INCH-POUND

MIL-R-83536
22 June 1990

MILITARY SPECIFICATION

RELAYS, ELECTROMAGNETIC, ESTABLISHED RELIABILITY, 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 established reliability (ER) (see table I), electromagnetic, hermetically sealed relays for use in aircraft, missile, spacecraft, ship, and other primary vehicles or in ground support equipment. 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) detailing 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 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. Caution: The use of any coil voltage (see 6.8) less than the rated coil voltage will compromise the operation of the relay. For additional application and caution information, see 6.1.

1.2 Part or Identifying Number (PIN). Part or Identifying Number (PIN) is a new term encompassing previous terms used in specifications such as part number, type designator, and identification number. The PIN shall consist of the letter "M", the basic number of the specification sheet, an assigned dash number (see 3.1), and a suffix letter designating failure rate level (see table I) as shown in the following example:

M	83536/1	-001	M
Military designator	Specification sheet number	Dash number	Failure rate level

1.3 Failure rate (FR) level designation. The failure rate level designation is shown in table I (see 4.6).

TABLE I. Failure rate level designation.

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Electronic Support Division AFLC, 2750 ABW/ES, Gentile Air Force Station, Dayton, OH 45444-5400, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5945

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

J-W-1177	-	Wire, Magnet, Electrical.
QQ-N-290	-	Nickel Plating (Electro deposited).
QQ-S-571	-	Solder, Tin Alloy, Tin Lead Alloy and Lead Alloy.
QQ-S-781	-	Strapping, Steel, Flat and Seals.
ZZ-R-765	-	Rubber, Silicone: Low- and High-Temperature and Tear Resistant.
PPP-B-566	-	Boxes, Folding, Paperboard.
PPP-B-601	-	Boxes, Wood, Cleated-Plywood.
PPP-B-621	-	Boxes, Wood, Nailed and Lock-corner.
PPP-B-636	-	Boxes, Shipping, Fiberboard.
PPP-B-676	-	Boxes, Setup.

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MIL-I-10	-	Insulating Compound, Electrical, Ceramic, Class L.
MIL-M-14	-	Molding Plastics and Molded Plastic Parts, Thermosett
MIL-P-116	-	Preservation, Methods of.
MIL-P-997	-	Plastic Material, Laminated, Thermosetting, Electrical Insulation: Sheets, Glass Cloth Silicon Resin.
DOD-D-1000	-	Drawings, Engineering and Associated Lists.
MIL-S-12883	-	Socket and Accessories for Plug-in Electronic Components General Specification for.
MIL-P-15037	-	Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamaine-Resin.
MIL-P-15047	-	Plastic-Material, Laminated Thermosetting, Sheets, Nylon, Fabric Base, Phenolic-Resin.
MIL-S-19500	-	Semiconductor Device, General Specification for.
MIL-G-45204	-	Gold Plating, Electrodeposited.
MIL-I-81023	-	Inductor, 28V, D.C. Laboratory Test General Specification for.

STANDARDS

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MIL-STD-129	-	Marketing for Shipment and Storage.
MIL-STD-147	-	Palletized Unit Loads on 40" x 48" Pallets.
MIL-STD-202	-	Test Methods for Electronic and Electrical Component Parts.

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MIL-STD-454	-	Standard General Requirements for Electronic Equipment.
MIL-STD-690	-	Failure Rate Sampling Plans and Procedures.
MIL-STD-750	-	Test Methods for Semiconductor Devices.
MIL-STD-790	-	Reliability Assurance Program for Electronic Parts Specifications.
MIL-STD-883	-	Test Methods and Procedures for Microelectronic Parts.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.
MIL-STD-1686	-	Electrostatic Discharge Control Program For Protection of Electrical and Electronic Parts.
MIL-STD-2073/1	-	DOD Material Procedures for Development and Application of Packaging Requirements.

HANDBOOK

DOD-HDBK-263	-	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) Metric.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI Y32.2	-	Graphic Symbols for Electric and Electronic Diagrams.

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), 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 which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.4 and 6.3).

3.3 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the relays to meet the performance requirements of this specification. Materials used shall be self-extinguishing, and shall not support combustion, give off noxious gases in harmful quantities, give off gases in quantities sufficient to cause explosion of sealed enclosures, cause contamination or form current carrying tracks which prevent meeting the post test requirements specified herein. The selection of materials shall be as such as to provide maximum shelf life. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Plastic. Laminated plastic material shall conform to MIL-P-997, MIL-P-15037, or MIL-P-15047. Molded plastic material shall conform to MIL-M-14 or the requirements of 3.3 for a material which is not specified. Cotton-filled or wood-flour-filled materials shall not be used.

3.3.2 Ceramic. Ceramic insulating material shall conform to MIL-I-10, grade L422 or higher. Ceramic used for external surfaces shall be glazed.

3.3.3 Fungus-resistant. Materials used in the construction of relays shall be fungus inert (see requirement 4 of MIL-STD-454).

3.3.4 Metals. Metals shall be of a corrosion-resistant type or shall be plated or treated to resist corrosion. Zinc plating, cadmium plating, or unfused pure tin plating shall not be used on internal parts of hermetically sealed relays. Zinc plating or cadmium plating shall not be used externally. Unfused tin plating shall have a plating thickness of 200 microinches minimum if used for external parts.

3.3.4.1 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 shall be as defined in 6.6 through 6.6.4, inclusive. In hermetic seals, the 0.25 volt difference between the header material and the housing material is not applicable.

3.3.5 Magnetic wire. Magnet wire shall conform to J-W-1177.

3.3.6 Rubber. Rubber shall conform to ZZ-R-765.

3.3.7 Mercury. The use of mercury or mercury compounds is prohibited.

3.3.8 Magnesium. The use of magnesium or magnesium alloys is prohibited (not applicable to contacts (see 6.8)).

3.3.9 Silicone or silicone compounds. The use of silicone (see 6.8) or silicone compounds for any purpose other than external gaskets is prohibited.

3.4 Design and construction. Relays shall be of the design, construction, weight, and physical dimensions specified (see 3.1).

3.4.1 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.

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

3.4.2 Sealing process. Relays shall be dried, degassed, and backfilled with gas in an atmosphere having a dew point less than -65°C (see 6.5), and shall be sealed by welding. Adjunct sealant (see 6.8), if used, must comply with the following characteristics:

a. Relays shall pass the gross leak test of 1 x 10^{-5} before the application of the adjunct sealant.

b. No adjunct sealants to be visible or detectable on the inside of the relay.

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

d. Shall not be applied to more than 20 percent of the exposed terminal. Trace color is permitted if it is a natural result of the sealant process.

e. Shall form, after curing, a permanent nonconductive, nonoutgassing, noncorrosive, noncontaminating, noncracking 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.

3.4.3 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.

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

3.4.4.1 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 retraceability characteristics shall be compatible with all performance requirements of the relays.

3.4.4.2 Coil terminal identification. Terminals 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).

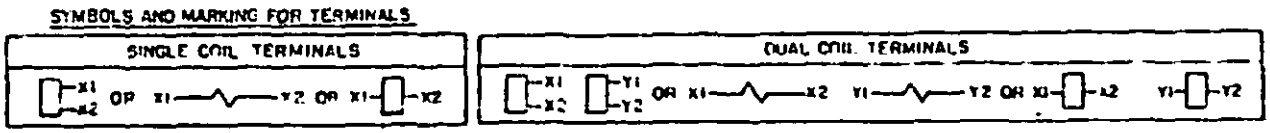


FIGURE 1. Symbols and marking for terminals.

3.4.4.3 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). If a neutral position can be attained, the relay shall be screened as specified in 3.11.7 and 4.8.8.7. Specified dropout value (voltage or current) and release time are not applicable to latching relays (see 6.1).

3.4.4.4 Semiconductor devices. Semiconductor devices shall be selected from MIL-S-19500 Qualified Products List and be JAN TX as a minimum whenever possible. Nonstandard semiconductor devices shall be JAN TX screened as specified in 4.8.3.3.

3.4.4.4.1 Electrostatic discharge sensitivity (ESDS). Relays supplied with semiconductor devices wired internally are not considered ESDS. However, the semiconductor devices may be ESDS sensitive and shall be processed in accordance with the ESDS program requirements of 4.1.3.

3.4.5 Circuit diagram. The circuit diagram as specified shall be a terminal view. Circuit symbols shall be in accordance with ANSI Y32.2. 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.

3.4.6 Mounting means (see 3.1).

3.4.6.1 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.

3.4.7 Terminals. Terminals shall be as specified (see 3.1).

3.4.7.1 Terminal finish. Finish of terminals shall provide a good electrical contact and meet the performance requirements specified herein. All terminals used for external soldered connections shall be tin plated or coated with composition Sn60, or Sn70 solder conforming to QQ-S-571 to facilitate soldering.

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

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

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

3.4.7.4 Wire marks. When tin 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 2).

3.4.7.5 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 so designed that the entire weight of the relay will be suspended and the stability of its mounting will be provided by an auxiliary mounting means other than the electrical terminals of a socket. Plug-in terminals shall be gold plated in accordance with MIL-G-45204, type II, class I, with a nickel underplating that shall be in accordance with 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-S-12883.

