INCH-POUND

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PERFORMANCE SPECIFICATION

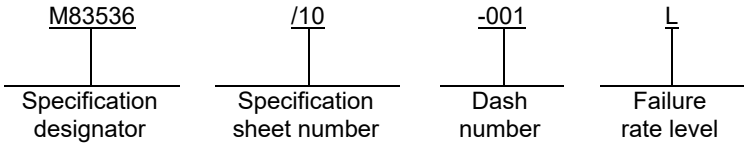
RELAYS, ELECTROMAGNETIC, ESTABLISHED RELIABILITY, 25 AMPERES AND BELOW, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for electromagnetic, hermetically sealed relays for use in aircraft, missile, spacecraft, ship, and other primary vehicles or in ground support equipment (see 6.1). These relays are designed to operate over the full range from low level to power switching with contact ratings up to 25 amperes alternating current (ac) or direct current (dc). Specification sheets (see 3.1) specifying requirements for 25 ampere relays are for relays that have a maximum load rating of 25 amperes for resistive load only. All other load ratings (motor, inductive, lamp) are less than 25 amperes. The failure rate (FR) level is established at a confidence level of 90 percent for qualification and 60 percent for maintenance of qualification based on 100,000 cycles at +125°C under the rated load conditions specified herein. For application and caution information, see 6.1.

1.2 Part or Identifying Number (PIN). The PIN consists of the letter "M", the basic number of the specification sheet, an assigned dash number (see 3.1), and a suffix letter designating FR level (see table I) as shown in the following example:



1.3 FR level designation. The FR level designation is shown in table I (see 4.6 and 6.1).

TABLE I. FR level designation.

FR level designation	FR level (percent per 10,000 cycles)
L	3.0
M	1.0
P	0.1
R	0.01

Comments, suggestions or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, OH 43218-3990, or emailed to relay@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.

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.

DEPARTMENT OF DEFENSE SPECIFICATION

MIL-DTL-12883	-	Sockets and Accessories for Plug-in Electronic Components, General Specification for

(See supplement 1 for list of specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Test Method for Electronic and Electrical Component Parts
MIL-STD-202-208	-	Test Method, Solderability
MIL-STD-202-112	-	Test Method, Seal
MIL-STD-202-301	-	Test Method, Dielectric Withstanding Voltage
MIL-STD-202-302	-	Test Method, Insulation Resistance
MIL-STD-202-303	-	Test Method, DC Resistance
MIL-STD-202-307	-	Test Method, Contact Resistance
MIL-STD-202-107	-	Test Method, Thermal Shock
MIL-STD-202-213	-	Test Method, Shock (Specified Pulse)
MIL-STD-202-204	-	Test Method, Vibration, High Frequency
MIL-STD-202-214	-	Test Method, Random Vibration
MIL-STD-202-212	-	Test Method, Acceleration
MIL-STD-202-211	-	Test Method, Terminal Strength
MIL-STD-202-210	-	Test Method, Resistance to Soldering Heat
MIL-STD-202-101	-	Test Method, Salt Atmosphere (Corrosion)
MIL-STD-202-312	-	Test Method, Life, Intermediate Current
MIL-STD-202-215	-	Test Method, Resistance to Solvents
MIL-STD-202-105	-	Test Method, Barometric Pressure (Reduced)
MIL-STD-690	-	Failure Rate Sampling Plans and Procedures
MIL-STD-750	-	Test Methods for Semiconductor Devices
MIL-STD-790	-	Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications
MIL-STD-883	-	Test Method Standard, Microcircuits
MIL-STD-1276	-	Leads for Electronic Component Parts
MIL-STD-1285	-	Marking of Electrical and Electronic Parts

DEPARTMENT OF DEFENSE HANDBOOK

MIL-HDBK-454	-	General Guidelines for Electrical Equipment

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

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

IEEE 315	-	Graphic Symbols for Electrical and Electronic Diagrams (Including Reference Designation Letters)

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO10012	-	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 from www.ansi.org.)

SAE INTERNATIONAL (SAE)

EIA557	-	Statistical Process Control Systems
SAE-AMS2422	-	Plating, Gold
SAE-AMS-QQ-N-290	-	Nickel Plating (Electrodeposited)

(Copies of these documents are available from www.sae.org.)

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, 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. Relays furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.4 and 6.3). Authorized distributors which are approved to MIL-STD-790 distributor requirements by the QPL manufacturers are listed in the QPL.

3.3 QPL system. The manufacturer shall establish and maintain a QPL system for parts covered by this specification. Requirements for this system are specified in MIL-STD-790 and MIL-STD-690 with details and exceptions specified in 4.2.1, 4.4.4, and 4.5. The confidence level for qualification is 90 percent and the confidence level for maintenance of qualification is 60 percent. In addition, the manufacturer shall also establish a Statistical Process Control (SPC) system that meets the requirements as described in 3.3.1.

3.3.1 SPC. The contractor shall implement and use SPC in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with EIA557or an equivalent system as approved by the qualifying activity. The SPC program shall be documented and maintained as part of the overall product assurance program as specified in MIL-STD-790. The implementation date for SPC shall be 12 months from the date of revision A of this specification.

3.4 Materials. Materials used externally shall be fungus inert (see Guideline 4 of MIL-HDBK-454), self-extinguishing, and shall not support combustion, nor give off noxious gases in harmful quantities. Materials used internally shall not give off gases in quantities sufficient to cause explosion of sealed enclosures, cause contamination of the contacts or other parts of the relay that will adversely affect life or reliability, or form current-carrying tracks when subjected to any of the tests specified herein. Ceramic used for external surfaces shall be glazed. The use of silicone (see 6.11) or silicone compounds for any purpose is prohibited. The selection of materials shall be such as to provide maximum shelf life. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

3.4.1 Metals. Metals shall be of a corrosion-resistant type or shall be plated or treated to resist corrosion. The use of mercury or mercury compounds is prohibited. The use of magnesium or magnesium alloys is prohibited (not applicable to contact systems).

3.4.1.1 Plated finishes.

a. Pure tin plating is prohibited internally and externally (see 6.6.1). Use of tin-lead finishes are acceptable provided that the minimum lead content is 3 percent. Other tin alloys are acceptable as approved by the qualifying activity.

b. Pure zinc plating is prohibited internally and externally.

c. Pure cadmium plating is prohibited internally and externally.

3.4.1.2 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tends toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy), is not acceptable. However, metal spraying or metal plating of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. Dissimilar metals should be as defined in 6.6. In hermetic seals, the 0.25 volt difference between the header material and the housing material is not applicable.

3.4.2 Magnet wire. Magnet wire used shall enable the relay to meet the performance requirements of this specification.

3.5 Interface and construction requirements. Relays shall meet the interface and construction requirements as specified in 3.1 (weight, physical dimensions.).

3.5.1 Case. Unless otherwise specified (see 3.1), the case shall not be electrically connected to the contacts or coil; however, it may be used as part of the magnetic circuit.

3.5.1.1 Case grounding. When specified (see 3.1), means for connecting the relay case to ground shall be provided.

3.5.2 Sealing process. Relays shall be dried, degassed, and backfilled with an atmosphere and sealed by welding such that the requirements of this specification are met. Adjunct sealant shall only be applied to relays that have initially passed the gross leak seal requirement of this specification. Adjunct sealant (see 6.11), if used, must comply with the following characteristics:

a. Shall not extend above 20 percent of the length of the exposed terminals above the glass meniscus.

b. Trace color is permitted if it is a natural result of the sealant process.

c. Shall form, after curing, a permanent nonconductive, non-cracking seal under all relay environments.

After the cover has been welded to the header, no rework shall be performed that requires removal of this cover from the header.

3.5.3 Contacts. Contacts shall have load ratings and arrangements (see MIL-STD-1285) as specified (see 3.1) and unless otherwise specified (see 3.1), shall be capable of carrying the maximum rated current continuously as well as making and breaking the specified current under all environmental conditions specified herein.

3.5.4 Coils. Coils shall be adequately insulated electrically from the contacts and the case. The resistance and rated voltage (or current) shall be as specified (see 3.1). Unless otherwise specified (see 3.1), coils shall be designed for continuous operation at maximum rated voltage and temperature.

3.5.4.1 Stabilization of permanent magnets. Permanent magnets and magnetic assemblies shall be artificially aged to minimize decay of flux levels. The residual induction (flux) in permanent magnetic assemblies shall be reduced to a level where it will not be affected by demagnetizing forces encountered in normal service, handling, and any tests specified herein. The re-traceability characteristics shall be compatible with all performance requirements of the relays.

3.5.4.2 Coil terminal identification. Terminal identification shall be marked as specified and in accordance with MIL-STD-1285. When specified, a bead of contrasting color shall be used to designate the X1 (positive, if applicable) terminal (see figure 1 and MIL-STD-1285) (see 3.1).

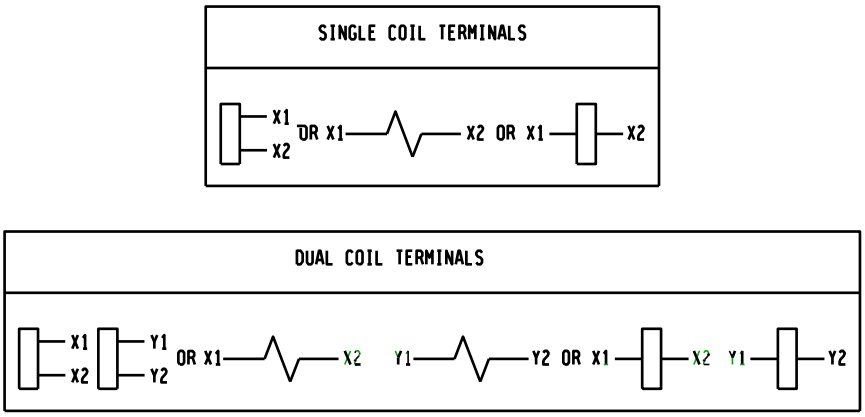


FIGURE 1. Symbols and markings for terminals.

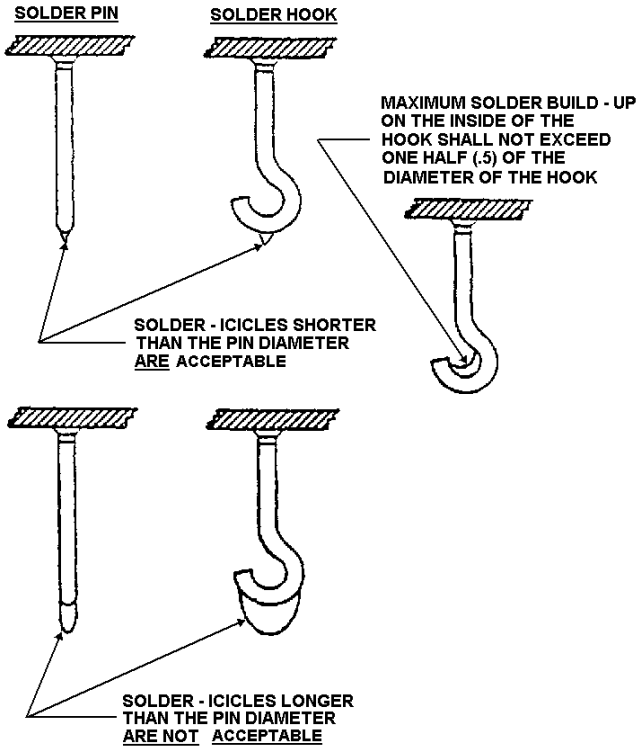
3.5.4.3 Latching relays. Latching relays with two coils shall be so designed that if both coils are energized simultaneously, the contacts shall not achieve a neutral position (both the normally closed and normally open contacts are open). The relay shall be screened as specified in 3.12.8 and 4.8.7.7. Specified dropout and hold values (voltage or current) and release time are not applicable to latching relays.

3.5.5 Circuit diagram. The circuit diagram as specified shall be a terminal view. Circuit symbols shall be in accordance with IEEE 315. For relays without an orientation tab, the circuit diagram, as specified (see 3.1) shall be orientated so that when the relay is held with the circuit diagram right side up as shown, and rotated away from the viewer about a horizontal axis through the diagram until the header terminals face the viewer, then each terminal shall be in the location shown in the circuit diagram.

3.5.6 Mounting means (see 3.1).

3.5.6.1 Bracket. Mounting brackets shall be an integral part of the relay, securely attached thereto in a manner to prevent any movement between the relay and the mounting bracket.

3.5.7 Terminals. Terminals shall be as specified (see 3.1). Manufacturer may supply hot solder dipped terminals provided that the hot solder dipping process has been approved by the qualifying activity and when specified on the individual order. Solder dipped terminals may be .003 inch (0.762 mm) larger than the maximum diameter specified (see 3.1). Icicles are a normal result of the hot solder dip process and shall not be grounds for rejection (see figure 2).



NOTES:
1. No solder is allowed on the header surface. Components (relay terminals) after solder-dip shall be capable of meeting MIL-STD-202-208, solderability requirements.
2. Solder-coat thickness shall be .0001 inch (.00254 mm) minimum.

FIGURE 2. Solder-dip acceptability criteria (solder-icicle length limits).

3.5.7.1 Solder-hook terminals. Solder-hook terminals shall be designed to accommodate two conductors, each rated to carry the maximum rated current of the contact or coil.

3.5.7.2 Wire leads. Wire leads shall be as specified (see 3.1).

3.5.7.2.1 Wire leads, solder pin (SP). Solder pin wire leads shall be as specified (see 3.1).

3.5.7.3 Wire marks. When plating is used, an underplating of copper may be used to assure good adhesion. A slight exposure of copper underplating or other underplating resulting from wire wrappings necessitated by the plating operation is acceptable (see figure 3).

3.5.7.4 Plug-in termination. Plug-in terminations shall conform to the arrangements or dimensions as specified (see 3.1). The mounting arrangement of the relay shall be provided by a means other than the electrical terminals of a socket. Plug-in terminals shall be gold plated in accordance with SAE-AMS2422, type II, class I, with a nickel underplating that shall be in accordance with SAE-AMS-QQ-N-290 and 50 to 150 microinches thick. Plug-in terminations shall conform to the arrangements and dimensions necessary for proper mating with the associated sockets in MIL-DTL-12883.

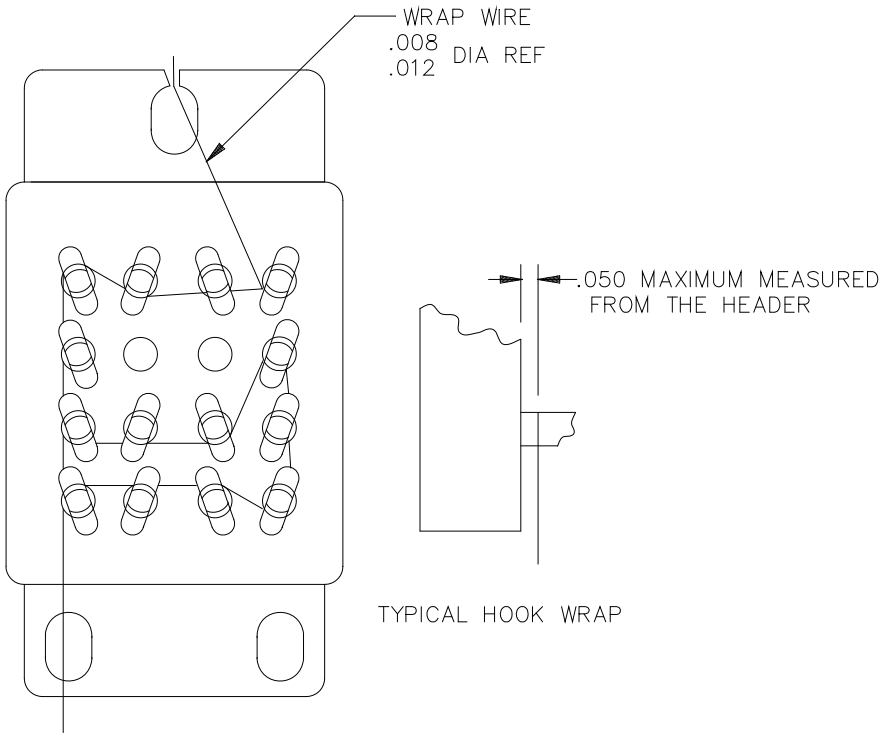


FIGURE 3. Wire marks.

