construction. The design and construction of the circuit breaker shall conform to the applicable specification sheet (see 3.1). If this specification and the specification sheet conflict, the specification sheet shall govern.

3.5.1 Mounting means. The circuit breaker shall be provided with a suitable mounting means as shown in the applicable specification sheet (see 3.1). Self-locking nuts shall meet the performance requirements of NASM25027.

3.5.1.1 Mounting screw clearance. The mounting screws shall be screwable into the circuit breaker to a minimum depth, as shown (see 3.1).

3.5.2 Actuator. The portion of the actuator visible when the circuit breaker is in the closed position shall be black and shall expose a white band when in the open or tripped position. The exterior portion of the actuator shall be insulated from all current carrying parts. The actuator shall not work out to an intermediate position, give a false trip indication, or be removable from the breaker.

3.5.2.1 Manual circuit opening. The circuit breakers defined herein shall be designed to permit manual opening of the circuit by pulling out the actuator.

3.5.2.2 Trip indication and reset. The circuit breakers shall be so designed that when the breaker contacts open automatically on overload, the actuator shall indicate the operation by moving to the tripped position as shown (see 3.1). Resetting shall be accomplished in accordance with the applicable specification sheet.

3.5.3 Attitude. The circuit breaker performance shall be unaffected by mounting position.

3.5.4 Terminals. Terminal construction shall be as specified in the applicable specification sheet (see 3.1) and shall be designed for use with terminal lugs conforming to SAE-AS25036 or SAE-AS20659. The use of pure tin as an underplate or final finish is prohibited. Tin content shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.5).

3.5.5 Housing. The circuit breaker mechanism shall be enclosed in a housing securely attached to the insulator base and to the mounting plate when one is used. The housing may be integral with the insulator base.

3.5.5.1 Strength of housing. The mounting nuts shall be backed or provided with other means to prevent mounting screws of excess length from interfering with the operation of the breaker. Screws of excess length shall not fracture the housing or the explosion-proofing seal.

3.5.6 Screw threads. Screw threads on removable or replaceable threaded parts shall be as specified in specification MIL-S-7742. Threading on non-metallic parts is not permitted.

3.5.7 Tamper-proof calibration. Circuit breakers shall be so sealed that tampering with the calibration is not possible without dismantling the device or breaking the seal.

3.5.8 Environmental conditions. The unit shall perform satisfactorily when subjected to any one or any combination of the following environmental conditions. There shall be no breakage, malfunction, or evidence of any damage that would impair the ability of the circuit breakers to meet the requirements of subsequent tests.

a. Temperature. Temperatures from -53.9°C (-65°F) to 121°C (250°F).

b. Altitude. Pressure altitude from sea level to 60,000 feet.

c. Explosion-proof. Operation in an explosive atmosphere.

d. Humidity. Relative humidity to 95 percent.

e. Salt atmosphere. Exposure to salt laden atmosphere.

f. Sand and dust. Exposure to sand and dust.

g. Vibration. Vibration incident to use in jet powered aircraft.

h. Shock. Mechanical shock of 25g.

i. Fungus. Moist fungi as encountered in tropical climates.

j. Acceleration. Acceleration of 10g for one minute.

3.6 Performance. The circuit breakers shall be designed to perform satisfactorily in accordance with the following requirements.

3.6.1 Dielectric strength. Each circuit breaker shall withstand without damage, at sea level pressure, a potential of 1500 volts RMS alternating current at commercial frequency for 1 minute for each of the conditions as specified in section 4 herein.

3.6.2 Insulation resistance. The insulation resistance between mutually insulated metal parts shall be 100 megohms or more.

3.6.3 Ultimate trip. At ambient temperatures from -53.9°C (-65°F) to 121.1°C (250°F), the circuit breaker shall trip in less than 60 minutes while carrying currents indicated by the trip curve, and shall not trip within 60 minutes while carrying currents indicated by the hold curve as shown in figure 1. When tripped in accordance with any condition shown by the trip curve, the breaker shall be resettable within 1 minute and with no load current.

3.6.4 Calibration. The circuit breaker shall trip within the limits defined on the applicable specification sheet (see 3.1).

3.6.5 Electrical losses. The voltage drop across the terminals while the circuit breaker is carrying rated current shall not exceed the value specified (see 3.1).

3.6.6 Reclosing. After automatic tripping with the actuator manually held in the reset or closed position, or with the actuator in the normally open position, the circuit breaker shall not automatically reclose when subjected to any temperature from -53.9°C (-65°F) to 121.1°C (250°F).

3.6.7 Rupture capacity.

3.6.7.1 Alternating current rupture capacity. The circuit breaker shall be capable of interrupting line-to-line and line-to-neutral faults on a 200-volt, three-phase, 400 Hz system defined (see 3.1).

3.6.7.2 Direct current rupture capacity. The circuit breaker shall be capable of interrupting direct current faults on a dc system defined by the applicable specification sheet (see 3.1).

3.6.8 Coordination. When any sustained overload or fault current within the coverage of these circuit breakers is applied to two breakers in series, with a ratio of current ratings of at least 2 to 1, the breaker with higher rating shall hold closed and the breaker with the lower rating shall trip.

3.6.9 Ratings. The ratings of the circuit breakers shall be as specified (see 3.1).

3.6.10 Trip free. The circuit breaker shall be so designed that the circuit cannot be maintained closed when carrying overload currents which normally would automatically trip them to the open position. Contacts shall not reclose nor be resettable until the actuator is first moved to the open position.

3.6.11 Overload cycling. The circuit breakers shall be capable of withstanding 100 cycles of manual make and automatic break of an inductive load of 200 percent of rated ac current at 0.75 power factor.