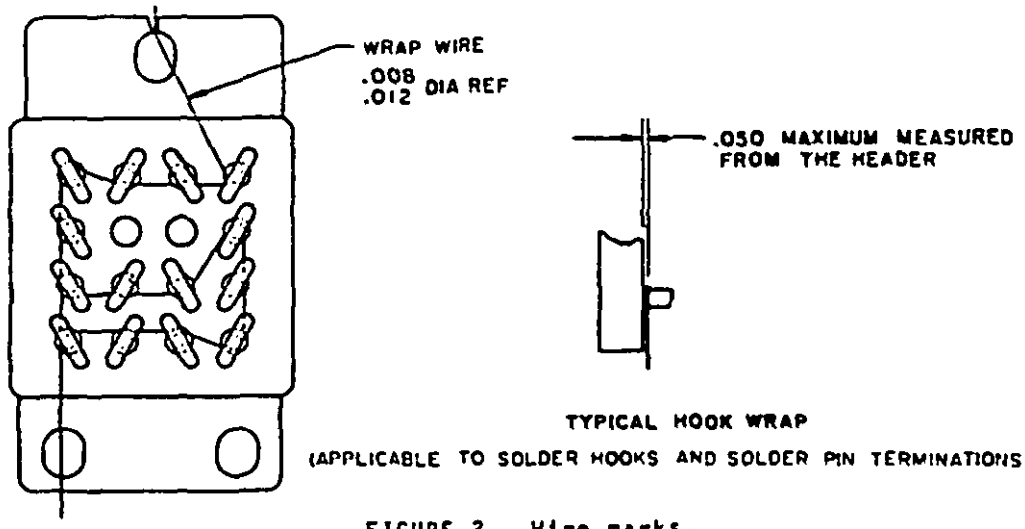


FIGURE 2. Wire marks.

3.4.8 Header glass. Header glass shall be examined as specified in 4.8.1.1.

3.4.9 Serialization. Relays supplied to this specification shall be serialized and one copy of variables test data shall be supplied with each relay as a part of group A acceptance testing (see 4.7.1.2). Actual measured values shall be shown for operate and release time, static contact resistance and voltage drop, contact voltage drop, and coil resistance as specified in 3.11.4, 3.11.2, and 3.11.1, respectively.

3.5 Cleaning and small particle inspection (when specified, see 3.1). Prior to hermetic sealing of the relay header to the relay can, the relays and cans shall be cleaned and examined for small particle contaminants as specified in 4.8.2.

3.6 Screening. When relays are tested as specified in 4.8.3, during cycling, the contact miss detector's monitoring level shall be less than 100 ohms. Unless otherwise specified (see 3.1), any relay shall have a final insulation resistance measurement of 10,000 megohms or greater.

3.7 Solderability. When tested as specified in 4.8.4, the terminal surfaces shall meet the acceptance requirements of method 208 of MIL-STD-202. The dipped surface of solid wire lead and pin terminals shall be at least 95 percent covered with a continuous new solder coating. The remaining 5 percent may contain only small pinholes or rough spots; these shall not be concentrated in one area. Bare base metal where the solder dip failed to cover the original coating is an indication of poor solderability and shall be cause for failure. For solder-lug terminals greater than .045 inch (1.14 mm) in diameter, 95 percent of the total length of fillet, which is between the standard wrap wire (see MIL-STD-202, method 208) 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.

3.8 Seal. When tested as specified in 4.8.5, there shall be no leakage in excess of 1×10^{-8} atmospheric cubic centimeters per second of air (atm cm^3/s).

3.9 Insulation resistance. When relays are tested as specified in 4.8.6, 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.

3.10 Dielectric withstanding voltage. When tested as specified in 4.8.7, relays shall withstand the test voltage specified without damage, and there shall be no leakage current in excess of 1 milliampere (mA) nor evidence of damage due to arcing (air discharge). After high level life tests, the dielectric withstanding voltage shall be at least 75 percent of the initial sea level value (see 3.1).

3.11 Electrical characteristics. 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 (see 6.1).

3.11.1 Coil resistance. When relays are tested as specified in 4.8.8.1, the coil resistance shall be as specified (see 3.1).

3.11.2 Static contact resistance and contact voltage drop. When relays are tested as specified in 4.8.8.2, unless otherwise specified (see 3.1) the static contact resistance shall not exceed 0.05 ohm and the contact voltage drop shall not exceed .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.

3.11.3 Specified pickup, hold, and dropout values (voltages). When relays are tested as specified in 4.8.8.3, the specified pickup, hold, and dropout values (voltages) shall be as specified (see 3.1). Specified dropout value (voltage or current) and release time are not applicable to latching relays (see 6.1).

3.11.4 Operate and release time. When relays are tested as specified in 4.8.8.4, the operate and release time shall be as specified (see 3.1). In multipole relays, all poles of each relay shall function simultaneously within 1 millisecond (ms). Double throw contacts shall show no evidence of any open contact closing before all closed contacts have opened. This applies to either state of the relay.

3.11.5 Contact dynamic characteristics (see 4.8.8.5).

3.11.5.1 Contact bounce (applicable to failure rate level "L"). Unless otherwise specified (see 3.1), when relays are tested as specified in 4.8.8.5.1, the duration of the contact bounce shall not exceed 1.0 ms.

3.11.5.2 Contact stabilization time (applicable to failure rate levels "M", "P" and "R"). When relays are tested as specified in 4.8.8.5.2, the time to reach and maintain a static contact resistance state shall not exceed the value specified (see 3.1).

3.11.6 Coil transient suppression (applicable to dc operated relays with internal coil suppression). When relays are tested as specified in 4.8.8.6, coils of dc operated relays shall not generate a back EMF greater than that specified (see 3.1), as maximum induced transient voltage.

3.11.7 Neutral screen (applicable to two coil latching relays only). Two coil latching relays shall be tested as specified in 4.8.8.7.

3.12 Thermal shock. When relays are tested as specified in 4.8.9, insulation resistance, specified pickup, hold, and dropout values (voltages), and operate and release time shall meet the requirements of 3.9, 3.11.3, and 3.11.4, 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.

3.13 Shock (specified pulse). Unless otherwise specified, when relays are tested as specified in 4.8.10, there shall be no opening of closed contacts in excess of 10 microseconds and there shall be no closure or abnormal bridging of open contacts in excess of 1 microsecond and no evidence of mechanical or electrical damage.

3.14 Vibration. Unless otherwise specified, when relays are tested as specified in 4.8.11, there shall be no opening of closed contacts in excess of 10 microseconds and there shall be no closure or abnormal bridging of open contacts in excess of 1 microsecond and no evidence of mechanical or electrical damage.

3.15 Acceleration. Unless otherwise specified, when relays are tested as specified in 4.8.12, the contacts of the relay shall remain in the deenergized 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. There shall be no structural failure or other damage which might impair the operation of the relay.

3.16 Terminal strength. When relays are tested as specified in 4.8.13, 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.

3.17 Magnetic interference. When relays are tested as specified in 4.8.14, the specified pickup and dropout values (voltages) shall meet the requirements specified in 3.11.3.

3.18 Coil life (applicable to continuous duty relays only). When relays are tested as specified in 4.8.15, there shall be no evidence of damage.

3.19 Resistance to soldering heat. When relays are tested as specified in 4.8.16, there shall be no damage which would adversely affect normal operation of the relay.

3.20 Salt atmosphere (corrosion). When relays are tested as specified in 4.8.17, 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). When relays are tested as specified in 4.8.18, the voltage drop across closed contacts shall be not more than 10 percent of applied circuit load voltage and the voltage across open contacts shall be not less than 90 percent of applied circuit voltage. The case-to-ground fuse shall remain electrically continuous.

3.22 Rupture (applicable to high level load ratings only). When relays are tested as specified in 4.8.19, 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. The terminal temperature rise shall not exceed +75°C. (Monitoring of terminal temperature rise shall be required only during qualification testing and group C testing).

3.23 Time current relay characteristics. When relays are tested as specified in 4.8.20, there shall be no evidence of contact welding or sticking and the contact voltage drop shall meet the requirements of 3.11.2 after the test. The terminal temperature rise shall not exceed +75°C. Monitoring of terminal temperature required only during qualification testing and groups C and D testing. The fuse connected between case and load system ground or neutral shall remain electrically continuous.

3.24 Intermediate current. Unless otherwise specified (see 3.1), when relays are tested as specified in 4.8.21, during cycling, the resistance of a closed contact shall be not more than 3 ohms and the voltage across an open contact shall be 95 percent or more of applied load voltage. After cycling, the static contact resistance shall not exceed the limits for high level relays specified after life test cycling at high temperature and at room ambient temperature.

3.25 Life. When relays are tested as specified in 4.8.22, during cycling, the contact miss detector's monitoring level shall be less than 100 ohms for low level testing and less than 10 percent of the open circuit voltage for high level testing and the voltage across open contacts shall be 90 percent or more of the open circuit voltage. The case to ground fuse shall remain electrically continuous. The static contact resistance following cycling shall be no greater than twice the initial specified contact resistance requirement. 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).

3.26 Resistance to solvents. When relays are tested as specified in 4.8.23, the marking shall remain legible.

3.27 Particle impact noise detection (PIND, when specified, see 3.1). When relays are tested as specified in 4.8.24, there shall be no evidence of free moving particulate contamination.

3.28 Continuous current. When relays are tested as specified in 4.7.15, 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 Marking.

3.29.1 "JAN" brand. 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 military 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" or "J" shall be placed on the first line above or below the "M" of the military part number or the "J" with the date code (example J8830). Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and applicable specification sheets or associated detail specifications, the manufacturer shall remove 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 No. 504,860 for the certification mark "JAN".

3.29.2 Identification marking (full). Relays shall be marked in accordance with method 1 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 3.29.2b). The date code shall provide traceability (see 4.1.2.1)

d. Source code.

e. Lot symbol.

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 3.4.5).

j. Terminal marking (when applicable, see 3.1, 3.4.4.2, and 3.4.7).

k. Serial number (see 3.4.9).

3.29.3 Failure rate level substitution. Relays qualified to lower (better) failure rates, may be substituted for higher failure rate parts. For example, a relay qualified to failure rate level "P" (0.1 percent/10,000 cycles) may be substituted for a failure rate "M" (1.0 percent/10,000 cycles) relay. Relays shall not be remarked unless specified in the contract or purchase order.

3.29.4 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 military specification sheet (see 3.1). Changes in manufacturer's number shall be governed by the drawing number requirements of DOD-D-1000.