3.5.7.5 Solder dip (re-tinning) leads. The manufacturer may solder dip/re-tin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity.

3.5.7.5.1 Qualifying activity approval. Approval of the solder dip process will be based on one of the following options. (Note: Solder dip of gold-plated plug-in leads is not allowed.) All visual examination criteria shall be in accordance with MIL-STD-202-208:

a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276 (the 200 microinch thickness is not applicable), the manufacturer shall use the same solder dip process for re-tinning as is used in the original manufacture of the product.

b. When the lead originally qualified was not hot solder dip lead finish 52 as prescribed above, approval for the process to be used for solder dip shall be based on the following test procedure:

(1) Six samples for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the relays shall be subjected to group A2 and group A4 inspections.

(2) Three of the six samples are then subjected to the solderability test (see 3.8). No visual defects are allowed.

(3) Remaining three samples are subjected to the resistance to soldering heat test (see 3.18).

(4) All six samples shall be subjected to group A2 and group A4 inspection. Minor scratching of the terminals due to insertion into test sockets shall not be cause for rejection.

3.5.7.5.2 Solder dip/ re-tinning options. The manufacturer may solder dip/re-tin as follows:

a. After the 100 percent group A1 screening tests and before the group A3 solderability test.

b. As a corrective action, if the lot fails the group A3 solderability test: Following the solder dip/re-tinning process in 4.7.2.2.2.2, as a minimum, insulation resistance (all terminals to case) shall be tested, and the A4 tests shall be performed, as applicable.

c. For relays that have been subjected to and passed group A inspection: Following the solder dip/re-tinning process, insulation resistance (all terminals to case), seal, and visual/mechanical inspection shall be performed.

3.5.8 Diodes. Relays supplied with diodes installed internally are not considered electrostatic discharge (ESD) sensitive. However, the diode may be ESD sensitive when not part of the coil circuit or wired internal to the coil. In such a case, the diode shall be processed in accordance with the requirements specified in 4.2.3. Manufacturers may, at their option, test diodes used internally as specified in method 3015 of MIL-STD-883 modified to 16,000 volts to eliminate the need for the ESD protection program described in 4.2.3.

3.6 In-process inspection (see 4.7.1).

3.6.1 Diode in-process screening (see 4.7.1.1). Perform in-process screening as specified. In-process inspection is not required when JAN TX diodes or diodes screened to JAN TX are used. Waiver of in-process screening requires qualifying activity approval.

3.7 Run-in screening (see 4.8.2). The contact miss detector's monitoring level shall be less than 100 ohms for relays tested during cycling. Unless otherwise specified (see 3.1), any relay shall have a final insulation resistance measurement of 10,000 megohms or greater.

3.8 Solderability (see 4.8.3). The critical (examination) area of solid wire lead and pin terminals shall be at least 95 percent covered with a continuous new solder coating in accordance with MIL-STD-202-208. For solder-hook terminals greater than .045 inch (1.1430 mm) in diameter, 95 percent of the total length of fillet, which is between the standard wrap wire and the terminal, shall be tangent to the surface of the terminal being tested, and shall be free of pinholes and voids. A ragged or interrupted line at the point of tangency between the fillet and the terminal under test shall be considered a failure.

3.9 Seal (see 4.8.4). The standard leak rate (L value in Eq (1) of MIL-STD-883 Method 1014) shall be 1×10^{-6} atm cm^3/s of air.

3.10 Dielectric withstanding voltage (see 4.8.5). There shall be no leakage current in excess of 1 milliampere (mA). After high level life tests, the dielectric withstanding voltage measured at atmospheric or reduced barometric pressure shall be at least 75 percent of the initial value (see 3.1).

3.11 Insulation resistance (see 4.8.6). Unless otherwise specified (see 3.1), the insulation resistance shall be 10,000 megohms or more. Unless otherwise specified (see 3.1), after the high level life tests, the insulation resistance shall be 1,000 megohms or more.

3.12 Electrical characteristics (see 4.8.7). The following tests as specified in 3.12.1 through 3.12.8 inclusive, shall comprise the electrical characteristics tests. Unless otherwise specified, electrical characteristics shall be 100 percent inspected and performed in the order as shown below. For the purposes of this specification, dropout value (voltage or current), hold value (voltage or current), and release time are not applicable to latching relays. For latching relays pickup value (voltage or current) is equivalent to latch/reset voltage, and operate time is equivalent to latch/reset time and shall apply to each coil.

3.12.1 Coil resistance (see 4.8.7.1). The coil resistance shall be as specified (see 3.1).

3.12.2 Maximum coil current (applicable to dc coils when specified and all ac coils) (see 4.8.7.2). The maximum coil current shall be as specified (see 3.1).

3.12.3 Static contact resistance and contact voltage drop (see 4.8.7.2). Unless otherwise specified (see 3.1), the static contact resistance shall not exceed 0.05 ohm and the contact voltage drop shall not exceed 0.100 volt maximum. In performing the contact voltage drop tests on plug-in relays, and in the event of a reading that exceeds the maximum allowable contact voltage drop when measured external to the connector, a measurement may be made directly at the pins of the relay. If the readings are then within the allowable limits, the relay will be considered to have passed.

3.12.4 Specified pickup or latch/reset, hold, and dropout values (voltages) (see 4.8.7.3). The specified pickup or latch/reset, hold, and dropout values (voltages) shall be as specified (see 3.1). Specified hold or dropout value (voltage or current) is not applicable to latching relays (see 6.1).

3.12.5 Operate and release time (see 4.8.7.4). The operate and release time shall be as specified (see 3.1). In multipole relays, during each of the operate and the release time measurements, the difference between the first moving contact to make and the last moving contact to make shall not exceed 1 ms. This shall be exclusive of contact bounce. Release time is not applicable to latching relays.

3.12.5.1 Break before make (see 4.8.7.5.1). Moving contacts within a multipole relay shall show no evidence of any open contact closing before all closed contacts have opened (see 3.1). This applies to either state of the relay.

3.12.6 Contact dynamic characteristics (see 4.8.7.5).

3.12.6.1 Contact bounce (see 4.8.7.5.1). Unless otherwise specified (see 3.1), the duration of the contact bounce shall not exceed 1.0 ms.

3.12.6.1.1 Contact break bounce. Contact break bounce (when specified, see 3.1) shall be checked on release of normally open contacts and shall not exceed the specified value. Contact break bounce occurs when a closed contact initially opens, then recloses one or more times before fully opening.

3.12.6.2 Contact stabilization time (see 4.8.7.6.2). The time to reach and maintain a static contact resistance state shall not exceed the value specified (see 3.1).

3.12.7 Coil transient suppression (applicable to dc operated relays with internal coil suppression) (see 4.8.7.6). Coils of dc operated relays shall not generate a back electromotive force (EMF) greater than that specified (see 3.1).

3.12.8 Neutral screen (applicable to two coil latching relays only) (see 4.8.7.7). Latching relays shall either not assume a neutral position or shall not fail to latch or reset after assuming a neutral position.

3.13 Thermal shock (see 4.8.8). Insulation resistance, specified pickup or latch/reset, hold, and dropout values (voltages), and operate and release or latch/reset times shall meet the requirements of 3.11, 3.12.3, and 3.12.4, respectively, at each temperature extreme. Following the temperature excursions, there shall be no cracking, peeling, or flaking of the finish; dielectric withstanding voltage at sea level atmospheric pressure shall meet the requirements of 3.10.

3.14 Shock (specified pulse) (see 4.8.9). Unless otherwise specified (see 3.1), there shall be no opening of closed contacts in excess of 10 microseconds (μs) and there shall be no closure or bridging of open contacts in excess of 1 μs and no evidence of mechanical or electrical damage.

3.15 Vibration (see 4.8.10). Unless otherwise specified (see 3.1), there shall be no opening of closed contacts in excess of 10 μs and there shall be no closure or bridging of open contacts in excess of 1 μs and no evidence of mechanical or electrical damage.

3.16 Acceleration (unless otherwise specified, see 3.1) (see 4.8.11). The contacts of the relay shall remain in the de-energized position with no voltage applied to the coil and in the energized position when rated coil voltage is applied to the coil. Latching type relays shall remain in each latched position with no voltage on the coil. Unless otherwise specified (see 3.1), there shall be no opening of closed contacts in excess of 10 μs and there shall be no closure or bridging of open contacts in excess of 1 μs and no evidence of mechanical or electrical damage.

3.17 Terminal strength (see 4.8.12). There shall be no evidence of loosening or breaking of the terminals, nor shall there be any other damage which would adversely affect the normal operation of the relay. Bending of terminals shall not be construed as damage.

3.18 Resistance to soldering heat (see 4.8.14). There shall be no damage which would adversely affect normal operation of the relay.

3.19 Coil life (see 4.8.13). There shall be no evidence of damage. The manufacturer shall notify the qualifying activity when changes to the coil design or manufacture occur. The qualifying activity reserves the right to invoke the coil life test prior to shipment of product as part of this requirement.

3.19.1 Coil endurance (see 4.8.13.1). The coil resistance shall be as specified (see 3.1).

3.20 Salt spray (see 4.8.15). There shall be no evidence of breaking, cracking, chipping, or flaking of the finish, nor exposure of the base metal, due to corrosion, which would adversely affect the application or performance characteristics of the relay.

3.21 Overload (applicable to high level load ratings only) (see 4.8.16). The voltage drop across closed contacts shall be less than or equal to 10 percent of the applied load voltage and the voltage across open contacts shall be 90 percent or more of the applied load voltage. The case-to-ground fuse shall remain electrically continuous. Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test. For failure criteria, see 3.24.

3.22 Rupture (applicable to high level load ratings only) (see 4.8.17). There shall be no electrical failure, such as contact welding or failure to make or break the specified rupture current. The fuse connected between case and load system ground or neutral shall remain electrically continuous. Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test. For failure criteria, see 3.24.

3.23 Time current relay characteristics (see 4.8.18). There shall be no evidence of contact welding or sticking and the contact voltage drop shall meet the requirements of 3.12.3 after the test. The fuse connected between case and load system ground or neutral shall remain electrically continuous. Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test.

3.24 Life (see 4.8.19). Unless otherwise specified (see 3.1), for low level testing, the contact miss detector's monitoring level shall be less than or equal to 100 ohms. For high level testing, the contact miss detector's monitoring level shall be less than or equal to 10 percent of the applied load voltage and the voltage across open contacts shall be 90 percent or more of the applied load voltage. Unless otherwise specified, the static contact resistance following cycling shall be no greater than twice the initial specified contact resistance requirement. The case to ground fuse shall remain electrically continuous. Relays having two or more sets of contacts and rated for multiphase (115/200 V ac, three-phase) shall be capable of switching multiphase on adjacent contacts. Phase to phase arcing shall constitute a failure. There shall be no mechanical or electrical failure. Welding of contacts, failure to make, carry, or break any rated load shall constitute a failure. The terminal temperature rise shall not exceed +75°C. (Monitoring of terminal temperature rise applicable to qualification and group C testing only). If the lamp load is equal to or less than 0.5 times the motor load rating, the lamp load test need not be run. Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test.

3.25 Intermediate current (see 4.8.20). During cycling, unless otherwise specified (see 3.1), the resistance of a closed contact shall be less than or equal to 3 ohms and the voltage across an open contact shall be 90 percent or more of applied load voltage. After cycling, the static contact resistance shall be measured at room ambient (25°C) and shall not exceed the limits as specified (see 3.1). Intermediate current shall not be considered a low level or high level contact load rating (see 6.1.1). There shall be no mechanical or electrical failure. Welding of contacts, failure to make, carry or break the load, or failure of the fuse connected between case and load system ground or neutral shall constitute a failure. Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test. During post life tests, failure of a diode shall constitute a failure.

3.26 Mechanical life (see 4.8.21). After cycling, the insulation resistance and dielectric withstanding voltage shall not exceed the limits as specified (see 3.1) and the operate and release times shall not exceed 120 percent of the limits specified (see 3.1). There shall be no mechanical or electrical failure. Failure of the fuse connected between case and load system ground or neutral shall constitute a failure. For relays with diodes, failure of a diode shall constitute a failure. The manufacturer's test system shall have the means to ensure that the required number of test cycles have been performed.

3.27 Resistance to solvents (see 4.8.22). The marking shall remain legible.

3.28 Continuous current (see 4.8.23). There shall be no damage such as loosening of terminals, or any deterioration of performance beyond the limits specified (see 3.1). The terminal temperature rise shall not exceed +75°C.

3.29 Internal moisture (see 4.8.24). The contact load shall be 10 mA to 50 mA at 10 mV dc to 50 mV dc. When measured within 5 seconds of contact closure, the contact resistance shall not exceed 100 milliohms.

3.30 Marking.

3.30.1 JAN and J marking. The United States Government has adopted and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of specifications. Accordingly, items acquired to, and meeting all of the criteria specified herein and in applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" and "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein on in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets, the manufacturer shall remove completely the military part number and the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 2,577,735 for the certification mark "J".

3.30.2 Identification marking (full). Relays shall be marked in accordance with method I of MIL-STD-1285 and shall include the following information:

a. PIN (see 1.2 and 3.1). The "JAN" or "J" shall not be marked in front of the PIN.

b. "JAN" or "J" brand. The "JAN or "J" shall appear directly above or below the "M" of the PIN.

c. Date code (at the option of the relay manufacturer the "J" with the date code may be used instead of 3.30.2b). The date code shall provide traceability (see 4.2.2).

d. Source code.

e. Lot symbol (optional).

f. Rated coil voltage (or current) (see 3.1) and when applicable, operating frequency.

g. Coil resistance.

h. Contact rating (the highest dc resistive load rating shall be marked) (see 3.1).

i. Circuit diagram (see 3.5.5).

j. Terminal marking (when applicable, see 3.1 and 3.5.4.2).

3.30.3 FR level substitution. With acquiring activity approval, relays qualified to lower (better) FR, may be substituted for higher FR parts. For example, a relay qualified to FR level "P" (0.1 percent/10,000 cycles) may be substituted for a FR "M" (1.0 percent/10,000 cycles) relay. Unless specified in the contract or order, relays shall not be remarked.

3.30.4 Interchangeability. All parts having the same PIN shall be directly and completely interchangeable with each other with respect to installation and performance to the extent specified in the specification sheet (see 3.1).

3.31 Header glass. Header glass may have small irregularities, such as bubbles, chips, and cracks. Microscopic examination with up to 10 power magnification shall be used. The acceptability of these defects will be based on figure 4, and the following:

a. Broken or open blisters having sharp edges are not acceptable.

b. Blisters whose diameters exceed one-third the radial distance between terminal and the corresponding header metal (for a cluster of blisters the combined diameters shall apply) are not acceptable.

c. Foreign material in or on the surface of the glass is not acceptable.

d. Dark spots (pigment concentrations) whose diameters exceed one-third the radial distance between terminal and the corresponding header metal are not acceptable.

e. Circumferential cracks which extend more than 90 degrees are not acceptable (see figure 4).

f. Radial cracks whose lengths exceed one-third the distance between the terminal and corresponding header metal are not acceptable (see figure 4).

g. Tangential cracks which are not confined to a single zone are not acceptable (see figure 4).

h. Surface chips whose lengths or widths exceed one-third the distance between the terminal and corresponding header metal are not acceptable (see figure 4).

i. Chipped meniscuses are acceptable to the extent that they do not extend below the surface of the glass, and to the extent of 3.31h.

j. Meniscuses which extend up the terminal greater than .020 inch (0.51 mm) or one-third the terminal diameter, whichever is greater, are not acceptable.

k. Peripheral cracks at the boundary of the glass and surrounding header metal are not acceptable.

l. Any terminals which appear to be separated from the glass are not acceptable.