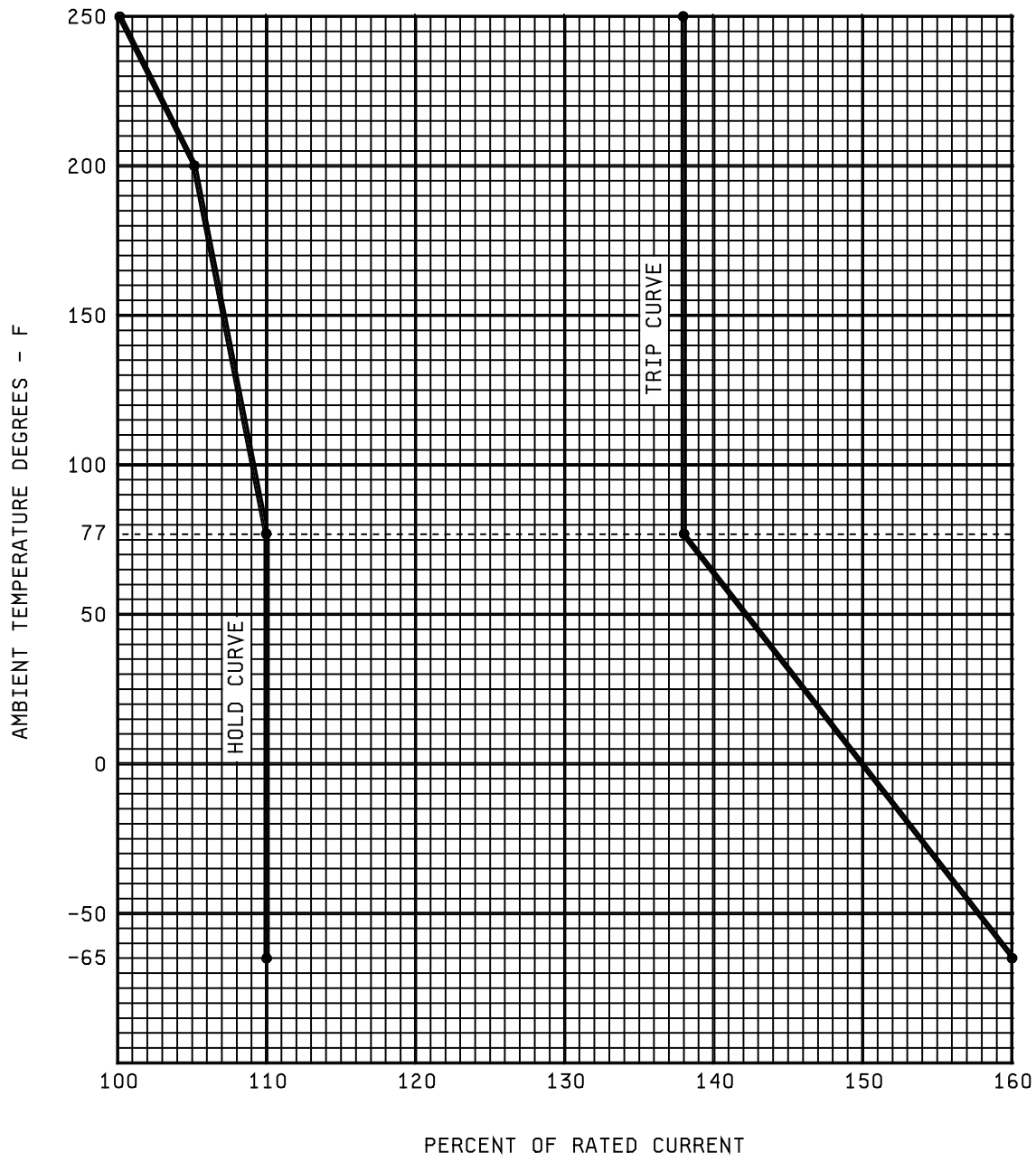


FIGURE 1. Ambient temperature (degrees F)

3.6.12 Strength of threaded parts.

3.6.12.1 Strength of terminals. The terminals shall be capable of withstanding the tensile load specified in Table I applied perpendicularly to the mounting plate of the circuit breaker for one minute. The terminals shall also be capable of withstanding a torque as specified in Table I applied to the screw heads and about the thread axis for 1 minute.

TABLE I. Strength of threaded parts.

TERMINALS		
SCREW THREADS	TENSILE LOAD (LB)	TORQUE (LB-IN)
8-32 UNC-2A	25	20
5/16-24 UNF-2A	70	80
MOUNTING MEANS		
SCREW THREADS	TENSILE LOAD (LB)	TORQUE (LB-IN)
6-32 UNC-3B	30	10
8-32 UNC-3B	35	20

3.6.12.2 Strength of mounting provisions. The mounting nuts shall be capable of withstanding an axial load as specified in table I for 1 minute. They shall also be able to withstand the torque specified in table I applied to a screw tightened in the nuts for 1 minute.

3.6.13 Operating force. The force required to manually open and close the breaker contacts, by means of the actuator, shall be as specified (see 3.1).

3.6.14 Strength of actuator. The unit shall be designed to withstand a 25 pound force applied to the push button in both directions applied along the axis of travel for 1 minute. The unit shall withstand a 40 pound force applied to the end of the extended push button in any direction for 1 minute.

3.6.15 Durability. The circuit breaker shall perform the number of cycles of mechanical operation specified (see 3.1). Half of these cycles shall be at no load and half shall be at 100 percent of rated current at rated voltage and frequency.

3.7 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The drawing number requirements of specification MIL-STD-31000 shall govern changes in the manufacturer's part numbers.

3.8 Markings.

3.8.1 Nominal current rating. The nominal current ratings of the circuit breaker, in whole numbers, shall be permanently and legibly marked on the button of the breaker as shown (see 3.1).

3.8.2 Caution. A caution marking shall be included on the unit in accordance with the applicable specification sheet (see 3.1).

3.9 Identification of product. Each unit shall be permanently and legibly marked for identification in accordance with MIL-STD-130.

3.10 Recycled, recovered, or environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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.

3.11 Workmanship. The circuit breaker, including all parts and accessories, shall be constructed and finished in a careful and workmanlike manner in accordance with good design and sound practice. Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils, marking of parts and assemblies, welding and brazing, painting, riveting, machine-screw assemblies, and freedom of parts from burrs and sharp edges.

3.11.1 Cleaning. The circuit breaker shall be thoroughly cleaned and loose spattered, or excess solder, metal chips, and other foreign material removed during and after final assembly.

3.11.2 Screw assemblies. Assembly screws and bolts shall be tight. The word tight means that the screw or bolt cannot be appreciably tightened further without damage or injury to the screw, bolt, or threads.

4. VERIFICATION

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. 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.

4.2 Classification of inspections. 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 (see 4.5).

4.3 Test equipment and inspection facilities. The manufacturer shall establish and maintain a calibration system in accordance with ISO/IEC 17025, ISO 10012, or equivalent system as approved by the qualifying activity.

4.3.1 Standard conditions. Unless otherwise specified all tests shall be conducted in still air at a temperature of 25 ±3°C (77 ±5.4°F) that shall be considered room ambient and at sea level pressure. The atmospheric pressure at the test facility may be used in lieu of sea level pressure, if the elevation of the test facility is not greater than 3000 feet above sea level.

4.3.2 Power supply. Unless otherwise specified, the power source for all tests, when required, shall be 118 ±3 volts at a frequency of 400 ±20 Hz with waveform and recovery voltage characteristics harmonic content in accordance with the requirements of MIL-STD-704.

4.3.3 Test cables. Unless otherwise specified, test cables in accordance with figure 2 shall be used for all tests that require circuit breakers to carry current.