3.30 Workmanship. The relays shall be fabricated in such a manner as to be uniform in quality, and shall be free from cracked or displaced parts, sharp edges, burrs, and other defects that will affect life, serviceability, and appearance.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification.

4.1.2.1 Traceability requirements. The manufacturer shall submit to the qualifying activity the procedure whereby the lot date codes are assigned that incorporates traceability. The following is a list of raw material/component parts and subassembly traceability requirements:

a. Header-contact subassembly with the lot number.

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

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

(3) Return springs.

(4) Semiconductors (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 and/or contact blade) (when applicable).

(2) Wound coils with the lot number.

(3) Armature assembly.

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

(5) Magnets (when applicable).

(6) Return springs (when applicable).

4.1.3 ESDS protection program (see 3.4.4.4.1). The manufacturer shall establish and maintain an ESD control program in accordance with MIL-STD-1686 and DOD-HDBK-263. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification. This program shall be documented by an ESD control plan which must be under document control. As a minimum, this plan must address the identification of ESDS sub-components and end items, facilities, training, design protection, handling procedures, marking, 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 Society of Automotive Engineers (SAE) and the Electronics Industry Association (EIA). This requirement is applicable to all manufacturers who handle ESDS component parts and/or materials in the relay manufacturing and/or testing process. This requirement is not limited to manufacturers qualifying ESDS end items.

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

a. Qualification inspection (see 4.4).

b. Retention of qualification (see 4.5).

c. Quality conformance inspection (see 4.7).

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

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 life 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 nongrounded 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, equipment used in the group A testing wherein the current is being switched 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 tests specified in 4.8.15 and 4.8.21 (coil life and intermediate current, respectively), 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 nonheat conduction material in a plane parallel to the normal air flow in the oven. 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 dual coil relays shall be repeated with the relay in each operated position.

4.3.7 Reliability requirements. The reliability requirements specified herein are in accordance with MIL-STD-690. The confidence level for qualification is 90 percent and the confidence level for maintenance of qualification is 60 percent.

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" failure rate initially and shall be based on results of the qualification inspection specified in table II.

4.4.1.1 Sample size. The number of relays to be subjected to qualification inspection shall be as specified in table II (see 1/ and 2/ of 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 groups II through VIII may be conducted concurrently. All sample units shall be subjected to the inspections of group II. These sample units shall then be divided into six 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.

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 failure rate 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), data from two or more styles of similar construction may be combined.

c. Procedure III: Maintenance of FR level qualifications. Maintenance period of 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.

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 failure rate of the product shall be increased one level or the product removed from the Qualified Products List. The qualifying activity shall be promptly informed of the failures.

4.5 Verification of qualification. At all failure rate levels and maintenance periods specified in table IV, the manufacturer shall compile a summary of the results of quality conformance inspections and (where applicable) extended FR test data, in the form of a verification of qualifications report, and forward it to the qualifying activity as the basis of continued qualification approval at 6-month intervals. In addition to the periodic submission of FR test data, the manufacturer shall immediately notify the qualifying activity whenever the FR data indicates that the manufacturer has failed to maintain his qualified FR level. Continuation shall be based on evidence that, over the 6-month period, the following has been met:

a. Verification by the qualifying activity that the manufacturer meets the requirement of MIL-STD-790.

b. The manufacturer has not modified the design of the item.

c. The specification requirements for the item have not been amended so as to affect the character of the item.

d. Lot rejection for group A inspection does not exceed 10 percent or one lot, whichever is greater.

e. Requirements for groups B, C, and D are met (where applicable).

f. The records of all FR tests combined substantiate that the "L" (3.0 percent), "M" (1.0 percent), or "P" (0.1 percent) FR levels have been maintained or that the manufacturer continues to meet the "R" (0.01 percent) FR level for which qualified, although the total component cycles of testing do not, as yet, meet the requirements of 4.4.4 (see table IV).

If group C or D test requirements were not met and the manufacturer has taken corrective action satisfactory to the Government, the forwarding of the verification of qualification report may be delayed until within 60 days after completion of retesting of the group C or D inspections. In this case, the qualifying activity shall be notified of this condition within the time the original verification of qualification report was due. All reports shall be certified by a responsible company official and the Government inspector.

4.6 FR level determination. Determination of FR levels shall be based upon data from all completed life and intermediate current tests. Data for 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 groups B and C quality 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 groups B and C quality 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 obtaining FR data.

4.6.1 Records. Test records shall be maintained which shall include the data derived from the sources specified in 4.6. The example forms shown in MIL-STD-690 include the minimum information required and a suggested format for this report. Test data on every production lot that has been submitted for quality conformance inspection shall be included.

4.6.2 FR level computation. Data from test records shall be used to compute the observed failure rates of the sample units using a maintenance of FR record form similar to figure 1 of MIL-STD-690. 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 shown on record form.

4.6.2.1 Contact FR computation. The data from tests shall be recorded in such a manner so that, if necessary, it can be analyzed to compute contact FR.

4.6.3 Exemption of data. Exemptions of data requirement in MIL-STD-690 shall apply.

4.6.4 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; e.g., qualification approval for level "R" will include qualification approval for levels "P", "M" and "L".

4.7 Quality conformance inspection.

4.7.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.7.1.1 Inspection lot. An inspection lot shall consist of all relays covered by a single specification sheet, produced and sealed under essentially the same conditions, and offered for inspection at one time within a period not to exceed 1 month. This shall not preclude the manufacturer from forming sublots at shorter intervals to assure control of critical processes.

4.7.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table V, in the order shown.

4.7.1.2.1 Sampling plan. The tests in subgroups 1, 2, 3, and 4 shall be performed on each relay offered for inspection, except as noted. If, during the 100 percent inspection of subgroup 3, over 5 percent of the relays are discarded, then the entire lot shall be rejected.

4.7.1.2.2 Rejected lots.

a. Subgroup 1. See 1/ of table V.

b. Subgroup 2. Rejected lots shall not be offered for reinspection.

c. Subgroup 3. Rejected lots shall not be offered for reinspection.

d. Subgroup 4. See 4/, 5/, and 6/ of table V.

TABLE II. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
Group I				
Cleaning and small particle inspection (when specified)- -	3.5	4.8.2	All sample units 2/	1/
Group II				
Screening - - - - - - - - - - - -	3.6	4.8.3	All sample units 2/	0
Visual and mechanical inspection (internal) 3/- - -	3.1, 3.3, 3.4, 3.30	4.8.1		
Solderability (3 sample units) - - - - - - -	3.7	4.8.4		
Insulation resistance - - - - -	3.9	4.8.6		
Dielectric withstanding voltage- - - - - - - - - - - -	3.10	4.8.7		
Electrical characteristics:				
Coil resistance- - - - - - - -	3.11.1	4.8.8.1		
Static contact resistance and contact voltage drop- - - - -	3.11.2	4.8.8.2		
Specified pickup, hold, and dropout values (voltages)- -	3.11.3	4.8.8.3		
Operate and release time - - -	3.11.4	4.8.8.4		
Contact dynamic characteristics - - - - - - -	3.11.5	4.8.8.5		
Coil transient suppression (when specified)- - - - - - -	3.11.6	4.8.8.6		
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7		
Seal- - - - - - - - - - - - - - -	3.8	4.8.5		
Visual and mechanical inspection (external) dimensional check on 2 sample units only - - - - - - - - - - -	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		

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
Group III				
Thermal shock	3.12	4.8.9	4	1
Resistance to solvents	3.26	4.8.23		
Shock (specified pulse)	3.13	4.8.10		
Vibration (sinusoidal)	3.14	4.8.11.1		
Vibration (random)	3.14	4.8.11.2		
Particle impact noise detection (PIND, when specified)	3.27	4.8.24		
Acceleration	3.15	4.8.12		
Terminal strength	3.16	4.8.13		
Insulation resistance	3.9	4.8.6		
Dielectric withstanding voltage	3.10	4.8.7		
Electrical characteristics:				
Coil resistance	3.11.1	4.8.8.1		
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2		
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3		
Operate and release time	3.11.4	4.8.8.4		
Contact dynamic characteristics	3.11.5	4.8.8.5		
Coil transient suppression (when specified)	3.11.6	4.8.8.6		
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7		
Seal	3.8	4.8.5		
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		

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
Group IV				
Magnetic interference	3.17	4.8.14	4	1
Coil life (applicable to continuous duty relays only)	3.18	4.8.15		
Resistance to soldering heat	3.19	4.8.16		
Salt atmosphere (corrosion)	3.20	4.8.17		
Insulation resistance	3.9	4.8.6		
Dielectric withstanding voltage	3.10	4.8.7		
Electrical characteristics:				
Coil resistance	3.11.1	4.8.8.1		
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2		
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3		
Operate and release time	3.11.4	4.8.8.4		
Contact dynamic characteristics	3.11.5	4.8.8.5		
Coil transient suppression (when specified)	3.11.6	4.8.8.6		
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7		
Seal	3.8	4.8.5		
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		
Group V				
Overload 4/	3.21	4.8.18	For qualification to level "L" 1/ 2/ 6 - - - - 0	
Life 5/	3.25	4.8.22	12 - - - - 1	
Terminal strength 6/	3.16	4.8.13	21 - - - - 2	
Insulation resistance	3.9	4.8.6	38 - - - - 5	
Dielectric withstanding voltage	3.10	4.8.7		
Electrical characteristics:				
Coil resistance	3.11.1	4.8.8.1	For qualification to level "M" 1/ 2/ 21 - - - - 0	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	38 - - - - 1	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3		
Operate and release time	3.11.4	4.8.8.4		
Contact dynamic characteristics	3.11.5	4.8.8.5		
Coil transient suppression (when specified)	3.11.6	4.8.8.6		
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7		
Seal	3.8	4.8.5		
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		

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
Group VI				
Intermediate current 7/	3.24	4.8.21	4	0
Insulation resistance	3.9	4.8.6		
Dielectric withstanding voltage	3.10	4.8.7		
Electrical characteristics:				
Coil resistance	3.11.1	4.8.8.1		
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2		
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3		
Operate and release time	3.11.4	4.8.8.4		
Contact dynamic characteristics	3.11.5	4.8.8.5		
Coil transient suppression (when specified)	3.11.6	4.8.8.6		
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7		
Seal	3.8	4.8.5		
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		
Group VII				
Rupture 4/ 8/	3.22	4.8.19	2	0
Insulation resistance	3.9	4.8.6		
Dielectric withstanding voltage	3.10	4.8.7		
Seal	3.8	4.8.5		
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		

See footnotes on next page.