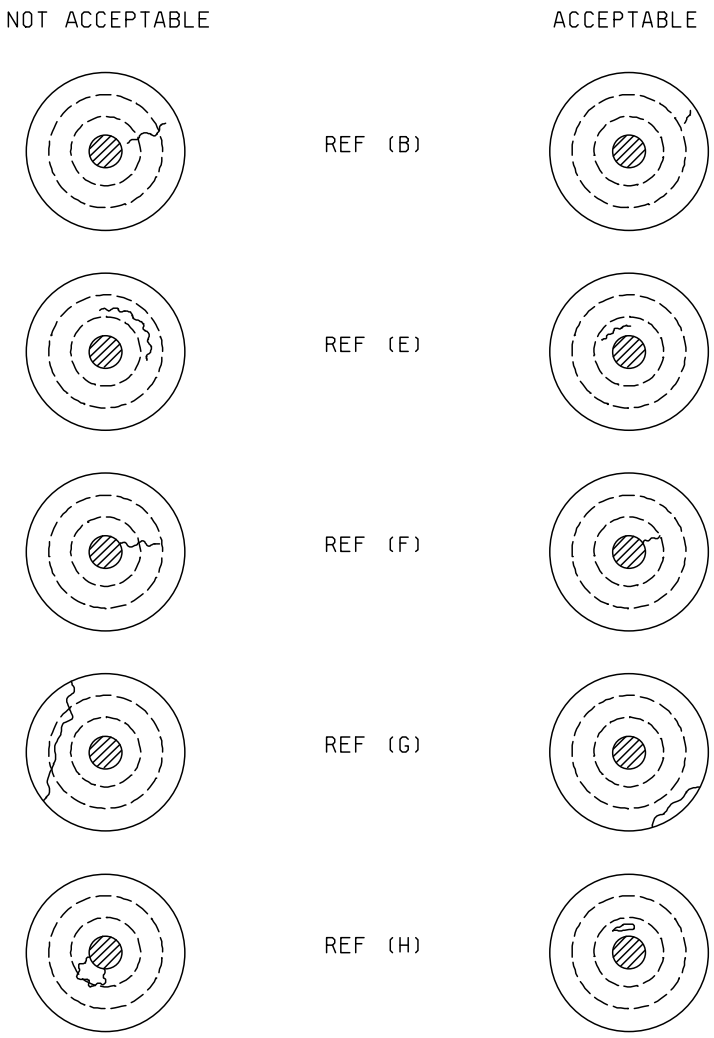
In case of dispute, all relays shall meet the applicable insulation resistance, dielectric withstanding voltage, and seal requirements, regardless of the acceptability of the header glass.

3.32 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.

3.33. Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of relay components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.6.1).

The use of lead-free tin alloy high temperature solders (e.g., Au80Sn20, Sn96Ag4, Sn96.5Ag3.5, etc.) for internal connections may be permitted based upon technical justification and requires approval from the qualifying activity, so long as the tin content of the relay components and solder does not exceed 97 percent, mass.

3.34 Workmanship. Relays shall be uniform in quality and shall be free of cracked or displaced parts, sharp edges, burrs, and other defects that could affect their life, serviceability, or appearance.



NOTE: Dashed lines indicate radial distance between terminal and header metal dividing the glass into three equal parts (zones).

FIGURE 4. Inspection aid.

4. VERIFICATION

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

a. Qualification inspection (see 4.4).

b. Verification of qualification (see 4.5).

c. In-process, conformance, and periodic inspections (see 4.7).

4.2 QPL system. The manufacturer shall establish and maintain a QPL system as described in 3.3. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and retention of qualification.

4.2.1 SPC. A SPC program shall be established and maintained in accordance with EIA557. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.

4.2.2 Traceability requirements. The manufacturer shall have a procedure whereby the lot date codes are assigned that incorporates traceability. The following list is the minimum required raw material/component parts and subassemblies for which traceability shall be applicable:

a. Header-contact subassembly with the lot number.

(1) Stationary and moving contact blade assembly (a contact may consist of a contact button or contact blade) (when applicable).

(2) Header with glass to metal sealed leads in place with the lot number.

(3) Return spring(s).

(4) Diodes (when applicable) with the lot number.

(5) Magnets (when applicable).

b. Motor subassembly with the lot number.

(1) Moving contact blade assembly (a contact may consist of a contact button or contact blade) (when applicable).

(2) Wound coils with the lot number.

(3) Armature assembly.

(4) Diodes (when applicable) with the lot number.

(5) Magnets (when applicable).

(6) Return spring(s) (when applicable).

4.2.3 ESD protection program. This requirement is applicable to all manufacturers who handle ESD component parts or materials in the relay manufacturing or testing process. The manufacturer shall establish and maintain an ESD control program. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification. As a minimum, this system must address the identification of ESD sub-components and end items, facilities, training, design protection, handling procedures, marking, cleaning, preservation, packaging, and quality assurance. A model ESD control program is available from the qualifying activity and may be used as a guideline document. Further guidance for ESD control is available from the EOS/ESD Association and the EIA.

4.3 Inspection conditions. Unless otherwise specified herein, the test conditions specified in the "GENERAL REQUIREMENTS" section of MIL-STD-202 shall be considered for reference purposes only. All inspections may be performed at ambient environmental conditions consistent with industry practice.

4.3.1 Power supply. Unless otherwise specified herein, the power supply shall have no more than 10 percent regulation at 110 percent of the specified test load current. A dc power supply shall have no more than 5 percent ripple voltage. An ac power supply shall be within 1 percent of the specified frequency and shall be sinusoidal with a form factor between 0.95 and 1.25.

4.3.2 Grounding. Unless otherwise specified (see 3.1), the negative side of the dc power supply shall be grounded. One side of single phase ac power supply shall be grounded.

4.3.3 Load conditions during tests. The coil(s) of the relay under test shall have one side connected to the coil power supply ground. All tests during which the contacts are loaded and being cycled, except dielectric withstanding voltage, shall be conducted with the case of the relay connected to the power supply ground or neutral through a normal blow fuse rated at 5 percent of the contact load maximum, but not less than 0.100 ampere. For relays with non-grounded case ratings, tests for isolated-case ratings may be made with the case electrically isolated from the power supply ground.

4.3.4 Testing devices. Unless otherwise specified herein, devices used in the testing of relays shall not load the contacts above 10 mA resistive at 6 V dc or peak ac maximum open circuit.

4.3.5 Mounting relays for ambient temperature tests. When the relays are subjected to the testing specified in 4.8.20 (intermediate current), they may be mounted on a heat sink in accordance with the following:

a. Each relay may be attached by its normal mounting means to a .063 inch (1.59 mm) thick minimum, flat aluminum plate heat sink. The heat sink shall be designed to place every relay in the center of its own square space whose total surface area (both sides) is eight times the outside surface area of the relay, excluding mounting. Relays without mounts shall be held to the heat sink with a metal strap .250 inch (6.35 mm) wide by .015 inch (0.38 mm) maximum thickness. The heat sink assembly shall be suspended by twine or other non-heat conducting material. The leads shall not constitute a heat sink.

b. Chamber temperature shall be controlled to maintain the temperature at the specified ambient extremes (see 3.1).

4.3.6 Methods of examination and test. Application of coil power to relays under test shall be such that plus polarity is applied to the color coded terminal when applicable; or to the lower numbered terminal when color coding is not used. Testing of latching relays shall be repeated with the relay in each operated position.

4.3.7 Tolerances. Unless otherwise specified (see 3.1), all electrical, environmental, and mechanical parameters shall have a tolerance of ±10 percent.

4.3.8 Alternate test equipment. Test circuits and test equipment herein are intended to provide guidance to the relay manufacturer. Use of any alternate test circuits or test equipment shall be approved by the qualifying activity prior to use.

4.3.9 Test equipment and inspection facilities. The manufacturer shall establish and maintain a calibration system in accordance with ISO/IEC 17025, ISO10012, or equivalent system as approved by the qualifying activity.

4.4 Qualification inspection. 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.

4.4.1 Qualification. Qualification shall be granted at the "L" or "M" FR initially and shall be based on results of the qualification inspection specified in table II. A certification of construction to the materials requirements of 3.4, and the interface and construction requirements of 3.5 shall accompany the submission of qualification inspection results to the qualifying activity.

4.4.1.1 Sample size. The number of relays to be subjected to qualification inspection shall be as specified in table II. The sample shall be selected from a production run and shall be produced with equipment or procedures normally used in production. The qualification sample shall be as defined in table II.

4.4.2 Inspection routine. Sample units shall be subjected to qualification inspection outlined in table II, in the order shown, except that group Q2 through group Q10 inclusive, may be conducted concurrently. All sample units shall be subjected to the inspections of Q1. These sample units shall then be divided into nine groups as specified in table II and subjected to the inspection specified for their particular group.

4.4.3 Failures. Failures in excess of those allowed in table II shall be cause for refusal to grant qualification approval.

TABLE II. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
Q1				
Visual and mechanical inspection (internal) 1/	3.1 and 3.31	4.8.1	All sample units	0
Run-in screening	3.7	4.8.2	All sample units	0
Internal moisture	3.29	4.8.24	All sample units	0
Solderability (3 sample units) 2/	3.8	4.8.3	All sample units	0
Dielectric withstanding voltage	3.10	4.8.5	All sample units	0
Insulation resistance	3.11	4.8.6	All sample units	0
Electrical characteristics	3.12	4.8.7	All sample units	0
Visual and mechanical inspection (external) (dimensional check on 2 sample units only)	3.1, 3.34, 3.30, 3.31	4.8.1	All sample units	0
Seal	3.9	4.8.4	All sample units	0
Q2				
Thermal shock	3.13	4.8.8	4	1
Resistance to solvents	3.27	4.8.22	4	1
Shock (specified pulse)	3.14	4.8.9	4	1
Vibration (sinusoidal)	3.15	4.8.10.1	4	1
Vibration (random)	3.15	4.8.10.2	4	1
Acceleration	3.16	4.8.11	4	1
Terminal strength	3.17	4.8.12	4	1
Dielectric withstanding voltage	3.10	4.8.5	4	1
Insulation resistance	3.11	4.8.6	4	1
Electrical characteristics	3.12	4.8.7	4	1
Seal	3.9	4.8.4	4	1
Q3				
Resistance to soldering heat	3.18	4.8.14	4	1
Coil life	3.19	4.8.13	4	1
Salt spray or salt atmosphere	3.20	4.8.15	4	1
Dielectric withstanding voltage	3.10	4.8.5	4	1
Insulation resistance	3.11	4.8.6	4	1
Electrical characteristics	3.12	4.8.7	4	1
Seal	3.9	4.8.4	4	1
Q4				
Overload (see table X) 3/	3.21	4.8.16	4	1
Life (rated resistive load and voltage from test) 3/	3.24	4.8.19	4	1
Dielectric withstanding voltage	3.10	4.8.5	4	1
Insulation resistance	3.11	4.8.6	4	1
Electrical characteristics	3.12	4.8.7	4	1

See footnotes at end of table.

TABLE II. Qualification inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
Q5				
Life 4/	3.24	4.8.19	6/	7/
Dielectric withstanding voltage	3.10	4.8.5	6/	7/
Insulation resistance	3.11	4.8.6	6/	7/
Electrical characteristics	3.12	4.8.7	6/	7/
Q6				
Intermediate current	3.25	4.8.20	4	1
Dielectric withstanding voltage	3.10	4.8.5	4	1
Insulation resistance	3.11	4.8.6	4	1
Electrical characteristics	3.12	4.8.7	4	1
Q7				
Mechanical life	3.26	4.8.21	4	1
Dielectric withstanding voltage	3.10	4.8.5	4	1
Insulation resistance	3.11	4.8.6	4	1
Operate and release time	3.12.5	4.8.7.5	4	1
Visual inspection (external)	3.1,3.30,3.34	4.8.1	4	1
Q8				
Rupture 5/	3.22	4.8.17	2	0
Dielectric withstanding voltage	3.10	4.8.5	2	0
Insulation resistance	3.11	4.8.6	2	0
Seal	3.9	4.8.4	2	0
Q9				
Time current relay characteristics	3.23	4.8.18	2	0
Dielectric withstanding voltage	3.10	4.8.5	2	0
Insulation resistance	3.11	4.8.6	2	0
Electrical characteristics	3.12	4.8.7	2	0
Seal	3.9	4.8.4	2	0
Q10				
Continuous current	3.28	4.8.23	2	0
Dielectric withstanding voltage	3.10	4.8.5	2	0
Insulation resistance	3.11	4.8.6	2	0
Electrical characteristics	3.12	4.8.7	2	0
Visual inspection (external)	3.1,3.30,3.34	4.8.1	2	0
Seal	3.9	4.8.4	2	0

See footnotes at top of next page.

TABLE II. Qualification inspection - Continued.

1/ One sample unit remaining unsealed shall be subjected to the internal inspection.
2/ Solderability samples are not subjected to dielectric withstanding voltage, insulation resistance, electrical characteristics, and seal.
3/ Applicable to high level ratings only. Overload samples to be assigned two for dc and two each for ac 3-phase. If ac 3-phase is not applicable, assign two samples for ac 1-phase.
4/ The sample size shall be equally divided among the specified contact ratings and shall be of sufficient size to test a minimum of one relay per contact rating with rated loads on all contacts. When there are more samples than loads, the remaining loads shall be assigned in sequence beginning with the highest dc rated load.
5/ One unit shall be tested for the ac rupture load and one for the dc rupture load. If only one rating is specified, that is, ac or dc, then both relays of the test sample group shall be tested for the one rating. If rupture is not specified (see 3.1), this group shall be omitted from the qualification program.
6/ Sample sizes for qualification shall be established based upon a 90 percent confidence level in accordance with table III plan.
7/ The allowed number of failures shall be dependent upon the number of cycles targeted in the qualification test plan, and is to be established prior to initiating qualification testing.

4.4.4 FR qualification. FR qualification shall be in accordance with the general and detailed requirements of MIL-STD-690, MIL-STD-790 in its entirety, and the following details:

a. Procedure I: Qualification at the initial FR level. The manufacturer may qualify his products to FR levels "L" or "M" initially.

b. Procedure II: Extension of qualification to lower FR levels. To extend qualification to a lower FR level (see table III), two or more styles of similar construction may be combined.

c. Procedure III: Maintenance of FR level qualifications. Maintenance period in table IV shall apply. Regardless of the number of production lots produced during this period, the specified number of life test unit cycles shall be accumulated to maintain qualification. If there is no production, contact the qualifying activity for instruction. The manufacturer shall preselect the sampling plan to be used during the maintenance period from table IV. In the event that failures occur exceeding the sampling plan selected (C = number), the FR of the product shall be increased one level or the product removed from the QPL. Noncompliance corrective action shall be in accordance with 4.7.3.3.

4.5 Verification of qualification. To retain qualification, the manufacturer shall provide verification to the qualifying activity (see 6.3) for the following items at 36-month intervals:

a. Design of the relay has not been modified.

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

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

d. FR levels.

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, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the relays. If during the two consecutive reporting periods there has been no production, then the manufacturers may be required, at the discretion of the qualifying activity, to submit their qualified products to testing in accordance with the qualification inspection requirements and to provide the reason why there was no production.

4.6 FR level determination. Determination of FR levels shall be based upon all completed life tests. Determination of FR levels shall be accumulated in the following manner:

a. The qualification test samples.

b. Test on every production lot which has been submitted for group B conformance inspection.

c. Test results of relays which have a similar internal design and construction, same production processes, same or higher environmental capability, and same electrical characteristics as the qualified relay and which have been tested in accordance with the group B conformance inspection conditions. These relay types must be reviewed and approved by the activity responsible for qualification prior to being considered as acceptable relays for use in FR level determination.

4.6.1 FR level computation. For this computation, a sample unit which fails at any given cycle shall be classed as a failure for all subsequent measurements. However, the contractor, at his option, may physically remove failed sample units from the test. If a failed sample unit is not removed, the cycles accumulated subsequent to its failure shall not be counted toward the cumulative component cycles.

4.6.2 Qualification approval for higher FR. Qualification approval granted for one of the lower FR levels will include qualification for all of the higher FR levels; for example, qualification approval for level "R" will include qualification approval for levels "P", "M" and "L".

TABLE III. Requirements for qualification and extension of qualification to lower (better) FR levels (90 percent confidence level).

FR level symbol	Qualified FR (percent/10,000 cycles)	Cumulative unit cycles in millions 1/					
		C = 0	C = 1	C = 2	C = 3	C = 4	C = 5
L	3.0	0.767	1.30	1.77	2.23	2.66	3.09
M	1.0	2.30	3.89	5.32	6.68	7.99	9.27
P	0.1	23.0	38.9	53.2	66.8	79.9	92.7
R	0.01	230	389	532	668	799	927

1/ C = acceptance number or number of failures permitted. C numbers greater than five shall be coordinated and approved by the qualifying activity.

TABLE IV. Sampling plan for maintenance of FR level qualification (60 percent confidence level).