4.4 Qualification inspection.

4.4.1 Sample size. The qualification inspection sample shall consist of 24 circuit breakers representative of the production equipment. The samples shall be identified with the manufacturer's part number and such other information as required by the procuring activity.

4.4.2 Inspection routine. Qualification inspection sample circuit breakers shall be subjected to the tests in the sequence shown in table II with the tests being conducted as described under 4.6 Methods of examination and test.

4.4.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

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:

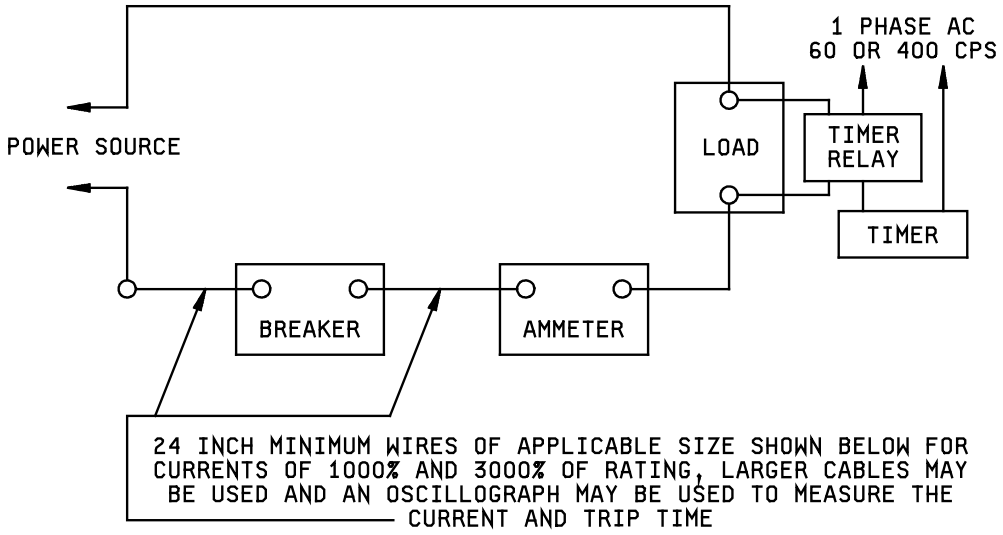
a. Design of the circuit breakers has not changed.

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

c. Verification that the periodic inspections (group B) have 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 QPL.

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 manufacture and test QPL fuses still exists and that the contractor wants to remain of 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.



(a) CIRCUIT-BREAKER CAPACITY (AMPERES)	WIRE SIZE (AN DESIGNATION)	UNINSULATED TERM. LUG (MS PART NR)	INSULATED LUG (MS PART NR)
LESS THAN 6	18	SAE-AS20659-102	SAE-AS25036-103
7 TO 10 INCL	16	SAE-AS20659-104	SAE-AS25036-108
11 TO 15 INCL	14	SAE-AS20659-104	SAE-AS25036-108
16 TO 20 INCL	12	SAE-AS20659-105	SAE-AS25036-112
21 TO 25 INCL	10	SAE-AS20659-105	SAE-AS25036-112
26 TO 40 INCL	8	SAE-AS20659-107	SAE-AS25036-115
41 TO 50 INCL	6	SAE-AS20659-130	SAE-AS25036-119
51 TO 60 INCL	6	SAE-AS20659-131	SAE-AS25036-121
61 TO 90 INCL	4	SAE-AS20659-132	SAE-AS25036-124
91 TO 120 INCL	2	SAE-AS20659-114	SAE-AS25036-127
121 TO 150 INCL	0	SAE-AS20659-118	SAE-AS25036-133
151 TO 200 INCL	00		SAE-AS25036-136

TEST WIRES AND TERMINALS SHALL CONFORM TO SPECIFICATION SAE-AS50861.

AMMETER: ACCURACY WITHIN .5 OF 1 PERCENT

(a) FOR CIRCUIT BREAKERS BETWEEN STEPS OF THE ABOVE TABLE, USE THE AN TYPE WIRE OF THE NEXT SMALLER SIZE.

FIGURE 2. Test cables

TABLE II. (Sheet 1 of 2) Qualification Test Sequence.

QUALIFICATION TEST	TEST PARAGRAPH	TEST SAMPLES											
		1	2	3	4	5	6	7	8	9	10	11	12
Examination of product	4.6.1	X	X	X	X	X	X	X	X	X	X	X	X
Dielectric strength	4.6.2	X	X	X	X	X	X	X	X	X	X	X	X
Insulation resistance	4.6.3	X	X	X	X	X	X	X	X	X	X	X	X
Ultimate trip	4.6.4	X	X	X	X	X	X	X	X	X	X	X	X
Calibration	4.6.5	X	X	X	X	X	X	X	X	X	X	X	X
Electrical losses	4.6.6	X	X	X	X								
AC rupture	4.6.7	X	X	X	X								
Reclosing	4.6.8					X							
DC rupture	4.6.9					X							
Explosion proof	4.6.10.7						X	X	X	X			
Humidity	4.6.10.1										X		
Salt atmosphere	4.6.10.2											X	
Sand and dust	4.6.10.3												X
Vibration	4.6.10.4												
Coordination	4.6.11												
Shock	4.6.10.5												
Trip free	4.6.12												
Overload cycling	4.6.13												
Fungus resistance	4.6.10.6												
Strength of terminals	4.6.14.1												
Strength of mounting provisions and housing	4.6.14.2, 4.6.14.2.1												
Operating force	4.6.15												
Strength of actuator	4.6.16												
Acceleration	4.6.10.8												
Durability	4.6.17												

TABLE II. (Sheet 2 of 2) Qualification Test Sequence.

QUALIFICATION TEST	TEST PARAGRAPH	TEST SAMPLES											
		13	14	15	16	17	18	19	20	21	22	23	24
Examination of product	4.6.1	X	X	X	X	X	X	X	X	X	X	X	X
Dielectric strength	4.6.2	X	X	X	X	X	X	X	X	X	X	X	X
Insulation resistance	4.6.3	X	X	X	X	X	X	X	X	X	X	X	X
Ultimate trip	4.6.4	X	X	X	X	X	X	X	X	X	X	X	X
Calibration	4.6.5	X	X	X	X	X	X	X	X	X	X	X	X
Electrical losses	4.6.6												
AC rupture	4.6.7												
Reclosing	4.6.8												
DC rupture	4.6.9												
Explosion proof	4.6.10.7												
Humidity	4.6.10.1												
Salt atmosphere	4.6.10.2												
Sand and dust	4.6.10.3												
Vibration	4.6.10.4	X	X	X									
Coordination	4.6.11				X	X							
Shock	4.6.10.5						X						
Trip free	4.6.12							X	X				
Overload cycling	4.6.13							X	X				
Fungus resistance	4.6.10.6									X			
Strength of terminals	4.6.14.1										X		
Strength of mounting provisions and housing	4.6.14.2, 4.6.14.2.1										X		
Operating force	4.6.15										X	X	X
Strength of actuator	4.6.16										X		
Acceleration	4.6.10.8										X		
Durability	4.6.17											X	X

4.5 Conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspections. Except as specified in 4.5.1.3, delivery of products which have passed the group A inspections shall not be delayed pending the results of the group B inspections.