TABLE II. Qualification inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
Group VIII				
Time current characteristics	3.23	4.8.20	2 9/	
Continuous current	3.28	4.8.25	2 9/	
Insulation resistance	3.9	4.8.6		
Dielectric withstanding voltage	3.10	4.8.7		
Electrical characteristics:				
Coil resistance	3.11.1	4.8.8.1		
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2		
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3		
Operate and release time	3.11.4	4.8.8.4		
Contact dynamic characteristics	3.11.5	4.8.8.5	4 9/	0
Coil transient suppression (when specified)	3.11.6	4.8.8.6		
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7		
Seal	3.8	4.8.5		
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1		

1/ Cleaning and small particle inspection shall not contribute failures for qualification purposes.
2/ Upon completion of cleaning and small particle inspection, the qualification samples shall continue through manufacturing prior to entrance into groups II through VIII. Manufacturers should select a sufficiently large sample size to insure the relays required for the sample size specified in group V are available upon completion of all manufacturing processes prior to beginning of the testing specified in groups II through VIII.
3/ One unsealed sample unit shall be subjected to the internal inspection.
4/ Applicable to high level ratings only.
5/ The sample size shall be equally divided among the specified contact rating and shall be of sufficient size to test a minimum of two relays per contact rating with rated loads on all contacts.
6/ Test four sample relays subjected to the highest current life test. These four samples shall be subjected to terminal strength and seal. No failures shall be allowed.
7/ Intermediate current operation test cycles apply to life failure rate qualification.
8/ One unit shall be tested for the ac rupture load and one for the dc rupture load. If no dc or ac load is specified, both units shall be tested for the load specified. If rupture is not specified (see 3.1), this group shall be omitted from the qualification program.
9/ The two units tested for time current characteristics and the two units for continuous current shall be combined for the remaining tests.

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

Failure rate level symbol	Qualified failure rate level (%/10,000 cycles)	Cumulative unit cycles in millions 1/					
		C = 0	C = 1	C = 2	C = 3	C = 4	C = 5
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.

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

FR level symbol	Qualified FR (%/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	.306	.673	1.03	1.39	1.75	2.10
M	1.0	6 months	.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	91.6	202	310	418	525	630

1/ C = Acceptance number or number of failures permitted.

TABLE V. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Inspection
Subgroup 1			
Cleaning and small particle inspection (when specified)	3.5	4.8.2	100 percent inspection 1/
Subgroup 2			
Vibration (sinusoidal)	3.14	4.8.11.1	100 percent inspection discard all failed relays
Vibration (random) 2/	3.14	4.8.11.2	
Particle impact noise detection PIND, when specified	3.27	4.8.24	
Screening, internal moisture	3.6	4.8.3.1	
Screening, run-in	3.6	4.8.3.2	
Subgroup 3			
Insulation resistance 3/	3.9	4.6.6	
Dielectric withstanding voltage 3/	3.10	4.8.7	
Electrical characteristics:			
Coil resistance 3/	3.11.1	4.8.8.1	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3	
Operate and release time	3.11.4	4.8.8.4	
Contact dynamic characteristics	3.11.5	4.8.8.5	
Coil transient suppression (when specified)	3.11.6	4.8.8.6	
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7	
Subgroup 4			
Solderability 4/	3.7	4.8.4	
Seal	3.8	4.8.5	
Visual and mechanical inspection (external) 5/6/	3.1, 3.3, 3.4, 3.29, and 3.30	4.8.1	

See footnotes on next page.

1/ Cleaning and small particle inspection shall not contribute any failures to the inspection lot that has been submitted for group A testing. Upon completion of cleaning and small particle inspection, the relays submitted in the applicable inspection lot shall continue through the manufacturing process and then be subjected to the tests as specified in subgroups 2 through 4.

2/ Unless otherwise specified (see 3.1), performance of random vibration shall be part of qualification inspection and group C inspection.

3/ Testing sequence optional for insulation resistance, dielectric withstanding voltage, and coil resistance only.

4/ Solderability shall be required on 13 sample relays drawn at random from each inspection lot. In the event of a failure, the entire lot shall be reworked and a second random sample taken. When rework requires the replating of the relay, the entire lot shall be submitted for all group A inspection after passing solderability. If the rework requires only the solder dipping of the terminals, then the entire lot shall be resubmitted for subgroups 3 and 4 testing after passing solderability.

5/ Physical dimensions and weight shall be measured on two sample units per lot, minimum. In the event of a failure, the entire lot shall be screened and rejects discarded.

6/ Marking defects only may be reworked.

4.7.1.2.3 Manufacturer's production inspection. If the manufacturer performs tests similar to those specified in subgroup 3, table V, as the final step of his production process, group A, subgroup 3, inspection may be waived and the data resulting from the manufacturer's production tests may be used instead. Authority to waive the subgroup 3 inspection shall be granted by the qualifying activity only. The following criteria must be complied with:

a. Tests conducted by the manufacturer during production shall be clearly identical to or more stringent than that specified for subgroup 3. Test conditions shall be equal to or more stringent than those specified for subgroup 3.

b. Manufacturer subjects 100 percent of the product supplied under this specification to his production tests.

c. The parameters measured and the failure criteria shall be the same or more stringent than those specified herein.

d. The lot rejection criterion is the same or more stringent than that specified herein.

e. The manufacturer shall make available all information concerning the test procedures and instrumentation used in his production tests. This data shall be provided as part of the evaluation required for MIL-STD-790. The manufacturer shall also make available to the Government all records of all detail test data resulting from production tests.

4.7.2 Periodic inspections. Periodic inspections shall consist of groups B, C, and D. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.7.2.4), delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

4.7.2.1 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.

4.7.2.1.1 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 failure rate level (see 4.4.4). In any event, a minimum of one sample unit shall be selected from each lot. The relays tested during a maintenance period shall be representative of all relays produced during this period. The accumulated data shall be used for maintenance and extension of failure rate qualification. Data from life test sample units and intermediate current sample units from group C inspection shall be included in this sample.

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

4.7.2.2 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.

4.7.2.2.1 Sampling plan. Three sample units shall be taken from production every month for group I, and four sample units every 6 months for groups II and III (see table VII).

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

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

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

4.7.2.3.1 Sampling plan. Four sample units for group I and four sample units for group II shall be taken from production every 36 months. No failures shall be permitted.

4.7.2.3.2 Defectives. If one or more sample units fail to pass group D inspection, the sample shall be considered to have failed.

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

TABLE VI. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Life 1/	3.25	4.8.22
Insulation resistance	3.9	4.8.6
Dielectric withstanding voltage	3.10	4.8.7
Electrical characteristics:		
Coil resistance	3.11.1	4.8.8.1
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3
Operate and release time	3.11.4	4.8.8.4
Contact dynamic characteristics	3.11.5	4.8.8.5
Coil transient suppression (when specified)	3.11.6	4.8.8.6
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7
Seal	3.8	4.8.5
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1

1/ Sample units shall be tested in the following sequence of contact loads until all specified loads are tested, as applicable: First, resistive; second, inductive; third, low level. When all specified loads are tested, then the sequence shall resume. Each sample shall be tested at only one contact rating with rated loads on all contacts.

4.7.2.4 Noncompliance. If a sample fails to pass the group B, C, or D inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity immediately of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which 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 C or group D inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C or group D inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.7.3 Inspection of packaging. The sampling and inspection of the preservation and interior pack marking shall be in accordance with the groups A and B quality conformance inspection requirements of MIL-P-116. The sampling and inspection of the packing and marking for shipment and storage shall be in accordance with the quality assurance provisions of the applicable container specification and the marking requirements of MIL-STD-129.

TABLE VII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection
Group I (every month)			
Intermediate current	3.24	4.8.21	3
Terminal strength	3.16	4.8.13	
Insulation resistance	3.9	4.8.6	
Dielectric withstanding voltage	3.10	4.8.7	
Electrical characteristics:			
Coil resistance	3.11.1	4.8.8.1	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3	
Operate and release time	3.11.4	4.8.8.4	
Contact dynamic characteristics	3.11.5	4.8.8.5	
Coil transient suppression (when specified)	3.11.6	4.8.8.6	
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7	
Seal	3.8	4.8.5	
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1	
Group II (every 6 months)			
Thermal shock	3.12	4.8.9	2
Shock (specified pulse)	3.13	4.8.10	
Vibration 1/	3.14	4.8.11	
Terminal strength	3.16	4.8.13	
Insulation resistance	3.9	4.8.6	
Dielectric withstanding voltage	3.10	4.8.7	
Electrical characteristics:			
Coil resistance	3.11.1	4.8.8.1	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3	
Operate and release time	3.11.4	4.8.8.4	
Contact dynamic characteristics	3.11.5	4.8.8.5	
Coil transient suppression (when specified)	3.11.6	4.8.8.6	
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7	
Seal	3.8	4.8.5	
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1	

See footnotes at end of table.

TABLE VII. Group C inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection
Group III (every 6 months)			
Overload 2/	3.21	4.8.18	2
Life 3/	3.25	4.8.22	
Terminal strength	3.16	4.8.13	
Insulation resistance	3.9	4.8.6	
Dielectric withstanding voltage	3.10	4.8.7	
Electrical characteristics:			
Coil resistance	3.11.1	4.8.8.1	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3	
Operate and release time	3.11.4	4.8.8.4	
Contact dynamic characteristics	3.11.5	4.8.8.5	
Coil transient suppression (when specified)	3.11.6	4.8.8.6	
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7	
Seal	3.8	4.8.5	
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1	

1/ Written reports of insulation resistance and operate and release time are required only as a part of thermal shock; written reports of the results of specified pickup, hold, and must dropout values (voltages), static contact resistance and contact voltage drop, and dielectric withstanding voltage are required only as a part of vibration.