FR level symbol	Qualified FR (percent/ 10,000 cycles)	Maximum qualification maintenance period	Cumulative unit cycles in millions 1/					
			C = 0	C = 1	C = 2	C = 3	C = 4	C = 5
L	3.0	6 months	0.306	0.673	1.03	1.39	1.75	2.10
M	1.0	6 months	0.916	2.02	3.10	4.18	5.25	6.30
P	0.1	12 months	9.16	20.2	31.0	41.8	52.5	63.0
R	0.01	24 months	9l.6	202	310	418	525	630

1/ C = acceptance number or number of failures permitted. C numbers greater than five shall be coordinated and approved by the qualifying activity.

4.7 In-process, conformance, and periodic inspections.

4.7.1 In-process inspection (see 3.6).

4.7.1.1 Diode in-process screening (see 3.6.1). Each manufacturer shall establish a diode screening process as approved by the qualifying activity. As a minimum, this process shall include a 24 hour minimum burn-in at +125°C minimum and may use MIL-STD-750 as a guide. This process shall be performed prior to run-in (see 4.8.2).

4.7.1.2 Internal foreign material control. The manufacturer shall, immediately preceding sealing, perform an audit on a weekly basis for the presence of foreign material within the relay package. Records shall be maintained to allow for verification of the performance of this audit. This audit may be satisfied during routine internal visual inspection. The magnification shall be 20X minimum. If the presence of any type of foreign material/contamination is discovered, the manufacturer shall perform the necessary analysis on a sample of suspect relays to determine the nature of the foreign material. The manufacturer shall then document the results of his investigation and corrective actions to eliminate the foreign material and shall maintain this information and make available to the qualifying activity when requested. The intent of this procedure is to require investigation and resolution of foreign material problems which do not have effective screening or detection methodology, but that could cause degradation and eventual failure of the relay. Repetitive findings without obvious improvements require escalation to Director of Manufacturing and Director of Quality Assurance, or their equivalents, to continue processing.

4.7.2 Conformance inspection. Conformance inspection of group A inspection.

4.7.2.1 Inspection and production lot.

4.7.2.1.1 Inspection lot. An inspection lot shall consist of all the relays of the same specification sheet, and those of similar design and construction as outlined in 6.3.2, manufactured under essentially the same processes and conditions during a manufacturing period of 1 month maximum. The manufacturer shall define the period for an inspection lot. For purposes of lot formation, all terminal types and mounting configurations may be combined.

4.7.2.1.2 Production lot. A production lot shall consist of all relays of the same PIN. Manufacture of all parts in the lot shall have been started, processed, assembled, and tested as a group. Lot identity shall be maintained throughout the manufacturing cycle.

4.7.2.2 Group A inspection. Group A inspection shall consist of the inspections specified in table V.

4.7.2.2.1 A1, A2, and A4 tests. The A1, A2, and A4 tests shall be performed on a production lot basis on 100 percent of the product supplied under this specification, except as noted. Relays that do not meet specification requirements of these groups shall be removed from the lot.

4.7.2.2.1.1 Sampling plan. The tests in A1, A2, and A4 shall be performed on each relay offered for inspection, except as noted.

4.7.2.2.1.2 Rejected lots. Relays that do not meet the requirements of the tests in A1 and A4 shall be rejected and shall be removed from the lot. If more than 5 percent of the relays are discarded during A2 testing, the production lot shall be rejected and not offered for re-inspection.

4.7.2.2.2 A3 tests.

4.7.2.2.2.1 Sampling plan. Two samples shall be selected randomly from each inspection lot and subjected to the A3 solderability test. If there are one or more defects, the lot shall be considered to have failed. Relays failing the A2 electrical tests, or rejected for other criteria which will not influence solderability, may be used for solderability testing. All rejected relays used as samples must accompany the acceptable relays through all processing environments. The rejected relays shall be marked in a definite manner in order to preclude mixing with acceptable parts.

4.7.2.2.2.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot:

a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.8.3. Production lots that pass the solderability test are acceptable for shipment after successful completion of group A4. Production lots failing the solderability test can be reworked as described in 4.7.2.2.2.2b and 4.7.2.2.2.2c.

b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process in accordance with 3.5.7.5. Two additional samples shall be selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test, the lot shall be rejected and shall not be furnished against the requirements of this specification.

c. The manufacturer may submit the failed lot to a strip and re-plate process followed by a complete group A inspection. The reworked lot shall be considered a new lot for the purpose of the 5 percent requirement of A2. If the lot fails this solderability test, the lot shall be rejected and shall not be furnished against the requirements of this specification.

TABLE V. Group A inspection. 1/

Inspection	Requirement paragraph	Test method paragraph	Inspection requirements
A1			
Vibration (sinusoidal)	3.15	4.8.10.1	100 percent
Run-in screening	3.7	4.8.2	100 percent
A2 2/			
Dielectric withstanding voltage	3.10	4.8.5	100 percent
Insulation resistance	3.11	4.8.6	100 percent
Electrical characteristics	3.12	4.8.7	100 percent
A3			
Solderability	3.8	4.8.3	2 samples
A4			
Visual and mechanical inspection	3.1,3.30, 3.31, 3.34	4.8.1	100 percent
(external) 3/		4.8.4	100 percent
Seal	3.9		

1/ Test groups shall be performed in the order shown.
2/ Testing sequence optional, except that dielectric withstanding voltage shall precede insulation resistance.
3/ Minor defects, such as marking may be reworked. A two piece sample of each lot shall be mechanically inspected and visually inspected for cracked glass. If cracks exceeding the allowable limits are found, the entire lot shall be inspected to the criteria of 3.31.

4.7.3 Periodic inspections. Periodic inspections shall consist of group B and group C. Except where the results of these inspections show noncompliance with the applicable requirements, delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

4.7.3.1 Group B inspection. Group B inspection shall consist of the tests specified in table VI and shall be made on sample units which have been subjected to and have passed the group A inspection.

4.7.3.1.1 Sampling plan. The test sample size shall be determined by the manufacturer so that the relay cycles generated meet the maintenance of qualification requirements specified for the qualified FR level (see 4.4.4). A minimum quantity of samples shall be selected from each inspection lot as determined by the quantity needed to maintain the FR level divided by the number of inspection lots in the reporting period. In all cases, the sampling plan shall be approved by the qualifying activity. As far as is practicable, the relays tested during a maintenance period shall be representative of all relays produced during this period.

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

TABLE VI. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Life 1/ 2/ 3/	3.24	4.8.19
Dielectric withstanding voltage 4/	3.10	4.8.5
Insulation resistance 4/	3.11	4.8.6
Electrical characteristics 4/	3.12	4.8.7
Visual inspection (external)	3.1, 3.30, 3.34	4.8.1

1/ Sample units shall be tested in a predetermined sequence as defined by the manufacturer and approved by the qualifying activity. All loads specified in the applicable specification sheet, except intermediate current and mechanical life, shall be represented. All loads need not be represented in a 6 month maintenance period but shall be represented within two 6 month maintenance periods.
2/ When 115/200 V ac, 3-phase rating is specified, 115 V ac, 1 phase testing is not required.
3/ If the lamp load is equal to or less than 0.5 times the motor load rating, the lamp load test need not be run.
4/ Testing sequence optional for insulation resistance, dielectric withstanding voltage, and coil resistance only.

4.7.3.2 Group C inspection. Group C inspection shall consist of the tests specified in table VII. Group C inspection shall be made on sample units selected from inspection lots which have passed the group A inspection.

4.7.3.2.1 Sampling plan. Three sample units shall be taken from production every month for C1, two samples for C2 every 6 months, two samples for C3 every 6 months, two samples for C4 every 6 months, two samples for C5 every 12 months, and two samples for C6, C7, and C8 every 36 months.

4.7.3.2.2 Failures. No failures shall be permitted except for intermediate current in C1 (see footnote 1/ in table VII).

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

4.7.3.3 Noncompliance. During group B and group C inspections, when a failure exceeds the allowable number of failures, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure within 5 working days. The manufacturer shall prepare to 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 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 B and group C inspections shall be repeated on additional sample units (all tests, or the tests which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group B or group C inspection has shown that the corrective action was successful.

TABLE VII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection
C1 (every month)			
Internal moisture	3.29	4.8.24	3
Intermediate current 1/	3.25	4.8.20	3
Dielectric withstanding voltage 2/	3.10	4.8.5	3
Insulation resistance 2/	3.11	4.8.6	3
Electrical characteristics 2/	3.12	4.8.7	3
Visual inspection (external)	3.1,3.30,3.34	4.8.1	3
C2 (every 6 months)			
Thermal shock	3.13	4.8.8	2
Shock (specified pulse) 3/	3.14	4.8.9	2
Vibration 3/	3.15	4.8.10	2
Terminal strength	3.17	4.8.12	2
Dielectric withstanding voltage 2/	3.10	4.8.5	2
Insulation resistance 2/	3.11	4.8.6	2
Electrical characteristics 2/	3.12	4.8.7	2
Visual inspection (external)	3.1,3.30,3.34	4.8.1	2
Seal	3.9	4.8.4	2
C3 (every 6 months)			
Overload (highest dc resistive load) 4/	3.21	4.8.16	2
Life (highest rated dc, 50 percent of rated life)	3.24	4.8.19	2
Dielectric withstanding voltage 2/	3.10	4.8.5	2
Insulation resistance 2/	3.11	4.8.6	2
Electrical characteristics 2/	3.12	4.8.7	2
Visual inspection (external)	3.1,3.30,3.34	4.8.1	2
C4 (every 6 months)			
Mechanical life	3.26	4.8.21	2
Dielectric withstanding voltage	3.10	4.8.5	2
Insulation resistance	3.11	4.8.6	2
Operate and release time	3.12.5	4.8.7.5	2
Visual inspection (external)	3.1,3.30,3.34	4.8.1	2
C5 (every 12 months)			
Coil endurance	3.19.1	4.8.13.1	2
Rupture (one dc and one ac)	3.22	4.8.17	2
Dielectric withstanding voltage	3.10	4.8.5	2
Insulation resistance	3.11	4.8.6	2
Seal	3.9	4.8.4	2
C6 (every 36 months)			
Salt spray	3.20	4.8.15	2
Acceleration	3.16	4.8.11	2
Resistance to soldering heat	3.18	4.8.14	2
Resistance to solvents	3.27	4.8.22	2
Dielectric withstanding voltage 2/	3.10	4.8.5	2
Insulation resistance 2/	3.11	4.8.6	2
Electrical characteristics 2/	3.12	4.8.7	2
Visual inspection (external)	3.1,3.30,3.34	4.8.1	2
Seal	3.9	4.8.4	2

See footnotes at end of table.

TABLE VII. Group C inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection
C7 (every 36 months)			
Time current relay characteristics (one dc and one ac)			
Dielectric withstanding voltage	3.23	4.8.18	2
Insulation resistance	3.10	4.8.5	2
Electrical characteristics	3.11	4.8.6	2
Seal	3.12	4.8.7	2
	3.9	4.8.4	2
C8 (every 36 months)			
Continuous current	3.28	4.8.23	2
Dielectric withstanding voltage	3.10	4.8.5	2
Insulation resistance	3.11	4.8.6	2
Electrical characteristics	3.12	4.8.7	2
Visual inspection (external)	3.1,3.30,3.34	4.8.1	2
Seal	3.9	4.8.4	2

1/ One intermediate current failure per 36 month maintenance period shall be permitted in accordance with FR groupings of similar relay types as approved by the qualifying activity.
2/ Testing sequence optional for insulation resistance, dielectric withstanding voltage, and coil resistance only.
3/ Each mounting configuration to which a manufacturer is qualified will be represented during the normal continuous periodic testing period. It will usually take more than one periodic testing period to achieve testing of all of the applicable mountings.
4/ Applicable to high level load ratings.

4.8 Methods of inspection.

4.8.1 Visual and mechanical. Relays shall be examined to verify that the materials, external interface and construction, physical dimensions (only required where mechanical inspection is specified), marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, 3.30, 3.31, and 3.32). Inspection requirements in 3.31 apply only when indicated.

4.8.2 Run-in screening (see 3.7).

a. High temperature. For qualification inspection only; relays shall be subjected to +125°C with rated voltage or current on the coil circuit for 1 hour for nonlatching relays; for latching relays, one coil shall be energized for 0.5 hour. At the end of this period, the pickup value (voltage), or latch and reset voltage, shall be measured to determine compliance to 3.1. For latching relays, repeat the test after the other coil has been energized for 0.5 hour. For group A testing, relays shall be subjected to +125°C; the test chamber shall stabilize at +125°C after the specimens have been inserted into the test chamber. The test shall be performed with rated voltage or current on the coil for 15 minutes minimum for nonlatching relays weighing one ounce or less and 30 minutes minimum for relays weighing over one ounce. At the end of each period, the specified pickup value (voltage) shall be measured to determine compliance with 3.1. For latching relays, one of the two coils shall be energized with rated voltage or current for 7.5 minutes minimum. For latching relays, repeat this test after the other coil has been energized with rated voltage or current for 7.5 minutes minimum. The specified pickup value (voltage) shall be measured to determine compliance with 3.1. While at this temperature, the relays shall be subjected to a 2,500 cycle run-in test. The cycling rate shall be calculated using the formulas below and the maximum operate and release times as specified, see 3.1 for the relay under test. For latching relays, use the latch/reset times. Relays shall have the contacts loaded as follows: Open circuit load voltage 10 mV dc to 50 mV dc or peak ac. The load current shall be 10 μA to 50 μA. The contact resistance or voltage drop, as applicable, of each pair of mated contacts shall be monitored during 40 percent minimum of each "on" and each "off" period. The test equipment shall automatically turn off when a failure occurs, or shall record every failure.

b. Low temperature. Following high temperature, for qualification only, relays shall be subjected to -65°C with the coil or coils de-energized for 1 hour. For group A testing, relays shall be subjected to -65°C; the test chamber shall stabilize at -65°C after the specimens have been inserted into the test chamber. The test shall be performed with the coil or coils de-energized for fifteen minutes minimum for relays weighing one ounce or less and thirty minutes minimum for relays weighing over one ounce. At the end of either period, the specified dropout value (voltage) shall be measured to determine compliance with 3.1. For latching relays, dropout voltage measurement is not required. While at this temperature, the relays shall be subjected to a 2,500 cycle run-in test in accordance with the procedure outlined in 4.8.2a.

4.8.2.1 Cycling-rate. The cycle rate shall be a maximum of 0.1/ (maximum operate time (seconds) plus maximum release time (seconds)) cycles per second where the operate and release times are those of the relay under test.

$$\text{Maximum cycle rate (cycles per second)} = \frac{0.1}{\text{Maximum operate time (seconds)} + \text{maximum release time (seconds)}}$$

For latching relays:

$$\text{Maximum cycle rate (cycles per second)} = \frac{0.1}{\text{2X Maximum latch/reset time (seconds)}}$$

4.8.3 Solderability (see 3.8). Relays shall be tested in accordance with MIL-STD-202-208. The following details and exceptions shall apply: All terminations of each part shall be tested.

4.8.4 Seal (see 3.9). Relays shall be tested in accordance with 4.8.4.1, as applicable. In case of dispute, method 1014 of MIL-STD-883, test condition B shall govern.

4.8.4.1 Relays sealed with or without a tracer gas. Relays shall be tested for fine leak and gross leak using one of the fine leak procedures and one of the gross leak procedures in the following table. Fine leak shall be performed prior to gross leak, unless MIL-STD-883 Method 1014 Test Condition B_2/B_1 is used. The standard leak rate (L value in Eq. (1) of MIL-STD-883 Method 1014) shall be 1 X 10^{-6} atm cm^3/s of air.

Fine Leak
MIL-STD-883 (method 1014) – Test Condition B_1
MIL-STD-883 (method 1014) – Test Condition A_2
Gross Leak
MIL-STD-883 (method 1014) – Test Condition B_2
MIL-STD-202-112 (method 112) – Test Condition D
MIL-STD-883 (method 1014) – Test Condition C
Fine Leak and Gross Leak Combination
MIL-STD-883 (method 1014) – Test Condition B_2/B_1 When using the radioisotope tests, it is recommended practice to use B_2 first to remove gross leakers prior to the fine leak test B_1, which minimizes the Kr85 entrapped in rejected devices.