4.5.1.1 Inspection lot. An inspection lot shall consist of all the circuit breakers covered by a single specification sheet produced 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 inspections specified in table IV, in the order shown.

4.5.1.2.1 Sampling plan. Group A inspection shall be based on an acceptable industry standard c=0 inspection plan (e.g. ASQ Z1.4). Samples shall be selected in accordance with table III, 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 defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

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

Lot size	Sample size	
	Electrical characteristics 2/	Examination of product
1 to 8	100 percent	3
9 to 15	13	3
16 to 25	13	3
26 to 50	13	5
51 to 90	13	6
91 to 150	13	7
151 to 280	20	10
181 to 500	29	11
501 to 1,200	34	15
1,201 to 3,200	42	18
3,201 to 10,000	50	22
10,001 to 35,000	60	29
35,001 to 150,000	74	29
150,001 to 500,000	90	29
500,001 and up	102	29

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 III. All of the in-process control data for these tests shall be made available to the qualifying activity upon request.

2/ Dielectric withstanding voltage and 200% overload calibration testing shall be 100% inspected. The inspection frequency may be reduced, with approval of the qualifying activity, based on supporting data supplied by the manufacturer.

4.5.1.2.3 Disposition of sample units. Sample units which have passed all the group A inspection may be delivered on the contract or order if the lot is accepted and the sample units are still within specified electrical tolerances.

TABLE IV. Group A inspection.

TEST	TEST PARAGRAPH
Examination of product	4.6.1
Dielectric Strength	4.6.2
Ultimate trip and Calibration (200 percent of rated current at 25°C (77°F))	4.6.4 4.6.5

4.5.1.3 Periodic inspection. Periodic inspection shall consist of group B inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.1.3.5), delivery of products which have passed group A inspection shall not be delayed pending the results of these periodic inspections.

4.5.1.3.1 Group B inspection. Group B inspection shall consist of the inspections specified in table V, in the order shown.

4.5.1.3.2 Sampling plan. Three circuit breakers shall be selected at random out of every 1000 units, or for every 3-months, whichever occurs first, from each style manufactured. Group B inspection shall be performed on sample units which have passed Group A inspection, unless the Government considers it more practical to select a separate sample.

TABLE V. Group B inspection.

TEST	TEST PARAGRAPH
Insulation resistance	4.6.3
Trip-free	4.6.12
Operating force (at room ambient temperature)	4.6.15

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

4.5.1.3.4 Disposition of sample units. Sample units which have passed group B inspection may be delivered on the contract.

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

4.6 Methods of examination and test.

4.6.1 Examination of product. Circuit breakers shall be inspected to verify that the materials, design, construction, weight, physical dimensions, marking and workmanship conform to the applicable requirements.

4.6.2 Dielectric strength. The circuit breaker shall be subjected to a potential of 1500 volts RMS alternating current at commercial frequency for one minute between each of the following:

a. The two terminals with the circuit breaker in the open or tripped position.

b. Normally energized parts and normally grounded parts with the circuit breaker in the open position.

c. The normally energized parts and normally grounded parts with the circuit breaker in the closed position.

Breakdown of insulation or current flow in excess of 1.0 milliampere shall constitute failure. When the actuator contains exposed metal parts, such exposed metal parts shall be connected by test lead to the normally grounded mounting plate when this test is conducted.

4.6.3 Insulation resistance. Circuit breakers shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

a. Test Condition B.

b. Points of measurement - between mutually insulated metal parts.

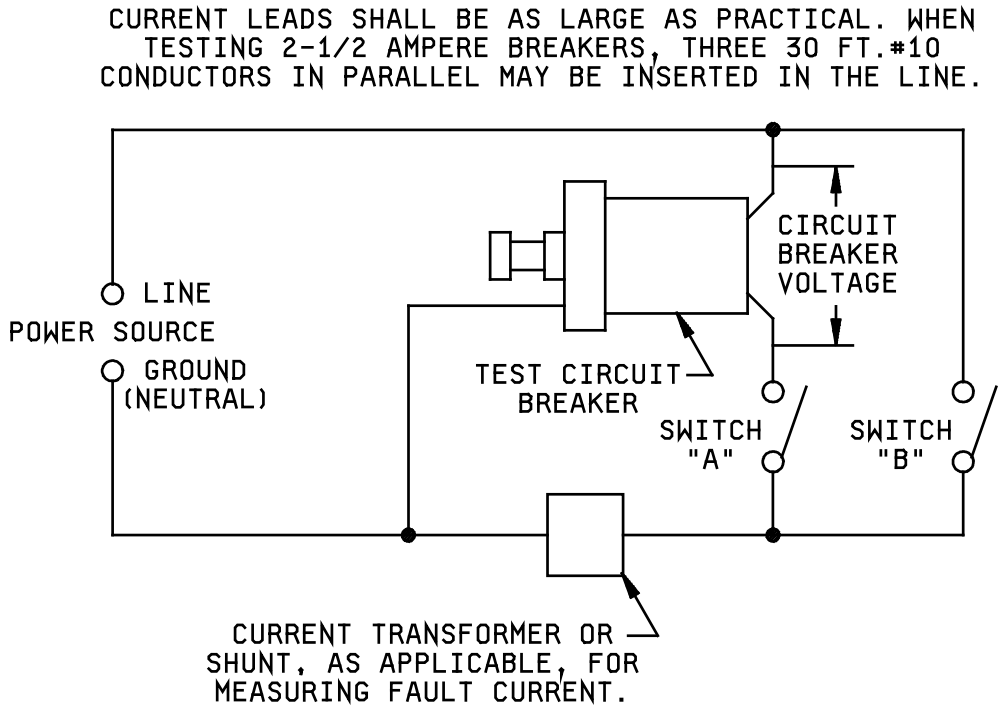
4.6.4 Ultimate trip. At each ambient temperature of -53.9°C (-65°F), and 25°C (77°F), the circuit breaker shall not trip when carrying 110 percent of rated current for 60 minutes. At the ambient temperature of 93.3°C (200°F) the breaker shall not trip while carrying 105 percent of rated current for 60 minutes. The breaker shall trip in less than 60 minutes while carrying 138 percent of rated current at 25°C (77°F) and at 93.3°C (200°F). At a temperature of -53.9°C (-65°F) the breaker shall trip in less than 60 minutes when carrying 160 percent of rated current. At the ambient temperature of 121.1°C (250°F), the breaker shall not trip when carrying 100 percent of rated current for 50 minutes, and shall trip in less than 60 minutes while carrying 138 percent of rated current. At a simulated altitude of 60,000 feet and an ambient temperature of 45°C (113°F), the breaker shall not trip when carrying 108 percent of rated current for 60 minutes, and shall trip in less than 60 minutes while carrying 138 percent of ratio current. The breaker shall be held at the test ambient temperature for at least 60 minutes before the application of any current. Thermocouples shall be attached to the terminals to determine that the temperature rise does not exceed the requirement of 75°C (167°F) for any of the tests of this paragraph.