2/ Applicable to high level load ratings.

3/ Highest resistive load shall be used.

TABLE VIII. Group D inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection
Group I (every 36 months)			
Resistance to solvents	3.26	4.8.23	4
Acceleration	3.15	4.8.12	
Insulation resistance	3.9	4.8.6	
Dielectric withstanding voltage	3.10	4.8.7	
Electrical characteristics:			
Coil resistance	3.11.1	4.8.8.1	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3	
Operate and release time	3.11.4	4.8.8.4	
Contact dynamic characteristics	3.11.5	4.8.8.5	
Coil transient suppression (when specified)	3.11.6	4.8.8.6	
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7	
Seal	3.8	4.8.5	
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1	
Group II (every 36 months)			
Magnetic interference	3.17	4.8.14	4
Coil life (applicable to continuous duty relays only)	3.18	4.8.15	
Resistance to soldering heat	3.19	4.8.16	
Salt atmosphere (corrosion)	3.20	4.8.17	
Insulation resistance	3.9	4.8.6	
Dielectric withstanding voltage	3.10	4.8.7	
Electrical characteristics:			
Coil resistance	3.11.1	4.8.8.1	
Static contact resistance and contact voltage drop	3.11.2	4.8.8.2	
Specified pickup, hold, and dropout values (voltages)	3.11.3	4.8.8.3	
Operate and release time	3.11.4	4.8.8.4	
Contact dynamic characteristics	3.11.5	4.8.8.5	
Coil transient suppression (when specified)	3.11.6	4.8.8.6	
Neutral screen (applicable to two coil latching relays only)	3.11.7	4.8.8.7	
Seal	3.8	4.8.5	
Visual and mechanical inspection (external)	3.1, 3.3, 3.4, 3.29, 3.30	4.8.1	

4.8 Methods of inspection.

4.8.1 Visual and mechanical. Relays shall be examined to verify that the materials, external design and construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.29, and 3.30).

4.8.1.1 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 3, 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° are not acceptable (see figure 3).

f. Radial cracks whose lengths exceed one-third the distance between the terminal and corresponding header metal are not acceptable (see figure 3).

g. Tangential cracks which are not confined to a single zone are not acceptable (see figure 3).

h. Surface chips whose lengths or widths exceed one-third the distance between the terminal and corresponding header metal are not acceptable (see figure 3).

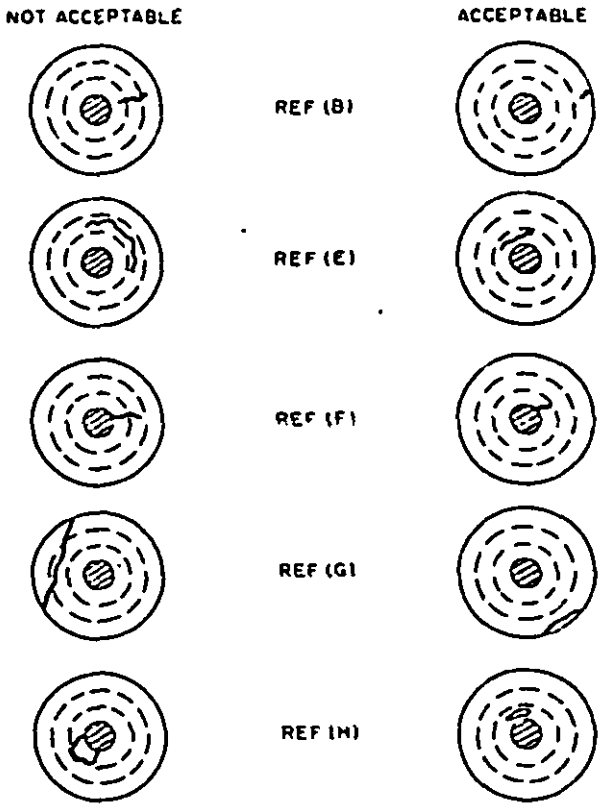
i. Chipped meniscuses are acceptable to the extent that they do not extend below the surface of the glass, and to the extent of 3.4.8h.

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.



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

FIGURE 3. Inspection aid.

4.8.2 Cleaning and small particle inspection (see 3.5). Prior to hermetic sealing of the relay can, a qualification activity approved procedure for cleaning and small particle inspection shall be used. Appendix A may be used as a guideline.

4.8.3 Screening (see 3.6).

4.8.3.1 Internal moisture. Relays (coils deenergized) shall be held at +15°C to +25°C for a minimum of 30 minutes. The insulation resistance of all contact pins to case only, shall be measured and observed. The relay coil shall be energized with 140 percent of rated voltage for a period of 2 1/2 minutes. The insulation resistance of all contact pins to case only shall be verified a minimum of once every 30 seconds during this period and the lowest value shall meet the requirements of 3.6.

4.8.3.2 Run-in.

4.8.3.2.1 High temperature run-in. Qualification inspection only: Relays shall be subjected to +125°C with rated voltage or current on the coil for 1 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 relays weighing 1 ounce or less and 30 minutes minimum for relays weighing over 1 ounce but not more than .3 pound. 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 in accordance with the rate outlined in 4.8.3.2.3. Relays shall have the contacts loaded as follows: Open circuit load voltage 10 to 50 µV dc or peak ac. The load current shall be 10 to 50 µA. Each pair of mated contacts shall be monitored during each operation in accordance with 4.8.3.2.4.

4.8.3.2.2 Low temperature run-in. Following high temperature, for qualification only, relays shall be subjected to -65°C with the coil or coils deenergized 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 deenergized for 15 minutes minimum for relays weighing 1 ounce or less and 30 minutes minimum for relays weighing over 1 ounce but not more than .3 pound. At the end of either period, the specified dropout 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 in accordance with the procedure outlined in 4.8.3.2.1.

4.8.3.2.3 Cycling-rate. The cycle rate shall be a maximum of .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.

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

$$\text{For latching relays: Maximum cycle rate} = \frac{0.1}{2\text{X maximum latch/reset time (seconds)}}$$

The coil shall be energized at rated voltage or current. Relays shall have the contacts loaded as follows: Open circuit load voltage 10 to 50 mV (dc or peak ac). The load current shall be 10 to 50 µA. Each pair of mated contacts shall be monitored during each operation in accordance with 4.8.3.2.4.

4.8.3.2.4 Monitoring. 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 turn off the test when a failure occurs, or shall record every failure.

4.8.3.3 Semiconductor devices in process screening (see 3.4.4.4). Relays containing semiconductor devices shall have had the semiconductor devices screened as follows prior to performance of the run-in in accordance with 4.8.3.2. This testing may be done by the supplier, in process, or as a final assembly.

a. Visual inspection in accordance with MIL-STD-750, method 2073 or method 2074 as specified.

b. Temperature cycle in accordance with MIL-STD-750, method 1051, test condition B.

c. Burn-in in accordance with MIL-STD-750, method 1038, test condition A or B, except temperature shall be +125°C minimum and test time shall be 24 hours minimum.

4.8.4 Solderability (see 3.7). Relays shall be tested in accordance with method 208 of MIL-STD-202. The following details and exceptions shall apply:

a. Number of terminations of each part to be tested: All.

b. The temperature of the molten solder shall be a uniform +260°C +5°C (+500°F +9°F).

4.8.5 Seal (see 3.8). Relays shall be tested in accordance with 4.8.5.1 or 4.8.5.2, as applicable. In case of dispute, method 1014 of MIL-STD-883, test condition B shall govern.

4.8.5.1 Relays sealed with a tracer gas. Relays sealed with a tracer gas shall be tested in accordance with method 112 of MIL-STD-202 or method 1014 of MIL-STD-883. The following details shall apply:

a. Method 112 of MIL-STD-202:

(1) Test condition C, procedure IV. Relays shall be back filled with a helium tracer gas (90 percent dry gas and 10 percent helium). For gross leak, silicone oil shall not be used.

(2) Leakage rate sensitivity: 1 X 10-8 atm cm 3/s.

(3) Measurements after test: Not applicable.

b. Method 1014 of MIL-STD-883, test condition B.

4.8.5.2 Relays sealed without a tracer gas. Relays sealed without a tracer gas shall be tested in accordance with method 1014 of MIL-STD-883. At the option of the manufacturer, either "a" or "b" may be used. The following details shall apply:

a. Method 1014 MIL-STD-883:

(1) Test condition A1 or A2.

(2) Measurements after test: Perform a gross leak test in accordance with method 112 of MIL-STD-202, test condition A, B, or D. Silicone oil shall not be used. At the option of the manufacturer, the gross leak test of method 1014 of MIL-STD-883, test condition C, may be used.

b. Method 1014 of MIL-STD-883, test condition B.

4.8.5.3 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 5 to 10 mil 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, method 112, test condition D, except the specimen shall be observed from the instant of immersion for 1 minute minimum to 3 minutes maximum.

4.8.5.3.1 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.

4.8.5.3.2 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.

4.8.6 Insulation resistance (see 3.9). Relays shall be tested in accordance with method 302 of MIL-STD-202 with the relay in the energized and deenergized positions. The following details shall apply:

a. Test condition: 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 IX.

TABLE IX. Test details for dielectric withstanding voltage.