4.8.4.2 Radioisotope dry gross leak test (optional). This test shall be used only to test devices that internally contain some krypton-85 absorbing medium, such as electrical insulation, organic, or molecular sieve material. This test shall be permitted only if the following requirements are met:

a. A .005 inch (0.1270 mm) to .010 inch (0.2540 mm) diameter hole shall be made in a representative unit of the device to be tested. (This is a one time test that remains in effect until a design change is made in the relay internal construction.)

b. The device shall be subjected to this test condition. If the device exhibits a hard failure, this test condition may be used for those devices represented by the test unit. If the device does not fail, this test shall not be used and instead a +125°C fluorocarbon gross leak shall be performed in accordance with MIL-STD-202-112, test condition D, except the specimen shall be observed from the instant of immersion for 1 minute minimum to 3 minutes maximum.

4.8.4.2.1 Apparatus. The following apparatus shall be required for this test:

a. Radioactive tracer gas activation console containing krypton-85/dry nitrogen gas mixture.

b. Counting station with sufficient sensitivity to determine the radiation level of krypton-85 tracer gas inside the device.

c. Tracer gas mixture: Krypton-85/dry nitrogen with a minimum allowable specific activity of 100 microcuries per atmosphere cubic centimeter. The specific activity of the krypton-85/dry nitrogen mixture shall be a known value and determined on a once-a-month basis as a minimum.

4.8.4.2.2 Procedure. The devices shall be placed in a radioactive tracer gas activation tank and the tank shall be evacuated to a pressure not to exceed 0.5 torr. The devices shall then be subjected to a minimum of 10 psig of krypton-85/dry nitrogen gas mixture for 30 seconds. The gas mixture shall then be evacuated in storage until a pressure of 2.0 torr maximum exists in the activation tank. The evacuation shall be completed in 5 minutes maximum. The evacuation tank shall then be backfilled with air (air wash). The devices shall then be removed from the activation tank and leak tested within 2 hours after gas exposure with a scintillation-crystal-equipped counting station. Devices indicating 1,000 counts per minute or greater above the ambient background of the counting station shall be considered a gross leak failure.

TABLE VIII. Test details for dielectric withstanding voltage.

Points of application	Test voltage
Between case, frame, or enclosure and between all contacts in the energized and de-energized positions (latch and reset positions for latching relays) Between case, frame, or enclosure and coil(s) (latch or reset positions for latching relays) Between all contacts and coil(s) (latch or reset positions for latching relays) Between open contacts in the energized and de-energized positions (latch and reset positions for latching relays) Between coils of latching relays (latch or reset positions for latching relays) Between contact poles in the energized and de-energized positions (latch and reset positions for latching relays) (applicable to multipole relays)	1,000 ±5 percent volts ac plus twice rated voltage or the specified value ±5 percent

4.8.5 Dielectric withstanding voltage (see 3.10). Relays shall be tested as specified in 4.8.5.1 and in accordance with 4.8.5.2. Testing in accordance with 4.8.5.2 is not applicable to group A, group B, group C1, group C5, or group C6 inclusive.

4.8.5.1 At atmospheric pressure. Relays shall be tested in accordance with MIL-STD-202-301. The following details shall apply:

a. Points of application and magnitude of test voltage: As shown in table VIII.

b. Maximum leakage current: 1 mA. For group A, leakage current measuring device shall be capable of measuring the leakage current to an accuracy of at least 10 percent.

c. Duration of application: 60 seconds minimum for qualification and group B and group C tests; 5 seconds minimum for group A tests.

d. Attributes data is acceptable.

4.8.5.2 At reduced barometric pressure. Relays shall be tested in accordance with MIL-STD-202-105. The following details shall apply:

a. Method of mounting: Normal mounting means.

b. Test condition: Test condition C.

c. Tests during subjection to reduced pressure: As specified in points of application in table VIII, except test voltage shall be 350 volts.

d. Duration of application: 60 seconds minimum for qualification and group C tests.

e. Attributes data is acceptable.

4.8.6 Insulation resistance (see 3.11). Relays shall be tested in accordance with MIL-STD-202-302 with the relay in the energized and de-energized positions. Unless otherwise specified, the following details shall apply:

a. Test condition: A (for relays with coil and contact ratings both below 60 volts), and B (for all other relays).

b. Points of measurement: As specified in points of application in table VIII.

4.8.7 Electrical characteristics (see 3.12).

4.8.7.1 Coil resistance (see 3.12.1). Relay coils shall be tested in accordance with MIL-STD-202-303 (see 6.9 for optional temperature conversion formula).

4.8.7.2 Maximum coil current (see 3.12.2). When rated voltage is applied to the coil terminals, the current must be within the limits as specified (see 3.1). Apply rated voltage for 5 seconds maximum.

4.8.7.3 Static contact resistance or contact voltage drop (see 3.12.3).

4.8.7.3.1 Static contact resistance (see 3.12.3). Relays shall be tested in accordance with MIL-STD-202-307. The following details and exception shall apply:

a. Method of connection: The point of measurement shall be on leads external to the case. Suitable jigs and fixtures shall be used.

b. Test load: Test current shall be 100 mA at a voltage equal to or below rated voltage, except those rated for low level. See 6.1.1 for low level voltage rating. For low level, the current shall be 10 mA maximum. (dc or peak ac).

c. Post test current: Load current and voltage shall be 100 mA maximum at a voltage equal to or below rated voltage, unless life tests are specified in the grouping. When life tests are specified in the grouping, the same current at a maximum of rated voltage as the life test, or 100mA maximum at 28vdc maximum, shall be used.

d. Points of measurements:
   (1) Between all normally closed mated contacts.

   (2) Between all normally open mated contacts, with the coil energized with rated coil voltage (or current) for non-latch type relays, or in the latch/reset position for magnetic latch type relays, with or without coil energized.

e. Number of activations prior to measurement: During static resistance tests, the number of activation prior to measurement is none.

f. Number of test activations: Maximum of three activations in each closed contact position for qualification Q1. For all remaining groups in the qualification table, group A, group B, and group C, one activation in each closed contact position.

g. Number of measurements per activation: One in each closed contact position. The readings shall be taken after the circuit has stabilized and within a maximum time of 2 seconds after activation.

4.8.7.3.2 Contact voltage drop (see 3.12.3). Relays shall be tested in accordance with MIL-STD-202-307. The following details and exception shall apply:

a. Method of connection: The point of measurement shall be on leads external to the case. Suitable jigs and fixtures shall be used.

b. Test load: Test current shall be rated resistive current at rated voltage or less. See 6.1.1 for low level voltage rating. If a lower test current is used, the millivolt drop shall be adjusted according to Ohm's law.

c. Post test loads for intermediate current and life: When intermediate current is specified in the grouping, the same current as intermediate current, or 100 mA, at a voltage equal to or below rated voltage shall be used. When life tests are specified in the grouping, the same current as the high level life test, or 100 mA, at a voltage equal to or below rated voltage shall be used. If a lower test current is used, the millivolt drop shall be adjusted according to Ohm's law.

d. Points of measurements:

(1) Between all normally closed mated contacts.

(2) Between all normally open mated contacts, with the coil energized with rated coil voltage (or current) for non-latch type relays, or in the latch/reset position for magnetic latch type relays, with or without coil energized.

e. Number of activations prior to measurement: During contact voltage drop tests, the number of activation prior to measurement is none.

f. Number of test activations: Maximum of three activations in each closed contact position for qualification Q1. For all remaining groups in the qualification table, group A, group B, and group C, one activation in each closed contact position.

g. Number of measurements per activation: One in each closed contact position. The readings shall be taken after the circuit has stabilized and within a maximum time of 2 seconds after activation.

4.8.7.4 Specified pickup or latch/reset, hold, and dropout values (voltages) (see 3.12.3). Specified pickup or latch/reset, hold, and dropout values (voltage) shall be measured as specified in 4.8.7.3.1, 4.8.7.3.2, 4.8.7.4.3, or 4.8.7.4.4. Unless otherwise specified (see 3.1), for qualification inspection, the relay shall be mounted in each of three mutually perpendicular planes. For conformance inspection, the relay mounting position is optional. A suitable indicating device shall be used to monitor contact position. During the test, all contacts shall not change state (break or remake) when the coil is energized at or above the specified pickup or latch/reset value (voltage); when the coil voltage is lowered to any value at or above specified hold value (voltage); or when the coil voltage is reduced from the specified dropout value (voltage) to zero. It is permissible to perform specified pickup or latch/reset, hold, and dropout values (voltages) using step function voltage changes as specified in 4.8.7.3.1 or 4.8.7.3.2, 4.8.7.4.3, and 4.8.7.4.4. Due to the fact that slow ramping will overheat relay coils and vary specified pickup or latch/reset, hold, and dropout values (voltages), the step function method shall be the governing method in cases of dispute. For qualification, and group C inspections testing, specified pickup or latch/reset, hold, and dropout values (voltages) shall be measured at minimum, ambient, and maximum temperatures specified (see 3.1). Following group B, group C1, group C3, and group C4 testing, the over the temperature range values for specified pickup, hold, and dropout shall apply at ambient temperature.

4.8.7.4.1 Specified pickup value (voltage) (not applicable to latching relays). The voltage shall be increased from zero until the relay operates, and the specified pickup value (voltage) shall be measured. It is permissible to perform specified pickup value (voltage) using a step function voltage change as follows and as illustrated on figure 5. In addition to step function changes in voltage levels as specified on figure 5, rapid voltage ramps, rapidly increasing small incremental steps and combination of step functions and ramps may be used to achieve the specified pickup, hold, and dropout values (voltages) sequencing.

a. Step up to the specified pickup value (voltage), contacts shall have transferred and all normally open contacts shall be made.

b. Apply rated coil voltage.

c. Step down to specified hold value (voltage). Normally open contacts shall still be making.

d. Step down to specified dropout value (voltage). All contacts shall have transferred and all normally closed contacts shall be making.

e. Step down to zero voltage.

4.8.7.4.2 Specified latch/reset value (voltage) (applicable to latching relays only). Before measuring the specified pickup value (voltage), establish that all contacts are in their last energized mode for latching relays (see 3.1). If not, apply rated voltage to establish last energized position. Gradually increase the voltage to the latching coil until the contacts transfer and the specified operate (latch) value (voltage) shall be measured. Apply rated latching voltage and reduce to zero. Gradually increase the voltage to the reset coil until the contacts transfer and the specified pickup (reset) value (voltage) shall be measured. It is permissible to perform maximum pickup (latch/reset) value (voltage) using a step function as follows and as illustrated on figure 5.

a. Step up to specified latch value (voltage) for latching relay. The contacts shall have transferred to the latch position.

b. Step up to rated voltage and then step down to zero.

c. Step up to specified reset value (voltage) for latching relays. The contacts shall have transferred to reset position.

d. Step up to rated voltage and then step down to zero.

4.8.7.4.3 Specified hold value (voltage) (not applicable to latching relays). Rated voltage shall be applied to the coil. The voltage shall then be reduced to the specified hold value (voltage) (see 3.1 and 6.11). All contacts shall not change state. It is permissible to perform this test using the step function voltage program described in 4.8.7.3.1 and on figure 5.

4.8.7.4.4 Specified dropout value (voltage) (not applicable to latching relays). Rated voltage shall be applied to the coil. The voltage shall then be gradually reduced until all contacts return to the de-energized position and the specified dropout value (voltage) shall be measured. It is permissible to perform this test using the step function voltage program described in 4.8.7.3.1 and on figure 5.

4.8.7.5 Operate and release time (see 3.12.5). Operate and release time shall be measured using an oscilloscope or other acceptable means approved by the qualifying activity. Rated voltage shall be applied to the coil. Contact load conditions shall be 6 V dc maximum or peak ac at 10 mA maximum. The circuit shown on figure 6, or equivalent, shall be used. The operate and release time shall be exclusive of contact bounce or contact stabilization time. Timing measurements shall be made on all contact sets. Release time is not applicable to latching relays. Electronic instrumentation or other suitable means may be used for group A inspection. Determination of compliance to the simultaneously switching requirement shall be made by comparing the highest time to the lowest time of the poles as measured for operate and release time. The procedure for measurement shall be approved by the qualifying activity.

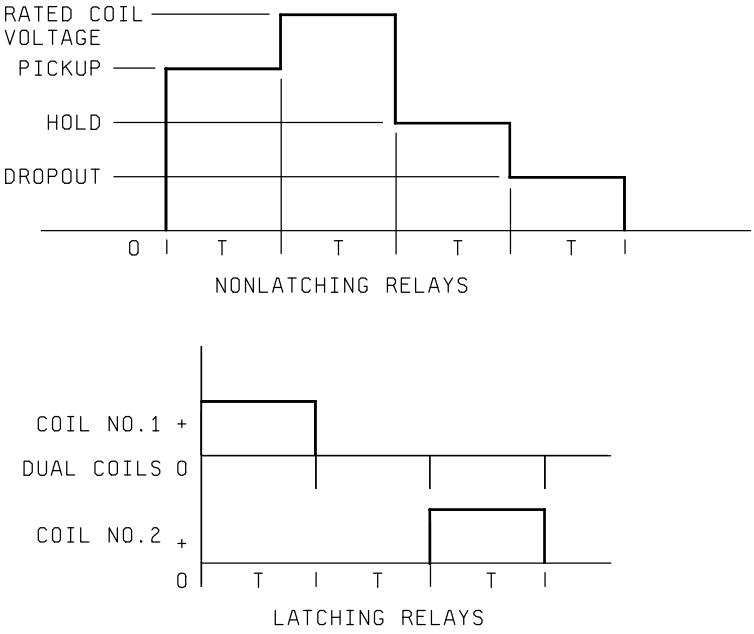


FIGURE 5. Pickup or latch/reset, hold, and dropout sequencing.

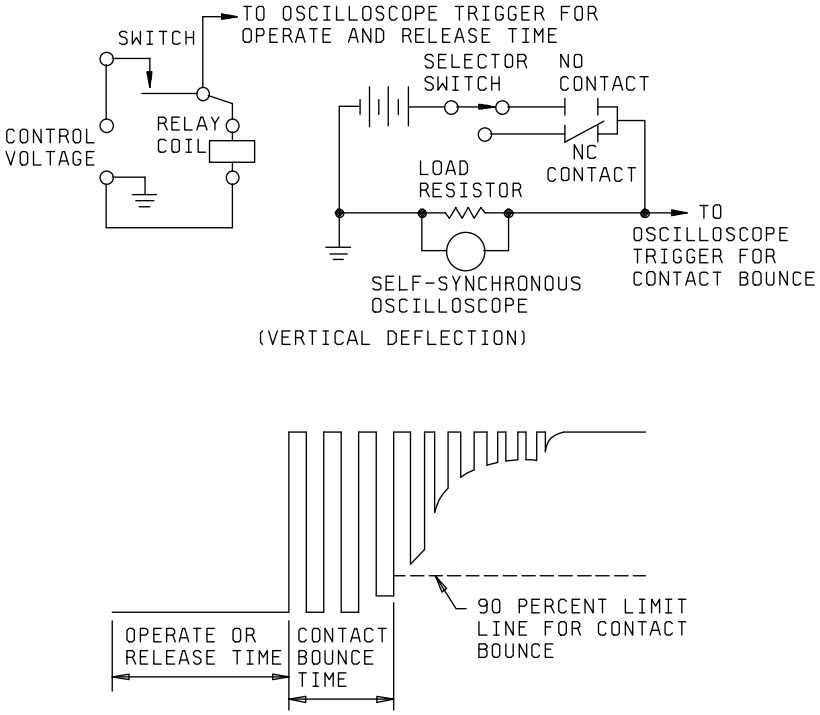


FIGURE 6. Typical circuit for operate and release time, contact bounce and contact stabilization time with typical traces.

4.8.7.5.1 Break before make (see 3.12.5.1). The circuit shown on figure 7 or an equivalent circuit approved by the qualifying activity shall be used to monitor contact position.