4.6.5 Calibration. The circuit breaker with leads attached shall be held in the specified ambient temperature for a minimum of 60 minutes prior to the application of any current. Using the circuit of figure 2, the tripping times shall be determined for loads of 200 percent, 400 percent, 1000 percent and 3000 percent of rated current, at the ambient temperatures of -53.9°C (-65°F), 25°C (77°F), and 93.3°C (200°F). The trip time for 200 percent of rated current at 25°C (77°F) shall be determined twice using a 400 Hz source and twice using a direct current source of power. The trip times shall be within the limits specified (see 3.1).

4.6.6 Electrical losses. While carrying rated current, the voltage drop from terminal to terminal of the circuit breaker shall be measured and shall not exceed the value specified (see 3.1).

4.6.7 Alternating current rupture. The rupture tests shall be conducted with the circuit breaker connected as shown in figure 3 for the line-to-line tests. These tests shall use the current available from the three-phase system defined on the applicable specification sheet (see 3.1). A minimum cooling period of 10 minutes shall be allowed after each rupture before the next fault is applied. After each rupture, the open circuit voltage shall be maintained across the breaker for a minimum of 5 seconds. The four sample circuit breakers, designated 1,2,3 and 4 shall be subjected to the tests of table V. Any electrical or mechanical malfunction during these tests shall constitute failure. Following the second, fourth and sixth fault tests, the room ambient tripping time for 200 percent of rated current shall be determined for each test sample and shall not be faster than 90 percent of the lower limit, nor slower than 110 percent of the upper limit, specified (see 3.1). At the conclusion of the above tests, the dielectric test shall be applied except 2.0 milliamperes shall be used in lieu of 1.0 milliampere. Also, at room ambient, the breaker shall not trip within 1 hour when subjected to 100 percent of rated current and shall trip within 1 hour when subjected to 150 percent of rated current. The interruption times for each fault application shall be recorded.

CURRENT LEADS SHALL BE AS LARGE AS PRACTICAL. WHEN TESTING 2-1/2 AMPERE BREAKERS, THREE 30 FT. #10 CONDUCTORS IN PARALLEL MAY BE INSERTED IN THE LINE.



RUPTURE CURRENT SHALL BE MEASURED BY A CURRENT TRANSFORMER OR SHUNT AS INDICATED AND A RECORDING OSCILLOGRAPH HAVING A RESPONSE TO AT LEAST 3000 HZ. THE VOLTAGE ACROSS THE BREAKER INCLUDING THE TRANSIENT RECOVERY VOLTAGE AFTER THE INTERRUPTION OF CURRENT SHALL ALSO BE RECORDED.

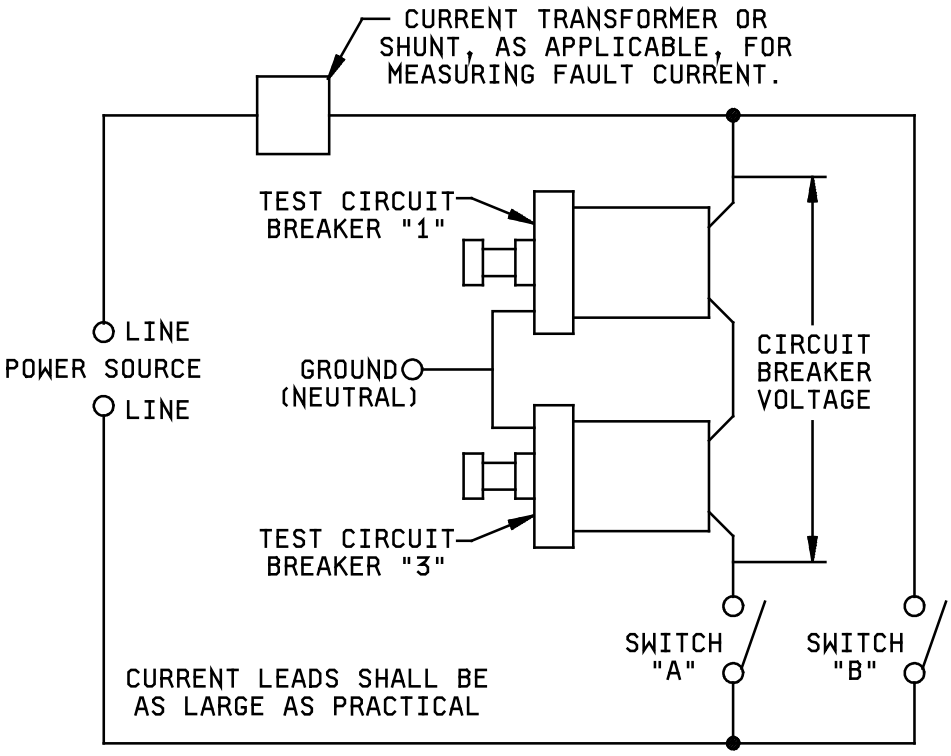
1. SHORT-CIRCUIT RUPTURE TEST

   (a) OPEN TEST CIRCUIT BREAKER AND SWITCH “A”.
   (b) CLOSE SWITHC “B” AND DETERMINE IF CURRENT CAPACITY OF CIRCUIT IS IN ACCORDANCE WITH REQUIREMENT.
   (c) OPEN SWITCH “B”.
   (d) CLOSE TEST CIRCUIT BREAKER.
   (e) CLOSE SWITCH “A”.

2. CLOSE-IN RUPTURE TEST.

   (a) OPEN TEST CIRCUIT BREAKER AND SWITCH “A”.
   (b) CLOSE SWITCH “B” AND DETERMINE IF CURRENT CAPACITY OF CIRCUIT IS IN ACCORDANCE WITH REQUIREMENT.
   (c) OPEN SWITCH “B”.
   (d) CLOSE SWITCH “A”.
   (e) CLOSE TEST CIRCUIT BREAKER.