Points of application	Test voltage
Between case, frame, or enclosure, and between all contacts in the energized and deenergized positions Between case, frame, or enclosure and coil(s) Between all contacts and coil(s) Between open contacts in the energized and deenergized positions Between coils of dual-coil relays Between contact poles in the energized and deenergized positions	1,000 ±5 percent volts ac plus twice rated voltage or as specified (see 3.1)

4.8.7 Dielectric withstanding voltage (see 3.10). Relays shall be tested as specified in 4.8.7.1 and, when specified (see 3.1), in accordance with 4.8.7.2. Testing in accordance with 4.8.7.2 is not required for group A testing.

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

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

b. Maximum leakage current: 1 mA.

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

4.8.7.2 At reduced barometric pressure. Relays specified for operations above 10,000 feet shall be tested in accordance with method 105 of MIL-STD-202. The following details shall apply:

a. Method of mounting: Normal mounting means.

b. Test condition: Test condition C, except maximum ambient temperature and the altitude shall be as specified.

c. Tests during subjection to reduced pressure: As specified in 4.8.6; except test voltage shall be 350 volts. Duration of application, see 4.8.7.1c.

d. Following these tests, relays shall be examined for evidence of arcing, flashover, insulation breakdown, and damage.

e. Not applicable.

4.8.8 Electrical characteristics.

4.8.8.1 Coil resistance (see 3.11.1). Relay coils shall be tested in accordance with method 303 of MIL-STD-202.

4.8.8.2 Contact voltage drop and static contact resistance (see 3.11.2).

4.8.8.2.1 Static contact resistance. Relays shall be tested in accordance with method 307 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of connection: Connection jigs or other suitable means.

b. Test load: 10 mA maximum at 6 V maximum (dc or peak ac). Post tests loads for high level life and intermediate current tests shall be 100 mA at 28 V dc.

c. Number of actuations prior to measurement: None.

d. Number of test activations: Three.

e. Number of measurements per activation: One in each closed contact position.

f. 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).

4.8.8.2.2 Contact voltage drop. Relays shall be tested in accordance with method 307 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of connection: Connection jigs or other suitable means.

b. Test load: Rated resistive at 6 V maximum (dc or peak ac). Contacts shall not make or break this load.

c. Number of actuations prior to measurement: None.

d. Number of test activations: Ten. For group A, one reading per contact shall be used.

e. Number of measurements per activation: One in each closed contact positions. Unless otherwise specified (see 3.1), the contact voltage drop shall be measured after 1.5 *.5 seconds.

f. 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).

g. Post test loads for high level life and intermediate current: Current and voltage shall be the same as the life or intermediate test current or 100 milliamperes at 28 volts dc maximum.

4.8.8.3 Specified pickup, hold, and dropout values (voltages) (see 3.11.3). Specified pickup, hold, and dropout values (voltage) shall be measured as specified in 4.8.8.3.1, 4.8.8.3.2, 4.8.8.3.3, or 4.8.8.3.4. Unless otherwise specified (see 3.1), for qualification and group D inspection, the relay shall be mounted in each of three mutually perpendicular planes. For quality conformance inspection, the relay mounting position is optional. A suitable indicating device shall be used to monitor contact position. For group A inspection, it is permissible to perform specified pickup, hold, and dropout values (voltages) using step function voltage changes as specified in 4.8.8.3.1 or 4.8.8.3.2, 4.8.8.3.3, and 4.8.8.3.4. Due to the fact that slow ramping will overheat relay coils and vary specified pickup, hold, and dropout values (voltages), the step function method shall be the governing method in cases of dispute. For qualification, group C and group D inspections testing, specified pickup, hold, and dropout values (voltages) shall be measured at minimum, ambient and maximum temperatures specified (see 3.1).

4.8.8.3.1 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. For group A inspection, it is permissible to perform specified pickup value (voltage) using a step function voltage change as follows and as illustrated on figure 4. In addition to step function changes in voltage levels as depicted on figure 4, 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. Apply rated coil voltage.

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

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

d. Step down to zero voltage.

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

4.8.8.3.2 Specified pickup (latch) 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 dual coil relays or in the plus contrasting color bead mode for single coil relays (see 3.1). If not, apply rated voltage to establish last energized position. Gradually increase the voltage to the latching coil or in the latching direction for single coil relays 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 or in the reset direction for single coil relays until the contacts transfer and the specified pickup (reset) value (voltage) shall be measured. For group A inspection, it is permissible to perform maximum pickup (latch/reset) value (voltage) using a step function as follows and as illustrated on figure 4.

a. Step up to specified pickup (latch) value (voltage) for dual coil relay or in the latch direction for single coil relays. The contacts shall have transferred to the latch position.

b. Step up to rated voltage and then stepdown to zero.

c. Step up to specified pickup (reset) value (voltage) for dual coil relays or in the reset direction for single coil relays. The contacts shall have transferred to reset position.

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

4.8.8.3.3 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 6.8). All contacts shall not change state. For group A inspection, it is permissible to perform this test using the step function voltage program described in 4.8.8.3.1 and figure 4.

4.8.8.3.4 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 deenergized position and the specified dropout value (voltage) shall be measured. For group A inspection, it is permissible to perform this test using the step function voltage program described in 4.8.8.3.1 and figure 4.

4.8.8.4 Operate and release time (see 3.11.4). 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 volts dc maximum or peak ac at 10 mA maximum. The circuit shown on figure 5, 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. 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 and shall be done as a part of qualification inspection only.

Specified pickup, hold, and dropout values (voltages)

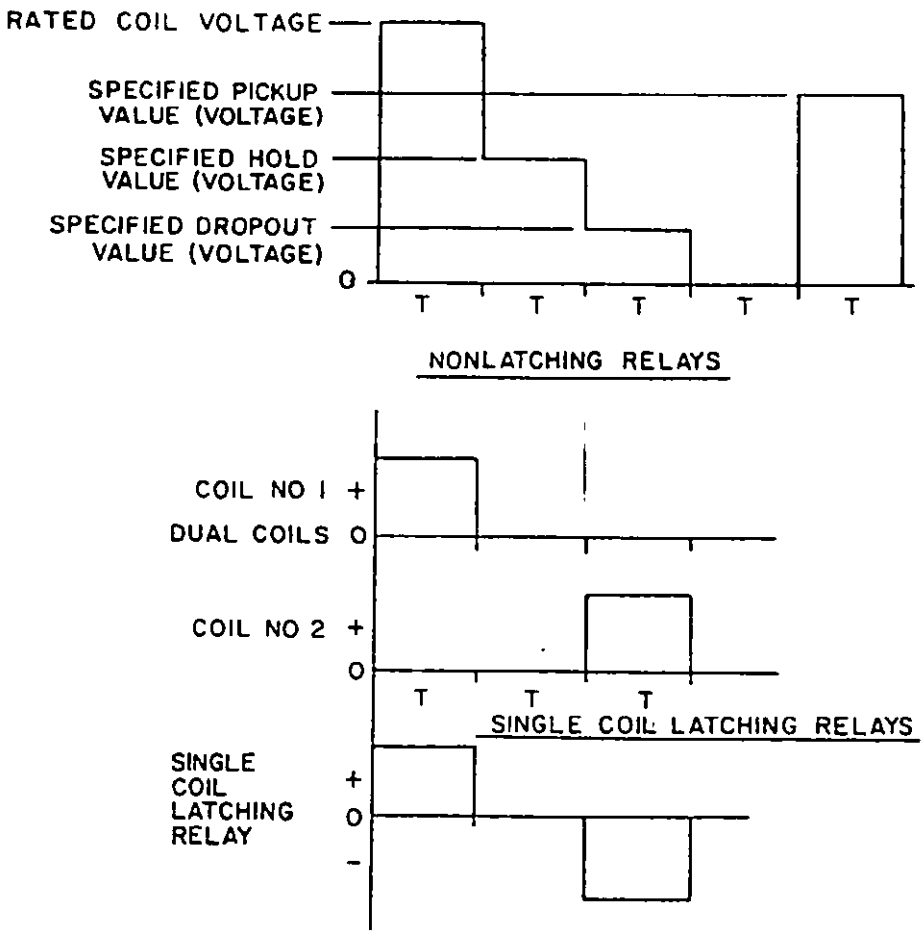
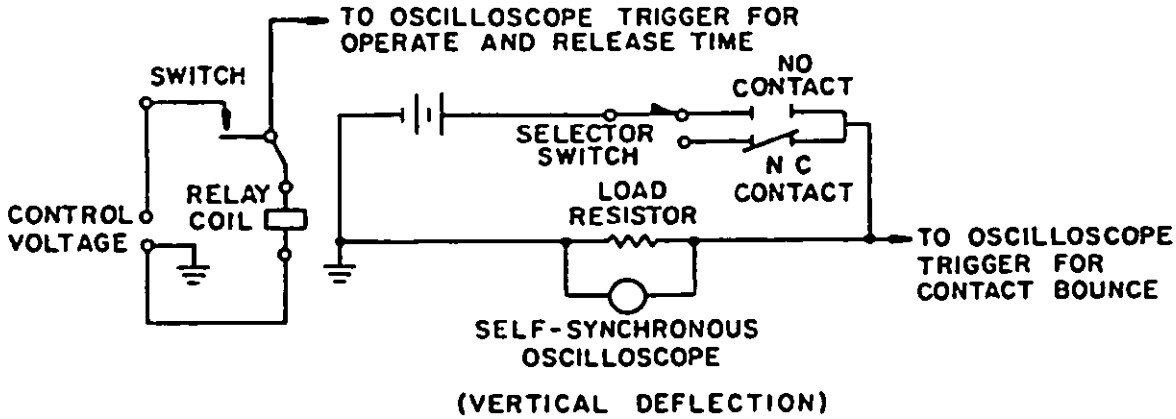


FIGURE 4. Optional specified pickup, hold, and dropout value (voltage) sequencing for group A inspection.