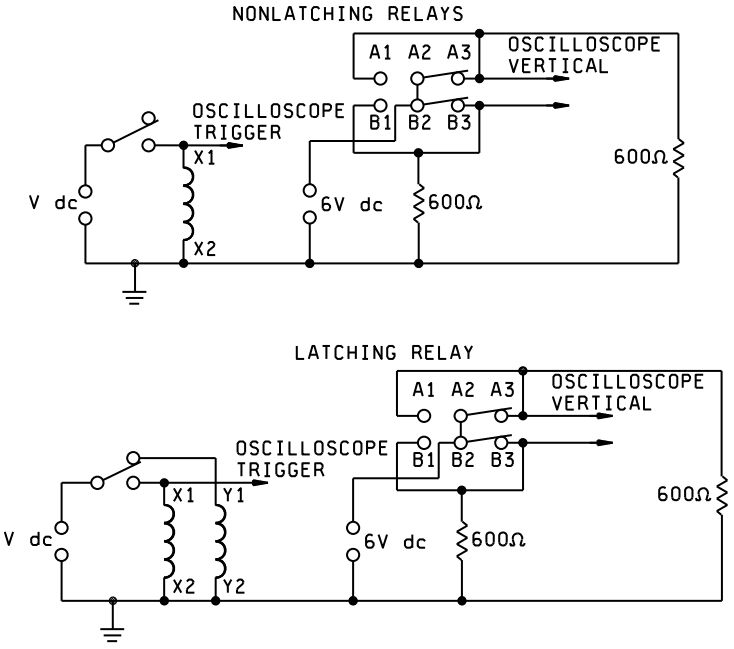


FIGURE 7. Typical break before make test circuits.

4.8.7.6 Contact dynamic characteristics (see 3.12.6).

4.8.7.6.1 Contact bounce (see 3.12.6.1). Contact bounce shall be measured on each contact set using an oscilloscope or other acceptable means approved by the qualifying activity. The trace shall show contact switching at operate and release and appropriate timing markers when using an oscilloscope. Rated voltage shall be applied to the coil. Contacts shall be loaded with 6 V dc maximum or peak ac at 10 mA maximum. After high level rated load life and intermediate current tests, contact bounce shall be measured at 100 mA at 28 V dc. A contact bounce shall be considered any occurrence equal to or greater than 90 percent of the open circuit voltage with a pulse width of 10 μs or greater. The circuit shown on figure 6, or equivalent, shall be used.

4.8.7.6.2 Contact stabilization time (see 3.12.6.2). Contact stabilization time shall be measured on each contact set using an oscilloscope or other acceptable means approved by the qualifying activity. The equipment shall have the capability of indicating a failure pulse width of greater than 1 μs. The trace shall show contact switching at operate and release, appropriate timing markers, and maximum allowable contact voltage drop markers (which equates to the allowable static contact resistance). Rated voltage shall be applied to the coil. Contacts shall be loaded with 50 mV dc maximum or peak ac at 50 mA maximum. Contact stabilization time shall be defined as the maximum time allowed for the contacts to reach and maintain a static contact resistance state following the actual operate or release time of the relay (essentially, it is the sum of the contact bounce time (see 6.11) and the time for the dynamic contact resistance to stabilize to the static contact resistance). The circuit shown on figure 6, or equivalent, shall be used. After high level rated load life and intermediate current tests, the contacts shall be loaded at 100 mA at 28 V dc and contact bounce in lieu of contact stabilization time shall be measured as specified in 4.8.7.5.1.

4.8.7.7 Coil transient suppression (applicable to dc operated relays with internal coil suppression) (see 3.12.7). The coil shall be connected as shown on figure 8 or by an equivalent test circuit and tested as specified below.

NOTE: Voltage greater than the maximum specified may damage the coil transient suppression device.

a. The switching relay shall be a mercury wetted contact switching relay or a solid state relay without any built-in transient suppression function. E is rated operating voltage for the relay under test. The switching relay is operated from a source voltage independent of E. The oscilloscope shall have a rise time of 20 ns or less. The horizontal (time) deflection scale shall be set at 0.5 millisecond (ms) to 1 ms per division (0.5 ms/cm to 1 ms/cm), and the vertical (voltage) defection to such that the vertical gain provided accuracy in reading. Example: 5 V/cm for a 12 V back EMF limit, or 10 V/cm for a 24 V back EMF limit. Both horizontal (time) and vertical (voltage) deflection traces shall be of a calibrated grid spacing (that is, cm or mm).

b. The source, E, shall be a low impedance source capable of delivering the rated coil voltage with no limiting resistor or potentiometer used to regulate the line voltage. (Having low source impedance representing a typical application is more important than having the exact rated voltage.)

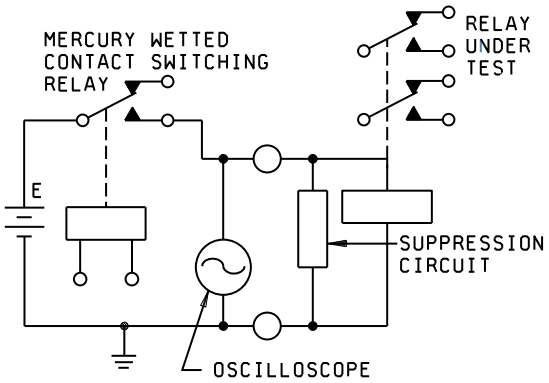
c. The switching relay shall be closed for a minimum of ten times the operate time of the test relay, or switching relay whichever is longer, to allow the oscilloscope and circuit network to stabilize and then opened to obtain the induced voltage deflection trace. Relay shall be cycled at 10 Hz ±2 Hz with approximately equal open and closed times.

(1) The reading shall be observed on the oscilloscope or other equivalent electronic test instrumentation. The magnitude of the induced voltage transient shall be noted. A typical trace is presented on figure 9.

(2) The maximum value of three consecutive readings shall be noted.

(3) Unless otherwise specified, the temperature at the time of the testing shall be +25°C ±5°C.

d. For group A testing, only one measurement and other suitable tests methods may be used to verify that the back EMF (coil kick) is within the specified limit.



NOTE: Voltage greater than the maximum specified may damage the coil suppression device.

FIGURE 8. Coil transient suppression test circuit.

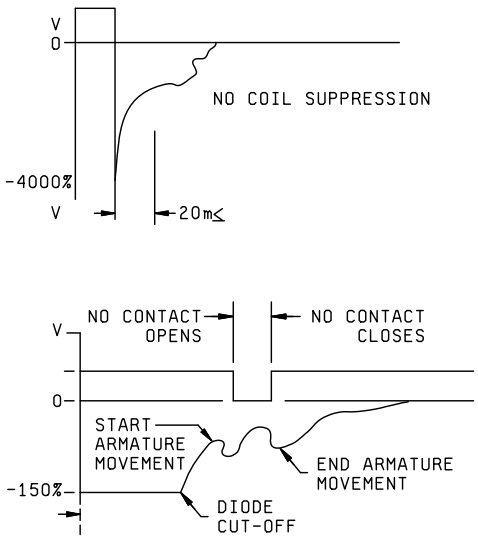


FIGURE 9. Typical transient voltage.

4.8.7.8 Neutral screen (applicable to latching relays only) (see 3.12.8). Relays shall be tested as follows:

a. Apply rated coil voltage to both coils simultaneously for a period of 10 ms minimum. After voltage is removed, determine if the relay contacts are in neutral position.

b. If the relay contacts will not maintain a neutral position, repeat step 4.8.7.7a twice. A relay which will not assume a neutral position for these three successive cycles is considered an acceptable part and does not require further testing. Relays which remain in a neutral position shall be tested as follows:

(1) Apply a 10 ms ±1 ms pulse of the maximum allowable (at +25°C) latch voltage to the latch coil. Verify that the relay has latched. Failure to latch shall be cause for rejection.

(2) Repeat step 4.8.7.7a above.

(3) Apply a 10 ms ±1 ms pulse of the maximum allowable (at +25°C) reset voltage to the reset coil. Verify that the relay has reset. Failure to reset shall be cause for rejection.

4.8.8 Thermal shock (see 3.13). Relays shall be tested in accordance with MIL-STD-202-107. The following details and exceptions shall apply:

a. Special mounting: Relays shall be suspended in the test chamber by twine, or other nonheat conducting material. Test leads may be used for mounting; however, they shall not provide a heat sink.

b. Test condition: Test condition B, except exposure time at temperature extreme during the fifth cycle shall be for 2 hours each.

c. Measurements at each temperature extreme during steps 1 and 3 of this fifth cycle at the end of each temperature exposure, and with the relays still in the conditioning chamber, the specified pickup and dropout values (voltages) and operate and release time, shall be measured as specified in 4.8.7.3 and 4.8.7.4, respectively. Specified pickup and dropout values (voltages) shall be measured in only one plane.

d. Examination after test: Relays shall be visually examined for cracking, peeling, and flaking of the finish, and the dielectric withstanding voltage and insulation resistance shall then be measured as specified in 4.8.5.1 and 4.8.6.

4.8.9 Shock (specified pulse) (see 3.14). Unless otherwise specified (see 3.1), relays shall be tested in accordance with MIL-STD-202-213. The following details and exceptions shall apply:

a. Mounting method: For relays having flanges or studs, mounting shall be by the flanges or studs; and for relays without flanges, mounting shall be by plugging into sockets, or other suitable means approved by the qualifying activity.

b. Test condition: Test condition A, B, or C, as applicable (see 3.1).

c. Electrical load conditions: In each direction of shock, the coil shall be de-energized during two shocks and energized with rated voltage during one shock.

d. For latching relays: In each direction there shall be two pulses in the latch position and two pulses in the reset position, with no coil voltage being applied during these pulses.

e. Measurements during shock: Contacts shall be monitored with an adequate test circuit as approved by the qualifying activity. The test circuit shall verify that no opening of closed contacts in excess of 10 μs and no false closure or bridging of open contacts occurs in excess of 1 μs. The contact load shall be 10 mA maximum at 6 V dc maximum (dc or peak ac).

f. Examination after test: Relays shall be examined for evidence of structural failure or other damage which might impair the operation of the relay.

4.8.10 Vibration (see 3.15).

4.8.10.1 Vibration (sinusoidal). Unless otherwise specified (see 3.1), relays shall be tested in accordance with MIL-STD-202-204. The following details and exceptions shall apply:

a. Mounting method: As specified in 4.8.9a.

b. Electrical load conditions: For qualification and group C inspections, relays shall be tested with the coil energized for 2 hours at rated voltage and with the coil de-energized for 2 hours, in each of the three mutually perpendicular (x, y, and z) axes (for latching relays, relays shall be tested with the coils de-energized; 2 hours with the latch coil last energized and 2 hours with the reset coil last energized in each of the 3 mutually perpendicular relay axes).

c. Test condition: Test condition D, except vibration level is the lesser of .195 inch (4.95 mm) double amplitude or 30 G, and unless otherwise specified (see 3.1), frequency range is 10 Hz to 3,000 Hz.

d. Tests during vibration: As specified in 4.8.9e.

e. Examination after test: Prior to removal from test fixture and without disturbing the relay, apply maximum over the temperature range pickup voltage value (see 3.1) to the coil and verify that relay contacts transfer. Remove coil voltage and verify that relay contacts transfer. Failure of relay contacts to transfer shall be cause for rejection. After removal from test fixture, the relays shall then be inspected for evidence of structural failure or other damage which might impair the operation of the relay.

f. Unless otherwise specified (see 3.1), for group A testing, only one cycle shall be performed over the frequency range of 100 Hz to 3,000 Hz. The relay shall be vibrated in the direction of contact motion. At the option of the manufacturer, the relay production lot may be divided in three equal groups and each group shall be tested in one of three mutually perpendicular axes (x, y, and z). When relays are tested as specified in the optional procedure, a failure of any relay in any axis shall require 100 percent inspection of all relays in the production lot in each axis. The cycle shall consist of 3 minutes up with the coil energized with rated voltage and 3 minutes down with coil de-energized. Latching relays shall remain in each latched position with no voltage applied to the coils 3 minutes in the latch position and 3 minutes in the reset position.

4.8.10.2 Vibration (random). Unless otherwise specified, relays shall be tested in accordance with MIL-STD-202-214. The following details and exceptions shall apply:

a. Mounting method: As specified in 4.8.9a.

b. Electrical load conditions: Relays shall be tested with the coil energized at rated voltage for 7.5 minutes and with the coil de-energized for 7.5 minutes, in each of three mutually perpendicular (x, y, and z) axes. Latching relays shall be tested with the coils de-energized; 7.5 minutes with the latch coil last energized and 7.5 minutes with the reset coil last energized. When applicable to group A inspection, the test time shall be 3 minutes for each state described above.

c. Test condition: Unless otherwise specified (see 3.1), test condition IG (0.4 G^2/Hz, 23.1 rms G).

d. Tests during vibration: As specified in 4.8.9e.

e. Examination after test: As specified in 4.8.10.1e.

4.8.11 Acceleration (unless otherwise specified, see 3.1 and 3.16). Relays shall be tested in accordance with MIL-STD-202-212. The following detail and exceptions shall apply:

a. Mounting method: As specified in 4.8.9a.

b. Test conditions: Unless otherwise specified (see 3.1), test condition A, 30 G's. (Acceleration shall be applied in each direction along three mutually perpendicular axes of the specimen. One axis shall be in the direction most likely to cause malfunction.) In each direction, the coil shall be de-energized for 5 minutes, rated coil voltage shall be momentarily applied; and the voltage shall be reduced to the maximum ambient pickup voltage as specified (see 3.1) for 5 minutes. Latching relays shall remain in each latched position with no voltage applied to the coils. Contacts shall be monitored for proper position.

c. Examination after test: As specified in 4.8.9f.

4.8.12 Terminal strength (see 3.17). Relays shall be tested in accordance with MIL-STD-202-211 in accordance with the following, as specified in 3.1. Unless otherwise specified herein, two terminals of each discrete design, size, and configuration shall be tested; however, if there is only one of such design, size, and configuration, it shall be tested.

4.8.12.1 Pull test (all terminal types). Terminals shall be tested as specified in test condition A, the force shall be as specified (see 3.1).

4.8.12.2 Bend test (all terminal types). Each terminal shall be bent 20 degrees to 30 degrees in both directions from the normal axis in a given plane and after returning it to normal, the terminal shall be bent 20 degrees to 30 degrees in both directions perpendicular to the previous plane. The terminals shall be returned to their normal positions. Following the bend test, the applicable pull force specified in table IX shall be applied to each terminal for a period of 15 seconds to 30 seconds.

TABLE IX. Pull force.

Terminal diameter		Pull force (pounds)
(inches)	(mm)	
.035 - .047	(0.89 - 1.19)	5 ±0.5
.023 - .0349	(0.58 - .886)	3 ±0.3
Less than .023	(0.58)	2 ±0.2

4.8.13 Coil life (unless otherwise specified, see 3.1) (see 3.19). Relays shall be tested for 1,000 hours as follows (see figure 10).

a. Relays may be mounted as specified in 4.3.5. Each contact terminal shall be connected as specified in 4.8.7.3.1.a.

b. During the maximum temperature portion of the test, rated coil voltage (see 3.1) shall be applied continuously and at least half of the normally open contacts shall carry rated current. During room temperature and minimum temperature exposures, the coil circuit shall be de-energized and contacts shall not be loaded. Ambient temperatures shall be varied as shown on figure 10, with heating and cooling rates not to exceed +1°C per second average. The portion of the cycle run at minimum temperature shall be approximately 10 percent of the test cycle time.

c. After the first 100 hours, and while still at the low temperature extreme, contact resistance (or voltage drop) shall be measured as specified in 4.8.7.2 and the values shall be recorded. Measurements of coil current as specified, and contact resistance as specified in 4.8.7.1 and 4.8.7.2, shall be taken at room temperature initially, then again after 250 ±25, 500 ±25, and 750 ±25 hours and the values shall be recorded. Pickup, hold, dropout, turn-on voltage or current, and turn-off voltage measurements shall be made as specified in 4.8.7.3, respectively during the last temperature cycle after allowing the relay to stabilize, deenergized at each of the temperature extremes, and the values shall be recorded.

d. After the relay(s) have been subjected to the coil life temperature cycles, measurements shall then be taken at room temperature of dielectric withstanding voltage, insulation resistance, contact resistance (or contact voltage drop), coil current, turn-on and turn-off time, and contact bounce as specified in 4.8.5, 4.8.7.1, 4.8.7.2, and 4.8.7.6, respectively. Relays shall then be examined for evidence of damage.

e. Following the test, the coil current or coil resistance, as applicable, shall be measured in accordance as specified (see 3.1).