FIGURE 3. Line-To-Line Neutral Test



RUPTURE CURRENT SHALL BE MEASURED BY A CURRENT TRANSFORMER OR SHUNT AS INDICATED AND RECORDING OSCILLOGRAPH HAVING A RESPONSE TO AT LEAST 3000 HZ. THE VOLTAGE ACROSS THE BREAKERS INCLUDING THE TRANSIENT RECOVERY VOLTAGE AFTER THE INTERRUPTION OF CURRENT SHALL ALSO BE RECORDED.

LINE-TO-LINE RUPTURE TEST

(a) OPEN TEST CIRCUIT BREAKERS “1” AND “3”, AND SWITCH “A”.

(b) CLOSE SWITCH “B” AND DETERMINE IF CURRENT CAPACITY OF CIRCUIT IS IN ACCORDANCE WITH REQUIREMENT.

(c) OPEN SWITCH “B”.

(d) CLOSE TEST CIRCUIT BREAKER “1”.

(e) CLOSE SWITCH “A”.

(f) CLOSE TEST CIRCUIT BREAKER “3”.

FIGURE 4. Line-To-Line Rupture Test

Table VI. AC Rupture Test procedures.

Test NB	PRESSURE ALTITUDE	TEST CONDITION	TEST UNITS	TEST CONDITIONS
1	Sea Level	Line-To-Neutral	1,2,3 and 4	1. Units 1 & 2 closed before fault initiation.
2				2. Units 3 & 4 complete fault circuit by closing in on fault.
3	60,000 Ft.	Line-To-Neutral	1,2,3 and 4	1. Units 1 & 2 closed before fault initiation.
4				2. Units 3 & 4 complete fault circuit by closing in on fault.
5	Sea Level	Line-To-Line	1,2,3 and 4	1. Units 1 & 2 closed before fault initiation.
				2. Units 3 & 4 complete fault circuit by closing in on fault.
				3. Units 1 & 3 connected in series.
6				4. Units 2 & 4 connected in series.

4.6.8 Reclosing. After being tripped automatically in normal manner, with 200 percent of rated current, the circuit breaker shall not automatically reclose for 1 hour. This test shall be conducted at each of the following ambient temperatures, after a conditioning period of 1 hour minimum at the temperature:

a. -53.9°C (-65°F)
b. 25°C (77°F)
c. 121.1°C (250°F)

Subsequent performance shall not be affected.

4.6.9 Direct current rupture. The circuit breaker shall be subjected to the direct current fault specified (see 3.1) using the circuit of figure 3 for the following four operations: The first two operations shall be at sea level pressure with the breaker already closed when the first fault is applied and with the breaker being closed in on the fault when the second fault is applied. This procedure shall be repeated at a simulated altitude of 60,000 feet. A minimum cooling period of 10 minutes shall be allowed after each rupture, before the next fault is applied. At the conclusion of this test, the room ambient tripping time for 200 percent direct current shall be determined and shall not be faster than 90 percent of the lower limit nor slower than 110 percent of the upper limit specified (see 3.1). The dielectric test shall be applied except 2.0 milliamperes shall be used in lieu of 1.0 milliampere. The interruption times for such fault application shall be recorded.

4.6.10 Environmental tests. The circuit breaker shall be subjected to the environmental tests as specified herein.

The following environmental tests shall be conducted in accordance with the indicated procedures of specifications MIL-STD-202 and MIL-STD-810 with any additions or exceptions as specified herein. When the requirements of specification MIL-STD-202 or MIL-STD-810 and this specification conflict, the requirements of this specification shall govern.

4.6.10.1 Moisture resistance. Three circuit breakers in the closed (ON) position with all hardware shown (see 3.1) installed finger tight shall be subjected and designated as test sample units 1, 2 and 3, and subjected to the moisture resistance test of method 106 of MIL-STD-202, except that no vibration is required during step 7b, and distilled demineralized or deionized water having a pH of between 6.5 and 7.2 at 25°C (77°F) shall be used to obtain the desired humidity. Prior to subjecting sample units 2 and 3 to this test, the contact resistance of each sample unit shall be determined as specified in 4.6.10.1.1. Before, during and after the moisture resistance test, the contacts shall be maintained in the closed position. On removal from the chamber, the breakers shall be manually shaken to remove excess water and then permitted to stabilize at room temperature for 45 minutes. The following operations shall be performed on the three samples as indicated:

For sample unit 1:

a. Conduct a normal trip test with 500 percent rated load. Failure to trip within 10 seconds shall constitute failure.

b. Stabilize for 1 hour at room temperature.

c. Conduct a trip-free test with 300 percent rated load.

d. Stabilize for 2 hours at room temperature.

e. Conduct the specified overload calibration trip test of 4.6.5 with 200 percent rated load except that tripping time may vary within ±10 percent of the specified limits.

f. Stabilize for 4 hours at room temperature.

g. Conduct the dielectric strength test of 4.6.2. The breaker must meet this test and shall show no evidence of breaking, cracking, spalling, excessive corrosion, or loosening of terminals. All hardware shall be removable without damage.

For sample units 2 and 3:

a. Without disturbing the contacts, the samples shall be subjected to the storage test (4.6.10.1.2).

4.6.10.1.1 Contact resistance. The purpose of this test is to establish a level of contact resistance before and after the tests on moisture resistance (4.6.10.1) and storage (4.6.10.1.2). No specific absolute value of contact resistance is required. The parameter desired is a comparison of contact resistance before and after 4.6.10.1 and 4.6.10.1.2. The circuit breaker contacts (sample units 2 and 3) shall be manually operated to successfully interrupt and make a test circuit having a dc resistance load of one-half the current rating on the circuit breaker or 200 milliamperes, whichever is less, at 26 ±2 volts. The contact resistance (specified as millivolt drop) shall be computed by averaging the results of 10 measurements. Each measurement shall be taken after a consecutive contact closure. All measurements shall be made across the circuit breaker external electrical terminals.

4.6.10.1.2 Storage test. Within 24 hours of completing prior applicable tests, the breakers shall then be stored, in an area free from chemicals which give off vapors known to be reactive with metals, for 10 days at a minimum temperature of 20°C and relative humidity of not less than 40 percent. Throughout the above test, the circuit breaker contacts shall be maintained in the closed position. Upon completion of 10 days, the breakers shall be subjected to the contact resistance test 4.6.10.1.1. The contact resistance shall not exceed the initial contact resistance by more than 250 millivolts. These circuit breakers shall be submitted to and meet the requirements for calibration at room ambient with 200 percent of rated current, except that the tripping time shall be within 80 percent of the lower limit and 120 percent of the upper limit specified. All hardware shall be removable without damage.