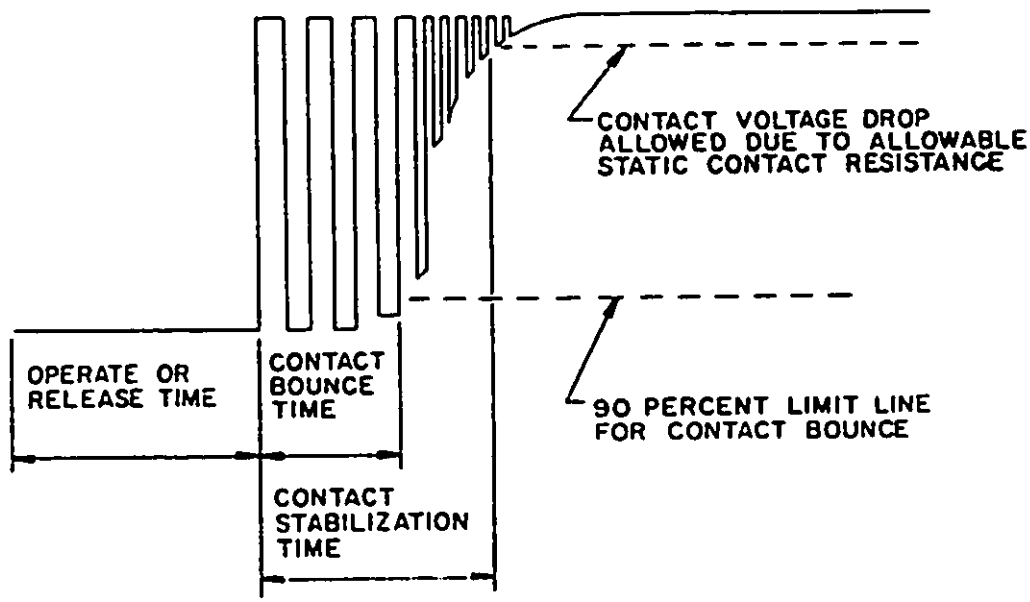


FIGURE 5. Typical circuit for operate and release time, contact bounce, and contact stabilization time with typical traces.

4.8.8.5 Contact dynamic characteristics (see 3.11.5).

4.8.8.5.1 Contact bounce (see 3.11.5.1). 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. Rated voltage shall be applied to the coil. Contacts shall be loaded with 6 volts 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 microseconds or greater. The circuit shown on figure 5, or equivalent, shall be used.

4.8.8.5.2 Contact stabilization time (see 3.11.5.2). 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 microsecond. 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 6.8) and the time for the dynamic contact resistance to stabilize to the static contact resistance). 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 4.8.8.5.1.

4.8.8.6 Coil transient suppression (applicable to dc operated relays with internal coil suppression (see 3.11.6). The coil shall be connected as shown on figure 6 and tested as specified below.

a. The switching relay shall be a mercury wetted contact switching relay or a solid state relay. E is rated operating voltage for the relay under test. The switching relay is operated from a source voltage independent of E. CRO is cathode-ray oscilloscope with a rise time of .020 microsecond or less. The horizontal (time) deflection scale shall be set at .5 to 1 millisecond per division (.5 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 (i.e., cm or mm).

b. The source, E, shall be a low impedance source (such as batteries) 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 to be driven at a 10 ±2 Hz cycling rate with approximately equal open and closed times.

(1) The reading shall be observed on the oscilloscope. The magnitude of the induced voltage transient shall be noted. A typical trace is presented on figure 7.

(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.

4.8.8.7 Neutral screen (applicable to two coil latching relays only) (see 3.11.7). Relays shall be tested as follows:

a. Apply rated coil voltage to both coils simultaneously for a period of 10 milliseconds 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 4.8.8.7a 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 ±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.

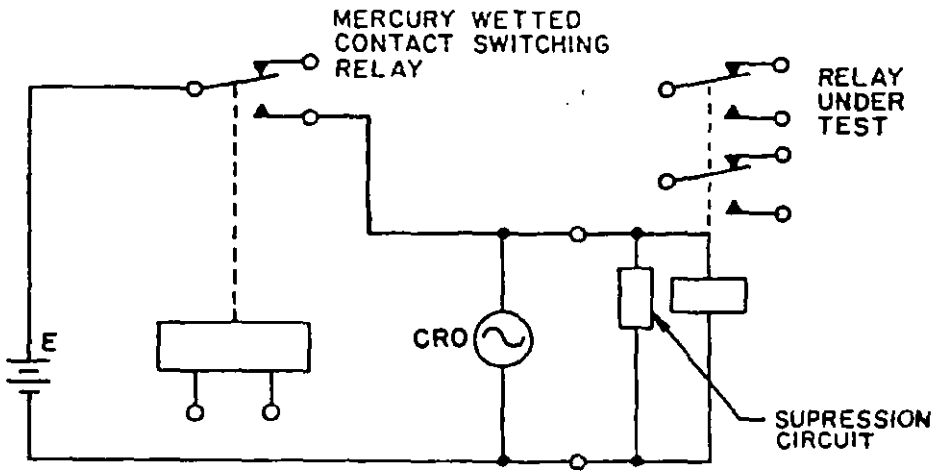
(2) Repeat step 4.8.8.7a above.

(3) Apply a 10 ±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.

4.8.9 Thermal shock (see 3.12). Relays shall be tested in accordance with method 107 of MIL-STD-202. The following details and exception shall apply:

a. Special mounting: Relays shall be suspended in the test chamber by twine, or other nonheat conducting material, in a plane parallel to the normal air flow. 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.



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

FIGURE 6. Coil transient suppression test circuit.

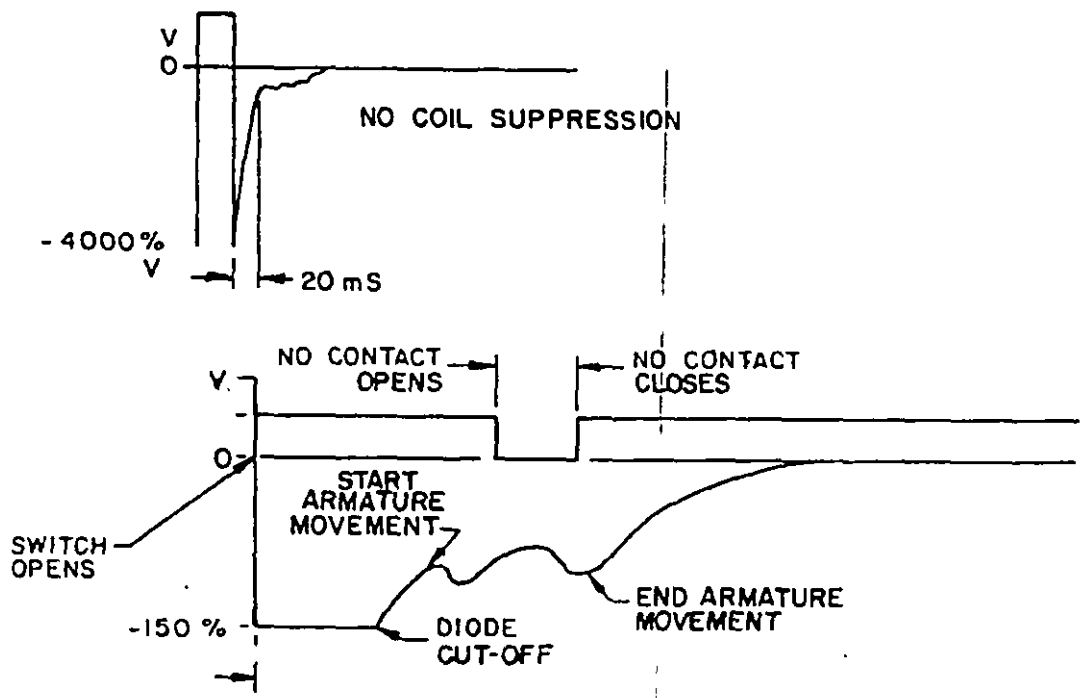


FIGURE 7. Typical transient voltage.

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 insulation resistance, specified pickup and dropout values (voltages) and operate and release time, shall be measured as specified in 4.8.6, 4.8.8.3 and 4.8.8.4, 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 shall then be measured as specified in 4.8.7.1.

4.8.10 Shock (specified pulse) (see 3.13). Unless otherwise specified (see 3.1), relays shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting method: Rigidly mounted by normal mounting means.

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 deenergized 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 microseconds and no false closure or abnormal bridging of open contacts occurs in excess of 1 microsecond. 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.

4.8.11 Vibration (see 3.14).

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

a. Method of mounting: As specified in 4.8.10a.

b. Electrical load conditions: Relays shall be tested with the coil energized for 2 hours at rated voltage and with the coil deenergized for 2 hours, in each of the three mutually perpendicular directions (relays with intermediate duty coils shall not be energized above their duty cycle). Contacts shall be loaded as specified in 4.8.11.1d.

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

d. Tests during vibration: As specified in 4.8.10c.

e. Inspection 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 3000 Hz. The relay shall be vibrated in each of three mutually perpendicular axes. For all contact forms except contact form "A", the cycle shall consist of 3 minutes up with the coil energized with rated voltage and 3 minutes down with coil deenergized. The cycle for form contact "A" shall consist of 3 minutes up with the coil deenergized and 3 minutes down with the coil energized. Latching relays shall remain in each latched position with no voltage applied to the coils.

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

a. Method of mounting: As specified in 4.8.10a.

b. Electrical load conditions: Relays shall be tested with the coil energized at rated voltage for 15 minutes and with the coil deenergized for 15 minutes, in each of three mutually perpendicular directions. Contacts shall be monitored as specified in 4.8.11.2d.

c. Test condition: Test condition 1G (0.4 G^2/Hz, 23.1 rms G).

d. Tests during vibration: As specified in 4.8.10e.

e. Examination after test: As specified in 4.8.11.1e.

4.8.12 Acceleration (unless otherwise specified, see 3.1 and 3.15). Relays shall be tested in accordance with method 212 of MIL-STD-202. The following detail and exceptions shall apply:

a. Mounting of specimens: As specified in 4.8.10a.

b. Test conditions: Test condition A, 30 G's, unless otherwise specified (see 3.1) (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 deenergized 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 4.8.10f.