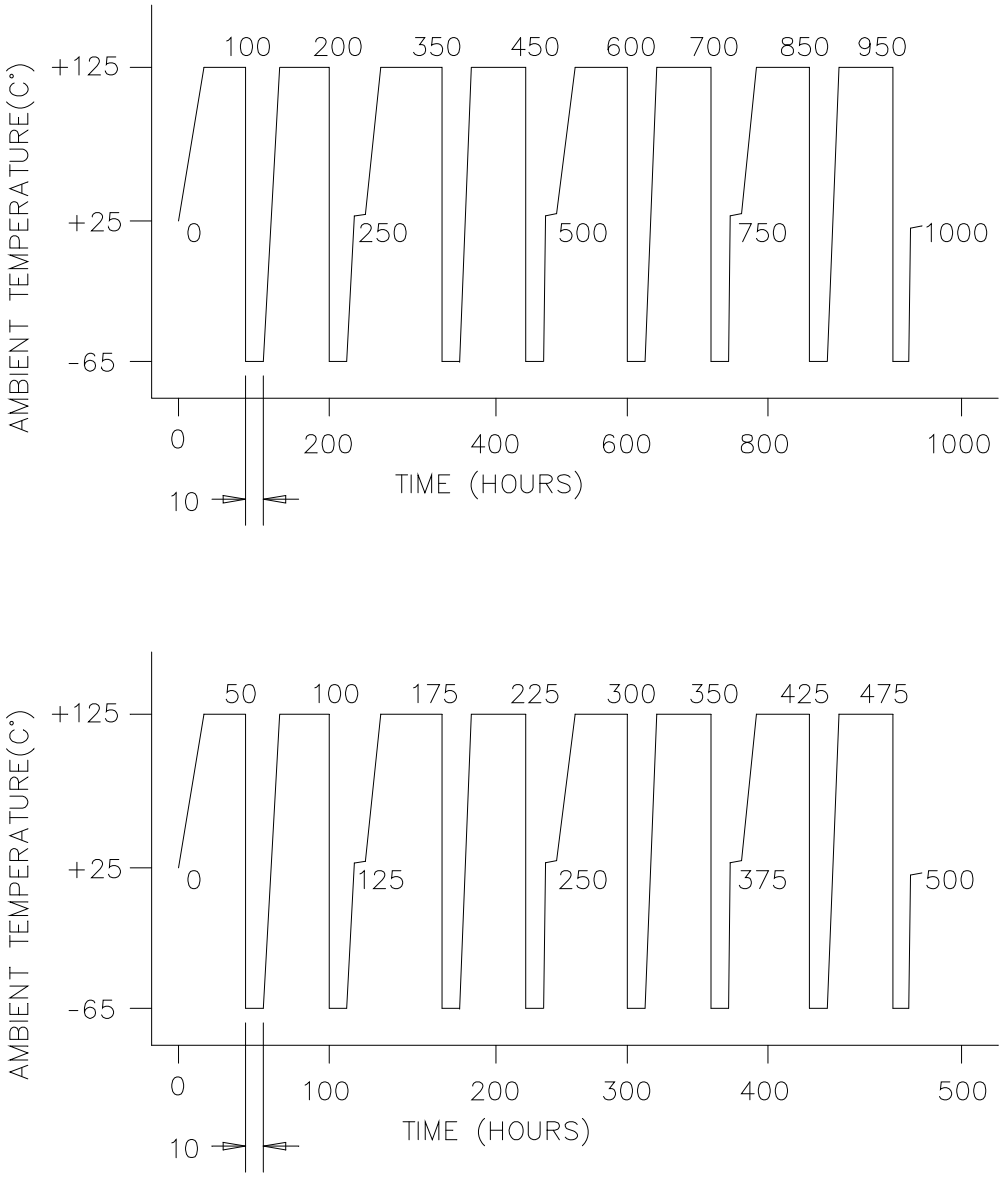


Figure 10. Coil life ambient temperatures.

4.8.13.1 Coil endurance (see 3.19.1). Relays shall be tested for 114 hours minimum as follows:

a. The coil current shall be tested prior to testing and shall be as specified (see 3.1).

b. Relays may be mounted as specified in 4.3.5. Each contact terminal shall be connected as specified in 4.8.7.1.

c. The test chamber shall be controlled to maintain the maximum specified ambient temperature (see 3.1).

d. Apply the maximum coil voltage (see 3.1) at a cycling rate of 4 ±.4 seconds on and 2 ±.2 seconds off for 114 hours minimum.

e. Following the test, the coil resistance shall be measured and shall be as specified (see 3.1).

4.8.14 Resistance to soldering heat (see 3.18). Relays shall be tested in accordance with MIL-STD-202-210. The following details and exceptions shall apply:

a. Depth of immersion in molten solder: Within .060 inch ±.020 inch (1.52 mm ±0.051 mm) of the relay base.

b. Test condition: B.

c. Measurements after test: Insulation resistance, coil resistance (maximum coil current when specified, see 3.1), contact resistance, and specified pickup or latch/reset, hold, and dropout values (voltages), shall be measured as specified in 4.8.6, 4.8.7.1, 4.8.7.3.1, and 4.8.7.4, respectively.

d. Examination after test: As specified in 4.8.9f.

4.8.15 Salt spray (see 3.20). Relays shall be tested in accordance with MIL-STD-202-101. The following details and exceptions shall apply:

a. Applicable salt solution: 5 percent.

b. Test condition: B.

c. Examination after test: Relays shall be examined for evidence of peeling, chipping, blistering, of the finish, and exposure of base metal due to corrosion that can adversely affect the operation or performance of the relay.

4.8.16 Overload (applicable to high level relays only) (see 3.21). The contacts of the relay shall be caused to make and break the overload values and durations as shown in table X for 50 operations at each of the maximum system voltage (open circuit) ratings. An individual relay shall be used for each load condition specified. For double throw relays, separate tests shall be performed for the normally open and for the normally closed contacts. Each relay case shall be connected to system ground through a single normal-blow fuse rated at the greater of 100 mA or 5 percent of load current. The equipment shall be capable of monitoring 40 percent minimum of the actual opened and closed time of each contact. The monitoring equipment shall automatically hold the relay under test in the state in which the failure occurs (energized or de-energized) and, unless otherwise specified, the contact voltage shall be removed. Unless otherwise specified, all contacts in each sample unit shall switch identical loads. Following cycling, the electrical continuity of each case-grounding fuse shall be checked. When 115/200 V ac 3-phase on relays with three or more poles, only three adjacent poles need to be tested.

TABLE X. Overload values and durations

Relay rating	Percent rated resistive load			Duty cycle (seconds)	
Amperes	28 V dc	115 V ac	115/200 V ac three-phase	On ±0.05	Off ±1
0 – 24 25 and up	400 800	400 800	600 800	0.2 0.2	20 20

4.8.17 Rupture (see 3.22). The relay shall be made to make and break its rated rupture resistive current each of the maximum voltage (open circuit) ratings, for a minimum of 50 cycles using the values of current and cycling time in table XI. An individual relay shall be used for each load condition specified. For double throw relays, separate tests shall be performed for the normally closed and normally open contacts. For those relays with both ac and dc ratings, ac and dc rupture tests shall be performed on separate samples at highest rated voltage (open circuit), as specified (see 3.1). Each relay case shall be connected to system ground through a single normal-blow fuse rated at the greater of 100 mA or 5 percent of load current. The equipment shall be capable of monitoring 40 percent minimum of the actual opened and closed time of each contact. The monitoring equipment shall automatically hold the relay under test in the state in which the failure occurs (energized or de-energized) and, unless otherwise specified, the contact voltage shall be removed. Unless otherwise specified, all contacts in each sample unit shall switch identical loads. Following cycling, the electrical continuity of each case-grounding fuse shall be checked. When 115/200 V ac 3-phase on relays with three or more poles, only three adjacent poles need to be tested.

TABLE XI. Rupture values and durations.

Relay resistive rating	Percent rated resistive load			Duty cycle (seconds)	
Amperes	28 V dc	115 V ac	115/200 V ac three-phase	On ±.05	Off ±1
25 and under	500	500	800	0.2	30

4.8.18 Time current relay characteristics (see 3.23). Each relay tested shall sustain five applications (make and carry only) of power concurrently on adjacent poles at each of the current levels and for the associated time duration as specified (see 3.1). An individual relay shall be used for each load condition specified. All contacts in each sample shall switch identical loads. Following cycling, the electrical continuity of each case-grounding fuse shall be checked. When 115/200 V ac 3-phase on relays with three or more poles, only three adjacent poles need to be tested. Relays shall be tested at 28 V dc and 115/200 V ac, 400 Hz, 3-phase. The load shall be resistive. Each relay case shall be connected to system ground through a single normal-blow fuse rated at the greater of 100 mA or 5 percent of load current. The cooling time between successive application of current shall be 30 minutes. Tests shall be performed at room ambient conditions and both the normally open and normally closed contacts shall be tested.

4.8.19 Life (see 3.24). Unless otherwise specified (see 3.1), relays shall be cycled for 100,000 cycles with contacts loaded in accordance with 4.8.19.1 through 4.8.19.6 inclusive, as applicable, and with a duty cycle in accordance with table XII. An individual relay shall be used for each load condition specified. At the option of the manufacturer, double throw relays may have the normally open and normally closed contacts tested separately. If the normally open and normally closed contacts are tested separately, an additional sample shall be provided for this option and both samples shall be required to meet all other tests in the test sequence. Relay coil energization shall be asynchronous with the power supply for ac loads. Each relay case shall be connected to system ground through a single normal-blow fuse rated at the greater of 100 mA or 5 percent of load current. The ambient temperature of the interior of the test chamber shall be +125°C minimum. The contact resistance or voltage drop, as applicable, shall be monitored during 40 percent minimum of each "on" and each "off" period. The monitoring equipment shall automatically hold the relay under test in the state in which the failure occurs (energized or de-energized) and, unless otherwise specified, the contact voltage shall be removed. Unless otherwise specified, all contacts in each sample unit shall switch identical loads. Following cycling, the electrical continuity of each case-grounding fuse shall be checked. When 115/200 V ac 3-phase on relays with three or more poles, only three adjacent poles need to be tested. When 115/200 V ac 3-phase rating is specified in an individual specification sheet along with 115 V ac 1 phase, testing of the 1 phase load is not required. High level life testing may be performed on separate samples for the normally open and normally closed contacts.

TABLE XII. Duty cycle (seconds).

Inductive (ac or dc)		Motor (ac or dc)		Resistive (ac or dc)		Lamp (28 V dc)	
On	Off 1/	On	Off 1/	On	Off 1/	On	Off
0.5 ±0.05	3 ±0.1	0.35 ±0.09 2/	2 ±0.1	1.5 ±1.0	1.5 ±1.0	2 ±0.05	7 ±2.0

1/ "Off" time may be decreased at the option of the manufacturer.
2/ Duration of the specified inrush current shall be 0.07 second ±0.02 second, after which it shall be reduced to its rated motor load for the remainder of the "On" period.

4.8.19.1 Resistive load. Cycling rate shall be 20 cycles ±2 cycles per minute. Suitable resistors shall be used. Current shall be rated resistive current as specified (see 3.1).

4.8.19.2 Motor load.

4.8.19.2.1 Motor load, dc. The relay shall be subjected to the minimum operating cycles for making six times the rated motor load at rated system voltage; carrying and breaking the rated motor load.

4.8.19.2.2 Motor load, ac. The ac motor load test shall be as specified in 4.8.19.2.1, except that the value of the ac inrush current shall be five times rated motor load current, or as specified (see 3.1).

4.8.19.3 Inductive load. Current shall be rated current. Appropriate inductive load components as approved by the qualifying activity shall be used (see 6.11). A suitable resistor may be placed in the circuit to obtain rated steady-state current flow.

4.8.19.3.1 Inductive load, dc. Unless otherwise specified (see 3.1), dc inductive loads shall be computed in accordance with the following procedures:

a. The inductor shall be mounted in its normal operating position on a nonmagnetic plate with no immediately adjacent metal.

b. The load circuit shall be energized through a bounce free contact from a power supply regulated to within 5 percent of the specific rated voltage as shown on figure 11.

c. By measuring the time for the current to reach 63 percent of its final value, the dc inductance is calculated as:

L = Rt where:

L is the inductance in henries,
R is the coil resistance in ohms, and
t is the time in seconds for current to reach 63 percent of its final value.

4.8.19.3.2 Inductive load, ac. The load shall consist of inductive and resistive elements with 0.7 ±0.05 lagging power factor at the voltage and frequency specified (see 3.1).

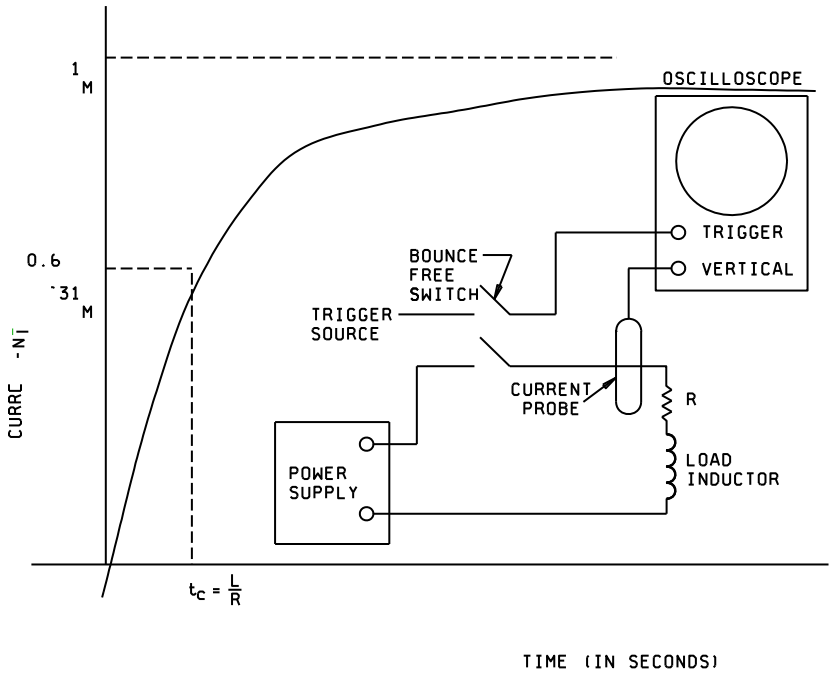


FIGURE 11. DC inductive load (inductive current rise time curve).

4.8.19.4 Lamp load. Either lamps or simulated loads may be used to provide the load as follows:

a. Simulated loads shall subject the relays to making 12 times the rated lamp load and breaking the rated lamp load. The duration of the 12 times inrush shall be 15 ms to 20 ms. The total "On" time shall be 5 seconds ±0.05 second and the "Off" time shall be 5 seconds ±0.05 second.

b. Lamps shall be screened to verify a minimum initial cold inrush of 12 times the rated lamp load. Only lamps meeting this requirement shall be used to provide load to the relays. The total "On" time shall be 2 seconds ±0.05 second and the "Off" time shall be 7 seconds ±2 second.

4.8.19.5 Low level load. The minimum cycle time shall be 10 times the sum of the maximum specified (see 3.1) operate and release times for the relay under test. For latching relays, the minimum cycle time shall be 10 (2 times operate time). Each contact load shall be 10 µA to 50 µA at 10 mV to 50 mV (dc or peak ac). The coil shall be energized at rated voltage during 50 percent ±10 percent of each operation. EXAMPLE: 10 x 8 ms = 80 ms which would be a maximum of 12.5 cycles (one opening and one closure of a set of contacts) per second.

4.8.19.6 Mixed loads. The relay shall be subjected to 50,000 cycles as follows. Normally open and normally closed contacts shall be tested. Tests on normally open and normally closed contacts shall be performed concurrently. The test voltage shall be 28 V dc ±1 V dc. During each cycle, the relay coil shall be energized for 29 seconds ±3 seconds and de-energized for 1.5 seconds ±0.5 second. During each cycle, the contacts to be tested shall make, carry, and interrupt the test current specified in the applicable paragraph below. While the contacts are carrying the test current, contact voltage drop measurements shall be made at the start of the test and shall not exceed the values shown in table XIII. Tests on main and auxiliary contacts shall be performed concurrently. The test shall be performed at the maximum ambient temperature specified (see 3.1). The test shall be performed at sea level. The inductor shall be calibrated as specified in 4.8.19.3. For two pole relays, use two samples, one for the rated resistive and the 0.5 ampere resistive loads, the second for the 0.3 ampere inductive load. The cycles and failures from both samples shall be included in the calculation of failure rates. (If both samples fail, it counts as two failures.) For three pole relays, only one pole shall be subjected to the rated resistive load. If the relay has more than four poles, the loads shall be repeated in the sequence listed as follows:

Pole number	Loads
1	Rated resistive load
2	0.5 ampere resistive load
3	0.3 ampere inductive load
4	Rated resistive load

One pole of the relays shall be tested with rated load on one normally open and one normally closed contact. The test shall be performed at the maximum ambient temperature specified (see 3.1). Both normally open and normally closed contacts shall make and break the above specified loads with no failure throughout the test.