4.6.10.2 Salt atmosphere. The circuit breaker in the closed (ON) position with all hardware shown (see 3.1) installed finger tight shall be subjected to the salt atmosphere test method 101, Test Condition B, of MIL-STD-202 with a 5-percent salt solution. Within 10 minutes after the test, the breakers shall be washed for 5 minutes under running water not warmer than 37.8°C accompanied by a slight brushing, and dried for 6 hours in a forced-draft oven at approximately 57°C. At the conclusion of this test, the breaker shall be held in at 500 percent of rated load, thus causing the breaker to trip free. Failure to trip within 10 seconds shall constitute failure. The breaker shall then meet the requirements for 200 percent overload calibration at room ambient at 25°C, except that the tripping time shall be within 80 percent of the lower limit and 120 percent of the upper limit specified. All hardware shall be removed without damage to the circuit breaker or hardware.

4.6.10.3 Sand and dust. While in the ON position and mounted on a dummy panel, the circuit breaker shall be subjected to sand and dust in accordance with the sand and dust test, method 110, Steps 1, 2 and 4, of MIL-STD-202 with no evidence of mechanical or electrical failure. At the conclusion of this test, the breaker shall be held in at 500 percent of rated load, thus causing the breaker to trip free. Failure to trip within 10 seconds shall constitute failure. The circuit breaker shall meet the requirements for 200 percent overload calibration at room ambient as specified in 4.6.5. The following details shall apply:

a. Step 1 - Toggle type circuit breakers shall be operated for 2,500 cycles (no load) at approximately seven cycles per minute.

b. Step 2 - The test item shall be nonoperating and the conditions shall be held for 6 hours.

4.6.10.4 Vibration. Circuit breakers shall be tested in accordance with one or more of the test paragraphs listed below. The following details shall apply for all vibration tests:

a. Mounting. Circuit breakers shall be mounted as designed in normal application.

b. Electrical load. Unless otherwise specified, circuit breakers shall carry their rated current load in the “on” position at room ambient temperature.

c. Measurements. Circuit breakers shall be continuously monitored by a continuity tester capable of detecting electrical discontinuities of 10 microseconds or less.

d. Post test measurements. Following vibration testing, circuit breakers shall be visually examined for physical damage, then subjected to the 200 percent overload calibration at 25°C and the dielectric withstanding voltage test specified in 4.6.5 and 4.6.2.

4.6.10.4.1 Random vibration. Circuit breakers shall be subjected to the vibration test method 214, test Conditions C through K, of MIL-STD-202. Circuit breakers shall be vibrated 3 hours in each of the three principle axes. During the first 1 1/2 hours of vibration in each axes, the circuit breakers shall be monitored for discontinuity. During the remaining time, the circuit breakers shall be monitored for tripping only.

4.6.10.4.2 Sine vibration. Circuit breakers shall be subjected to the vibration test method 204, test Condition A, of MIL-STD-202.

4.6.10.4.3 High level sine vibration. Circuit breakers shall be subjected to vibration testing in accordance with method 204 of MIL-STD-202. The following test conditions shall apply:

a. Test Condition B - No electrical load.

b. Test Condition C - Rated electrical load.

4.6.10.5 Shock. Circuit breakers shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - by normal means.

b. Test condition A, or as specified.

c. Electrical load conditions.

Three separate shocks shall be applied to each of the three principle axes with the breaker contacts in the closed position, and three separate shocks shall be applied to each of the axes with the breaker contacts in the open position. The breaker shall be carrying rated current. A chronoscope, an oscilloscope or other device capable of detecting momentary opening or closing periods not exceeding 1/2 millisecond duration, shall be used to determine that the breaker contacts in the closed position remain closed, and circuit breaker contacts in the open position remain open. Following the test, the breaker shall meet the requirement of the 200 percent overload calibration of 4.6.5 at 25°C.

4.6.10.6 Fungus. The circuit breaker shall be tested in accordance with MIL-STD-810, method 508. Within 1 hour after the test period, the breaker shall be subjected to and shall pass the following tests:

a. Shall be subjected to and shall clear an overload equal to 200 percent of rated current.

b. Shall then meet the requirements for calibration at room ambient with 200 percent of rated current except the tripping time shall be within 60 percent of the lower limit and within 120 percent of the upper specified limit.

c. Shall be subjected to the dielectric test as specified in 4.6.2 except that 2.0 milliamperes leakage shall be allowed in lieu of 1.0 milliampere.

Inability to meet these requirements shall constitute failure.

4.6.10.7. Explosion proof. The circuit breaker shall be subjected to explosion test, method 109 of MIL-STD-202, except that the test shall be conducted only at sea level. Ignition of the explosive mixture outside the breaker shall constitute failure.

4.6.10.8 Acceleration. The circuit breaker shall be mounted by its normal mounting means on a centrifuge in a position most likely to cause malfunctioning. The centrifuge shall be brought up to the radial speed required to produce a radial acceleration of 10g. The rates of centrifuge acceleration and deceleration shall be controlled so that the vector sum shall not exceed 10g. Once the specified radial acceleration is obtained, it shall be stabilized and maintained for a period of not less than 1 minute. The poles of the breaker shall be carrying rated current during, and for 30 minutes prior to test. The test shall be repeated with the breaker contacts in the open position. An oscilloscope or oscillograph shall be used to determine the ability of the breaker contacts to remain in the proper position. There shall be no opening or closing of contacts and there shall be no damage caused by acceleration. Following the test, the breaker shall be subjected to the 200 percent overload calibration (4.6.5) at 25°C.

4.6.11 Coordination. This test shall be conducted in two parts as follows:

a. Coordination at overload conditions. This test shall be applied to the circuit breaker to determine if it will hold closed when subjected to a specified current for a time period of 75 to 85 percent of the fastest trip time specified by the calibration curve for the current used. This test shall be conducted with apparatus and test methods similar to those used for calibration except that a current interruption device shall be added to break the circuit after predetermined intervals of current flow. The currents to be used shall be 400, 1000, and 2000 percent of rated. This test shall be conducted at each of the ambient temperatures of -53.9°C (-65°F), 25°C (77°F), and 93.3°C (200°F). Two test samples of each rating except for the 2-1/2 ampere and 50 ampere, shall be used.

b. Coordination at maximum fault condition. The maximum line-to-neutral fault current (see 3.1) shall be applied to series connected combinations of circuit breakers as shown (see 3.1), using the circuit of figure 4. Prior to the application of the fault current, the breaker with the highest rating, shall be subjected for a minimum period of 30 minutes to the test ambient temperature of -17.8°C (0°F). These tests shall be conducted on two similar combinations for each of the combinations required. The test for each combination shall consist of applying the fault current three successive times with the breakers held in the respective test ambient temperatures, and with a minimum period of 10 minutes allowed between applications of current.