TABLE XIII. Allowable contact voltage drop for mixed loads test.

Contact ratings amperes rated resistive load	Initial millivolt drop (max)	Initial allowable resistance calculated (ohm)	Allowable millivolt drop after tests begins (max.)		
			Amperes 0.5 (resistive)	Amperes 0.3 (inductive)	Rated resistive load
2 (auxiliary contacts)	100	0.050	56	34	125
5	100	0.020	38	23	125
10	100	0.010	31	19	125
25	100	0.004	28	17	125

4.8.20 Intermediate current (see 3.25). Intermediate current shall not be considered a low level or high level contact load rating (see 6.1.1). Intermediate current life cycles shall not be used for FR determination or maintenance. Relays shall be tested as specified in MIL-STD-202-312. The following details and exceptions shall apply:

a. Maximum contact resistance: As specified in 3.25.

b. Coil energizing voltage: Rated voltage (see 3.1).

c. Cycling rate: 10 cycles ±2 cycles per minute with minimum of 75 percent coil "ON" time. For latching relays, the relay shall be in each position for approximately one-half the cycle time. Each coil shall be energized for a minimum of 75 percent of each operation.

d. Contact current/voltage: 100 mA at 28 V dc.

e. Monitoring: At least 40 percent of the closed time of each contact during each cycle shall be monitored for contact resistance.

f. Number of cycles: 50,000 cycles.

g. Ambient temperature: +125°C minimum.

4.8.21 Mechanical life (see 3.26). Relays shall be cycled 400,000 cycles at room ambient temperature. The cycling rate shall be as specified in 4.8.19.5. Each contact load shall be 10 µA to 50 µA at 10 mV to 50 mV (dc or peak ac). The coil shall be energized at rated voltage during 50 percent ±10 percent of each cycle. Mechanical life cycles shall not be used for FR determination or maintenance.

4.8.22 Resistance to solvents (see 3.27). Relays shall be tested in accordance with MIL-STD-202-215 except temperature of solvent solutions a (Solvent 1), b (Solvent 2), and c (Solvent 3) shall be maintained at +63°C to +70°C. The following details and exceptions shall apply:

a. Portion to be brushed: All marking.

b. Optional procedure for solvent d is not applicable.

c. Specimens to be tested: One sample shall be tested with each solvent solution. For qualification inspection, samples in excess of the available number of solvents shall be exempt from test. For group C testing, two additional samples shall be selected. The additional samples may be electrical rejects from group A2.

d. Examination after test: Specimens shall be examined for legibility of marking.

4.8.23 Continuous current (see 3.28). This test shall be performed at the maximum temperature and altitude specified. Other conditions of the test shall be in accordance with 4.8.19. During the first 3 hours of this test, the relay coil shall not be energized. Normally closed contacts shall be loaded with the highest rated resistive load. At the end of the 3 hour period with no change in the ambient conditions, the pickup voltage of the relays shall be determined and shall be within the limit specified. During the next portion of the test, the relay shall be energized continuously for 97 hours. The coil voltage shall be the maximum specified. Contacts that are in the closed position when the relay coil is energized shall carry the rated resistive current at any convenient voltage. Immediately following the operating period and with the relay still at the specified temperature, the relay shall be tested to determine that the energized function is completed when pickup voltage is applied. The relay shall sustain no visible damage such as loosening of terminals or loss of seal. Terminal temperature rise shall be monitored throughout the test and shall not exceed +75°C.

4.8.24 Internal moisture (see 3.29). The relays shall be energized at rated coil voltage or current and stabilized at the maximum rated temperature specified (see 3.1). The relays shall then be held for 1 hour minimum with the coils energized at rated voltage or current for nonlatching relays; for latching relays, one coil shall be energized for 30 minutes minimum, then the other coil shall be energized for 30 minutes minimum. After 1 hour minimum, the coil voltage or current shall be increased to 140 percent of rated coil voltage or current for 2 minutes minimum for nonlatching relays and 2 minutes minimum for each coil of latching relays. After 2 minutes, the coil voltage or current shall be removed and the relays immediately transferred to a thermal chamber stabilized (prior to opening of the chamber) at the minimum rated temperature specified (see 3.1). The transfer between chambers shall be accomplished in 5 minutes maximum. Immediately energize the coils with rated voltage or current and maintain the relays at the minimum rated temperature after the chamber has restabilized for a period of 1 hour minimum for nonlatching relays; for latching relays, one coil shall be energized for 30 minutes minimum, then the other coil shall be energized for 30 minutes minimum. After 1 hour minimum, remove the coil voltage or current (for non-latching relays), or remove the coil voltage or current and reapply to opposite coil (for latching relays), and within 5 seconds of contact closure measure the contact resistance. The contact load shall be 10 mA to 50 mA at 10 mV dc to 50 mV dc. The contact resistance across the closed contacts shall not exceed 100 milliohms. If a relay indicates a failure, and icing of the test socket is suspected to be the cause of failure indication, one complete retest is permitted with the relay mounted in a different socket.

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 which may be helpful, but is not mandatory.)

6.1 Intended use. Relays conforming to this specification are intended for use in electronic and communication equipment. Their principal areas of application are for aircraft, missiles, spacecraft, and ground-support electronic and communication equipment. This does not preclude the use of these relays in other military applications.

CAUTION: The use of any coil voltage less than the rated coil voltage will compromise the operation of the relay.

CAUTION: An external single diode parallel to the relay coil may affect the characteristic of the relay, and reduce the required life significantly.

CAUTION: Transfer relay contacts should not be used to ground load in one position and to 115 volt terminal in other position. Transfer relay contacts should not be used to transfer load between phases, nor between unsynchronized ac sources.

CAUTION: When latching relays are installed in equipment, the latch and reset coils should not be pulsed simultaneously. Coils should not be pulsed with less than the nominal coil voltage and the pulse width should be a minimum of three times the specified operate time of the relay. If these conditions are not followed, it is possible for the relay to be in the magnetically neutral position.

CAUTION: High in-rush currents caused by capacitive, inductive, motor, and lamp loads, can erode or weld contacts reducing life leading to premature relay failure.

CAUTION: Failure rate level is determined under the life tests as specified in this specification. The failure rate may not be applicable under your application's load or environmental conditions.

CAUTION: Misapplication is one of the major causes of relay failures, users are cautioned against using a relay in an application for which it is not rated. Users are advised to contact the qualifying activity for assistance with application problems. A helpful reference is the Engineers' Relay Handbook available from the National Association of Relay Manufacturers. Copies of this document is available from http://www.arcat.com.)

6.1.1 Contact rating. The contact ratings of relays covered by this specification are based on load life tests which establish the relay capability to switch rated loads. For the purposes of this specification, contact load ratings are defined as follows:

a. Low level: 10 µA at 50 mV to 10 mA at 6 V.

b. Intermediate: 10 mA at 6 V to 100 mA at 28 V.

c. High level: Above 100 mA at 28 V.

6.1.2 FR level. FR level (percent per 10,000 cycles) as specified in table I, is based on an average of 10 cycles per hour, per application, for 1,000 hours in accordance with MIL-STD-690.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification, the applicable associated specification, and the complete PIN (see 1.2).

b. Issue of ASSIST to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

c. Packaging (see 5.1).

d. If special or additional identification marking is required (see 3.30).

e. Marking requirements for FR level (see MIL-STD-690).

f. If the terminals are to be solder dipped (re-tinned).

6.3 Qualification. With respect to relays requiring qualification, awards will be made only for relays which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 83536 whether or not such relays 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 relays 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 relays covered by this specification. Information pertaining to qualification of relays may be obtained from (Relay Team, P.O. Box 3990, Columbus, OH 43218-3990, vqp.ch@dla.mil). An online listing of relay so qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.3.1 Provisions Governing Qualification SD-6. Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to the Standardization Documents Order Desk, Building 4D, 700 Robbins, Philadelphia, PA 19111-5094.

6.3.2 Qualification and maintenance by similarity. This information is for reference only. Refer to the individual specification sheets for detailed information.

6.3.2.1 Qualification by similarity. The graphic guide shown illustrates the relative complexity of individual specification sheets within a style group for use in determining qualification inspection (reduced testing) candidate specification sheets. Arrow direction indicates flow towards less complex designs. Asterisk indicates most complex design of style group.

* /2	→	/1	* /19	→	/18
* /4	→	/3	* /22	→	/21
* /6	→	/5	* /24	→	/23
* /8	→	/7	* /26	→	/25
* /10	→	/9	* /33	→	/32
* /13	→	/12	* /35	→	/34
* /16	→	/15			

6.3.2.2 Maintenance by similarity. The data accumulated for the style groups listed below may be combined for group B and group C inspections maintenance and extension of FR levels in accordance with MIL-STD-690. Testing samples must be representative of production. Maintenance plan is contingent upon qualifying activity approval. Failures exceeding the sampling plan selected (C = number), regardless of the specific specification sheet affected, affect all other specification sheets within the respective style group.

a. DPDT, low level to 5 amperes: /1, /2.

b. DPDT, low level to 5 amperes, magnetic latch: /3, /4.

c. 4PDT, low level to 5 amperes: /5, /6.

d. 4PDT, low level to 5 amperes, magnetic latch: /7, /8.

e. DPDT, low level to 10 amperes: /9, /10.

f. DPDT, low level to 10 amperes, magnetic latch: /12, /13.

g. 4PDT, low level to 10 amperes: /15, /16.

h. 4PDT, low level to 10 amperes, magnetic latch: /18, /19.

i. 3PDT, low level to 10 amperes: /21, /22.

j. 3PDT, low level to 10 amperes, magnetic latch: /23, /24.

k. 6PDT, low level to 10 amperes: /25, /26.

l. 3PDT, 25 amperes, permanent magnet drive: /32, /33

m. 1PDT, low level to 10 amperes, permanent magnet drive: /34, /35

6.4 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a material quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: https://www.shelflife.dla.mil/.

6.5 Sealing. The following procedure is suggested as a guide; however, every effort should be made to utilize the most effective procedure consistent with the state of the art.

a. Evacuate to less than 200 microns.

b. Heat to maximum rated ambient temperature with continued evacuation (see 3.1).

c. Maintain heat and vacuum for 12 hours or longer, continuing the treatment until a maximum pressure of 80 microns is reached.

d. Turn off heaters and maintain pressure for 4 hours.

e. Close evacuation valve and fill chamber with the desired pressurizing gas.

f. Seal relay before removing from chamber.

6.6 Intermetallic contact. The finishing of metallic areas to be placed in intimate contact by assembly presents a special problem, since intermetallic contact of dissimilar metals results in electrolytic couples which promote corrosion through galvanic action. To provide the required corrosion protection, intermetallic couples are restricted to those specified in MIL-STD-889.

6.6.1 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).

6.7 Magnetic orientation. Magnetic orientation of a relay may be determined by energizing the coil with a known polarity and checking for attraction or repulsion of a permanent magnet to an external surface of the relay.

6.8 Fixturing losses. It is known that there is inherent resistance in sockets and wiring. The qualifying activity will evaluate the manufacturer's system to determine conformance to specification requirements.

6.9 DC coil resistance. In the event that measurement is impractical, the relay may be stabilized at any other ambient temperature for 2 hours, the resistance measured and the resistance recalculated using the temperature coefficient of resistance formula for copper magnet wire.

$$R_{23} = \frac{R_T}{1 + K\,(T-23)}$$

where: R_T = Resistance at the new ambient temperature.
R_{23} = Resistance at +23°C.
K = Temperature coefficient (0.00393 for copper 23°C).
T = New ambient temperature in degrees C.

6.10 Inductors. Inductors meeting the requirements of MIL-I-81023, “Inductor, 28 V.D.C. Laboratory Test General Specification for” have been considered acceptable.

6.11 Glossary. The definitions listed below are not a complete glossary of relay terminology, but rather are intended as definitions of the technical terms as applied within this specification.

Adjunct sealant: Any hydrocarbon or silicon material used on the exterior of the unit to improve the hermetically of a hermetically sealed relay.

Bounce time: The interval between first make of the contact until the uncontrolled making and breaking of the contact ceases.

Chatter, contact: The undesired opening of mating contacts resulting from uncompensated ac operation, or from external shock and vibration.

Coil: One or more windings on a common form.

Coil voltage, rated: The coil voltage at which the relay is to operate and meet all specified electrical, mechanical and environmental requirements.
Contacts: The current carrying parts of a relay that open or close electrical circuits.

Contact arrangement: The combination of contact forms that make up the entire relay switching structure.

Contact bounce: Intermittent opening of contacts after initial closure due to contact impact. Represented by the time interval from initial closure of a contact to the end of bounce during pickup and dropout.

Contact force: The force exerted by a movable contact against a mating contact when the contacts are closed.

Contact gap: The distance between a pair of mating relay contacts when the contacts are open.

Contact weld: A contact failure due to fusing of closed contacts, resulting in their failure to open.

Cycle, relay: A relay cycle is defined as when a relay picks up and drops out, (one opening and one closure of a set of contacts). Therefore, a cycle consists of two operations.

Degassing: A process of thermally cleaning a relay (at elevated temperatures) to drive off harmful gasses. Degassing is usually performed using vacuum pumps.

Dropout value (voltage), specified (not applicable to latching relays): As the current or voltage on an operated relay is decreased, the value at or above which all relay contacts must restore to their unoperated positions.

Hermetically sealed relay: A relay contained within an enclosure that is sealed by fusion to insure a low rate of gas leakage. This usually refers to metal-to-metal, or metal-to-glass sealing.

Hold value (voltage), specified (not applicable to latching relays): As the current or voltage on an operated relay is decreased, the value which must be exceeded before any contact change occurs.

Latching relay: A two position relay whose contacts transfer only as a result of coil energization (depending on design) (of either a particular polarity, or of a particular coil), remain in that position with no coil energization, and transfer to the alternate position only as a result of coil energization (of either the opposite polarity, or of the other coil, respectively).

Miss: Failure to establish the intended circuit conditions (high or low output resistance, as applicable).

Normally closed contacts: Those contacts that are closed with the relay de-energized.

Normally open contacts: Those contacts that are open with the relay de-energized.

Operate time: The interval between the application of a step function input signal and closing of all normally open contacts. Bounce time is not included.

Pickup value (voltage), specified: As the current or voltage on an unoperated relay is increased, the value (voltage) at or below which all contacts must function.

Polarized relay: A relay, the operation of which is primarily dependent upon the direction (polarity) of the energizing current(s) and the resultant magnetic flux. The opposite of neutral relay. Also called "polar relay".

Relay: Most simply defined as an electrically controlled device that opens and closes electrical contacts to effect the operation of other devices in the same or another electrical circuit.

Release time: The interval between the trailing edge of a step function input signal and closing of all normally closed contacts. Bounce time is not included. Not applicable to latching relays.

Shelf life: A period of time a relay can be stored unused before detrimental changes occur which would cause the item not to properly perform its function within the requirements of this specification.

Silicone: Any of a group of semi-inorganic polymers based on the structural unit R_2 Si0, where R is an organic group, characterized by wide range thermal stability, high lubricity, extreme water repellence, and physiochemical inertness, used in adhesives, lubricants, protective coatings, paints, electrical insulation, synthetic rubber, and prosthetic replacements for bodily parts.

Transfer time: The time interval between the opening of the closed contact and the closing of the open contact of a break-make-contact combination. For multipole relays, transfer time is defined as the interval between the opening of the last closed contact and the closing of the first open contact of any set.

6.12 Subject term (key word) listing.

AC coil
All welded
Coil transient suppression
Hermetically sealed
Low level contact rating
Magnetic latch

6.13 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 previous issue.

Custodians:
Army - CR
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