Failure shall be indicated by any of the following:

a. Opening of the breaker with the higher ratings.

b. Failure of the breaker with the low rating to open.

c. Any electrical malfunction.

d. Any mechanical malfunction.

Tests shall be conducted on the 400 Hz source specified for the ac rupture test.

In the event that breakers of one type or part number have been previously qualified to this specification, any additional types of part numbers shall also be required to demonstrate coordination for each possible inter-type combination of the required ratings for this test.

4.6.12 Trip free. The circuit breaker shall be held in the closed or reset position and subjected to 138 percent of rated current until tripping occurs and for 600 seconds afterwards. The test shall be repeated using 200 percent of rated current. The breaker shall automatically trip within the limits specified (see 3.1) and shall not reclose of its own accord. The breaker shall be reclosable only after moving the actuator to the full open position. This test shall be conducted at each of the following ambient temperatures after conditioning the breaker for a minimum of 60 minutes in the test ambient:

a. 25°C (77°F)

b. 121.1°C (250°F)

c. -53.9°C (-65°F) - At this test temperature, a test current of 160 percent of rated current may be used in lieu of 138 percent of rated current.

4.6.13 Overload cycling. The circuit breaker shall be subjected to 100 cycles of manual make and automatic break of 200 percent of rated current at a lagging power factor of not greater than 0.75. The first 50 cycles shall be performed at 2 minute intervals by applying the test current to the breaker while in a closed or reset condition. The second 50 cycles shall be performed at 2 minute intervals by closing the breaker in on the test current and holding the actuator in until after a trip-free trip out. At the end of this test, the breaker shall be subjected to and pass each of the following tests:

a. Shall carry 115 percent of rated current for one hour.

b. Shall trip automatically within one hour when carrying 138 percent rated current.

c. The operating force test of 4.6.15.

d. The dielectric test of 4.6.2.

e. The 200 percent rated current trip time at 25°C of 4.6.5.

Inability to meet these requirements shall constitute failure.

4.6.14 Strength of threaded parts.

4.6.14.1 Strength of terminals. A tensile load as specified by table I shall be applied to each terminal for 1 minute, perpendicularly to the mounting plate of the breaker. A torque as specified in table I shall then be applied to the screw head about the thread axis for 1 minute. Loosening or breaking of the housing about the terminals, stripping of the screw threads' or deterioration of the seal to such an extent that the explosion resistance is affected shall constitute failure.

4.6.14.2 Strength of mounting provisions. An axial load as specified in table I shall be applied to the mounting nuts for a period of 1 minute. The torque specified in table I shall then be applied to the screw head about the thread axis for 1 minute without damage to the mounting means.

4.6.14.2.1 Strength of housing. Screws long enough to bottom within the mounting means shall be torqued with the value shown in table I. Loosening or breaking of either the nut or the mounting provisions shall constitute failure.

4.6.15 Operating force. The force necessary for operation of the circuit breaker shall be determined. The force shall be applied parallel to the line of travel of the actuator. The forces required for operation of the breakers either during or as a result of the tests shall not exceed the values specified (see 3.1). The specified operating force shall be applicable with the breaker carrying rated load under rated ambient conditions.

4.6.16 Strength of actuator. A 25-pound force shall be applied for 1 minute in both directions, along the line of push-button travel. With the push-button in the fully extended position, a force of 40 pounds shall be applied at the extremity for 1 minute in two mutually perpendicular directions, each normal to the line of push-button travel. Malfunction or mechanical breakage shall constitute failure.

4.6.17 Durability. The circuit breaker shall be subject to the number of cycles as specified (see 3.1) of make and break operation, simulating manual operation, including over-travel forces, etc. No load cycles shall be at the uniform rate of 60 cycles per minute. Load cycles shall be at the uniform rate of 2 cycles per minute when current is carried, except that the cycling rate may be faster if the manufacturer agrees to the use of such faster rate. The time-on the time-off ratio shall be within the limits of 1 to 3 and 1 to 4. The resistive load cycles shall be performed with 100 percent of rated current at 0.95 ±0.05 power factor and the inductive load cycles shall be performed with 100 percent rated current at a lagging power factor of not greater than 0.75. The tests shall be conducted in the following sequence, repeated until a total number of cycles specified (see 3.1) have been performed.

a. Resistive load 1000 cycles.
b. No load 1000 cycles.
c. Inductive load 1000 cycles.
d. No load 1000 cycles.

At the end of each 4000 cycles, the trip time shall be determined for 200 percent of rated current and shall neither be faster than 95 percent of the lower limit nor slower than 105 percent of the higher limit as shown (see 3.1). After the above tests, the circuit breaker shall carry 105 percent of rated current for one hour, shall trip automatically within one hour when carrying 145 percent of rated current, and shall meet the operating force requirements shown (see 3.1). Any mechanical or electrical malfunction during the cycling or post-cycling tests shall constitute failure.

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

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

6.1 Intended use. The circuit breakers covered by this specification are intended for use in ambients to 250°F to provide overload and short circuit protection for dc or ac circuits in B-52 aircraft which require a breaker that cannot be manually maintained closed when an overload condition exists.

6.2 Acquisition requirements. Procurement documents should specify the following:

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

b. Complete military or contractor's type or part number, as applicable (including the CAGE).

c. ASSIST Online database should be cited in the solicitation, and if required, the specific issue of individual documents referenced. If not otherwise specified, the versions of the individual documents referenced will be those in effect on the date of release of the solicitation (see 2.).

d. Packaging requirements (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-VQP, 3990 E. Broad Street, Columbus, OH 43218-3990, online at http://www.landandmaritime.dla.mil/Programs/QmlQpl/

6.4 Definitions.

6.4.1 Ultimate trip current. Ultimate trip current is the smallest value of current that will cause tripping of the circuit breaker under a given set of ambient conditions.

6.4.1.1 Ultimate trip limits. The specified limits for ultimate trip current are maximum trip current and minimum ultimate trip current. At the maximum specified ultimate trip current the breaker will open within the specified time, and at the minimum specified ultimate trip current the breaker will not open.

6.4.2 Push-pull circuit breaker. Push-pull circuit breakers are those which may be manually actuated by an actuator moving in a direction perpendicular to the plane of the mounting plate.

6.4.3 Trip free. A trip-free circuit breaker is a breaker so designed that the circuit cannot be maintained closed when carrying overload currents that would automatically trip the breaker to the open position.

6.5 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 top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM B545 (Standard Specification for Electrodeposited Coatings of Tin).

6.6 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).

6.7 Subject term (key word) listing.

Actuator
Coordination
Insulation resistance
Operating force
Ultimate trip

6.8 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
Air Force - 85
DLA - CC

Review activities:
Army - MI
Air Force - 99

Preparing activity
DLA - CC

(Project 5925-2012-020)

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.