4.8.13 Terminal strength (see 3.16). Relays shall be tested in accordance with method 211 of MIL-STD-202 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.

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

4.8.13.2 Bend test (all terminal types). Each terminal shall be bent 20° to 30° in both directions from the normal axis in a given plane and after returning it to normal, the terminal shall be bent 20° to 30° 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 X shall be applied to each terminal for a period of 15 to 30 seconds.

TABLE X. Pull force.

Terminal diameter (inches)	(mm)	Pull force (pounds)
0.035 - 0.047	(.89 - 1.19)	5 ±0.5
0.023 - 0.0349	(.58 - .886)	3 ±0.3
Less than 0.023	(.58)	2 ±0.2

4.8.13.3 Twist test (wire lead terminals only). All terminals shall be tested as specified in test condition D except application of torsion shall be 180° for a total of four rotations 720°. Following the test, the pull test shall be performed as specified in 4.8.13.1 except the direction of the applied force shall be 45° ±5° from the normal axis of the terminal for a period of 15 to 30 seconds.

4.8.14 Magnetic interference (see 3.17). The relay under test and eight similar relays shall be mounted in the same physical orientation by nonmagnetic means, as shown on figure 8. Unless otherwise specified, grid-spaced relays shall be mounted so that all terminals are positioned in the closest possible grid pattern. Unless otherwise specified, the spacing between terminals and tops of adjacent terminals shall be as shown on figure 8. Specified pickup, hold and dropout values (voltages) shall be measured on the relay under test as specified in 4.8.8.3 with the coils of the eight outer relays energized at rated voltage (Unless otherwise specified, the magnetic polarity of each relay shall be similarly oriented.) This measurement shall be repeated with the coils of the eight outer relays deenergized.

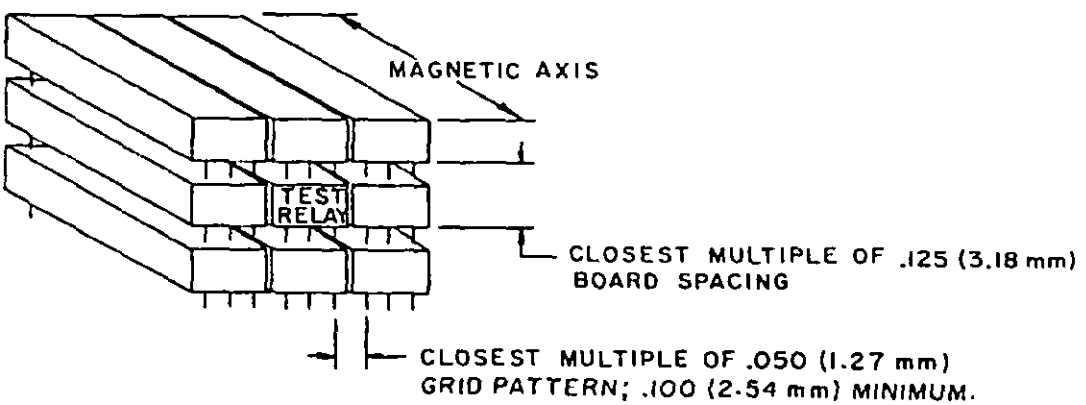
4.8.15 Coil life (not applicable to intermittent duty relays) (see 3.18). Unless otherwise specified, see 3.1, relays shall be tested for 1,000 hours as follows (see figure 9):

a. Relays shall be mounted as specified in 4.3.5. Each contact terminal shall be connected as specified in 4.8.8.2.1a.

b. During the maximum temperature portion of the test, rated coil voltage 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 shall not be loaded. Ambient temperatures shall be varied as shown on figure 9, 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, static contact resistance and operate and release time shall be measured as specified in 4.8.8.2 and 4.8.8.4 and the values shall be recorded. Measurements of coil resistance and static contact resistance as specified in 4.8.8.1 and 4.8.8.2, shall be taken at room temperature initially, then again after 250 ±25 hours, and 750 ±25 hours and the values shall be recorded. Specified pickup, hold, and dropout values (voltages) (only in the special mounting plane) (see 4.3.5) measurements shall be made as specified in 4.8.8.3 during the last temperature cycle after allowing the relay to stabilize, deenergized, at each of the temperature extremes, and the values shall be recorded. Measurements shall be taken at room temperature of dielectric withstanding voltage, insulation resistance, coil resistance, static contact resistance, operate and release time, and contact bounce as specified in 4.8.7.1, 4.8.6, 4.8.8.1, 4.8.8.2, 4.8.8.4, and 4.8.8.5, respectively. Relays shall then be examined for evidence of damage.

d. Examination after test: As specified in 4.8.10f.



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 8. Mounting array for adjacent similar relays.

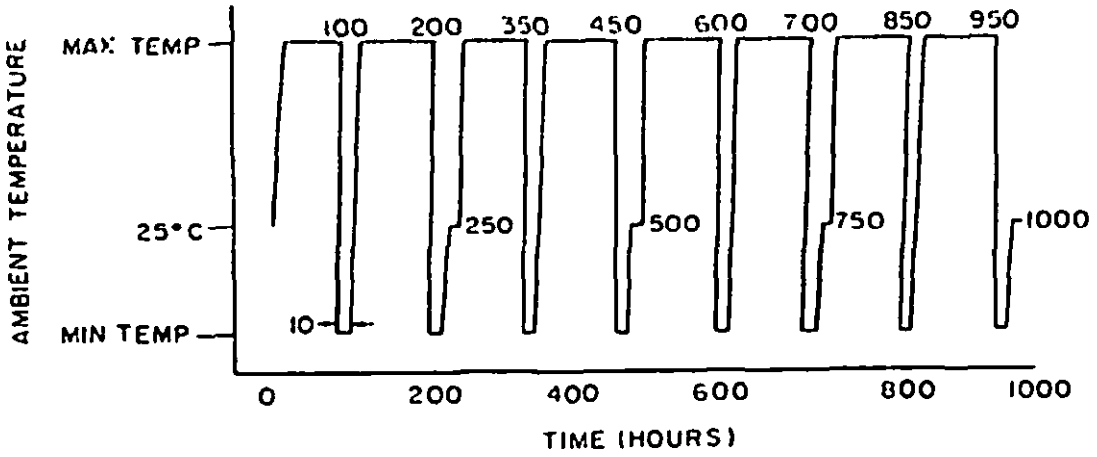


FIGURE 9. Ambient temperatures.

4.8.16 Resistance to soldering heat (see 3.19). Relays shall be tested in accordance with method 210 of MIL-STD-202. The following details and exception shall apply:

a. Depth of immersion in molten solder: Within .060 ±.020 inch (1.52 ±.051 mm) of the relay base.

b. Test condition: Test condition B.

c. Measurements after test: Insulation resistance, coil resistance, contact resistance, and specified pickup, hold, and dropout values (voltages), shall be measured as specified in 4.8.6, 4.8.8.1, 4.8.8.2, and 4.8.8.3, respectively.

d. Examination after test: As specified in 4.8.10f.

4.8.17 Salt spray or salt atmosphere (corrosion) (see 3.20). Relays shall be tested as specified in 4.8.17.1 or 4.8.17.2 when specified (see 3.1).

4.8.17.1 Salt spray, MIL-STD-202. Relays shall be tested in accordance with method 101 of MIL-STD-202. The following details and exceptions shall apply:

a. Applicable salt solution: 5 percent.

b. Test condition: 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.

4.8.17.2 Salt atmosphere (corrosion), MIL-STD-750. Relays shall be tested in accordance with method 1041 of MIL-STD-750. The following detail shall apply: Examination after test: As specified in 4.8.17.1c.

4.8.18 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 XI for 50 operations at each of the maximum system voltage (open circuit) ratings. For double throw relays, separate tests shall be performed for the normally open and for the normally closed contacts.

TABLE XI. 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	400	400	600	0.2	20
25 and up	800	800	800	0.2	20

4.8.19 Rupture (see 3.22). The relay shall be made to make and break its rated rupture current at each of the maximum voltage (open circuit) ratings, for a minimum of 50 cycles using the values of current and cycling time in table XII. 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).

TABLE XII. 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 ±0.05	Off ±1
25 and under	500	500	800	0.2	30

4.8.20 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). Relays shall be tested at 28 V dc and 115/200 V ac, 400 Hz, three-phase. The load shall be resistive. 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.

4.8.21 Intermediate current (see 3.24). Relays shall be tested as specified in method 312 of MIL-STD-202. The following details and exceptions shall apply:

a. Maximum contact resistance: As specified in 3.24.

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

c. Cycling rate: 10 ±2 cycles per minute with minimum of 75 percent coil "on" time.

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.

4.8.22 Life (see 3.25). Unless otherwise specified (see 3.1), relays shall be cycled for 100,000 cycles with contacts loaded in accordance with 4.8.22.1 through 4.8.22.4, as applicable. An individual relay shall be used for each load condition specified. 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. Ambient temperature of relays shall be +125°C minimum. Each contact shall be monitored during each operation in accordance with 4.8.3.2.4. All contacts in each sample unit shall switch identical loads. Following cycling, the electrical continuity of each case-grounding fuse shall be checked.

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

4.8.22.2 Motor load.

4.8.22.2.1 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 and breaking the normal rated motor load.

4.8.22.2.2 Motor load, ac. The ac motor load test shall be as specified in 4.8.22.2.1, except that the value of the ac inrush current shall be five times rated motor load current, or as specified (see 3.1).

4.8.22.3 Inductive load. Current shall be rated current. Appropriate inductive load components in accordance with MIL-I-81023 shall be used. A suitable resistor may be placed in the circuit to obtain rated steady-state current flow. Cycling rate shall be 10 ±1 cycles per minute with equal "on" and "off" periods.

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

a. The relay 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 10.

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.

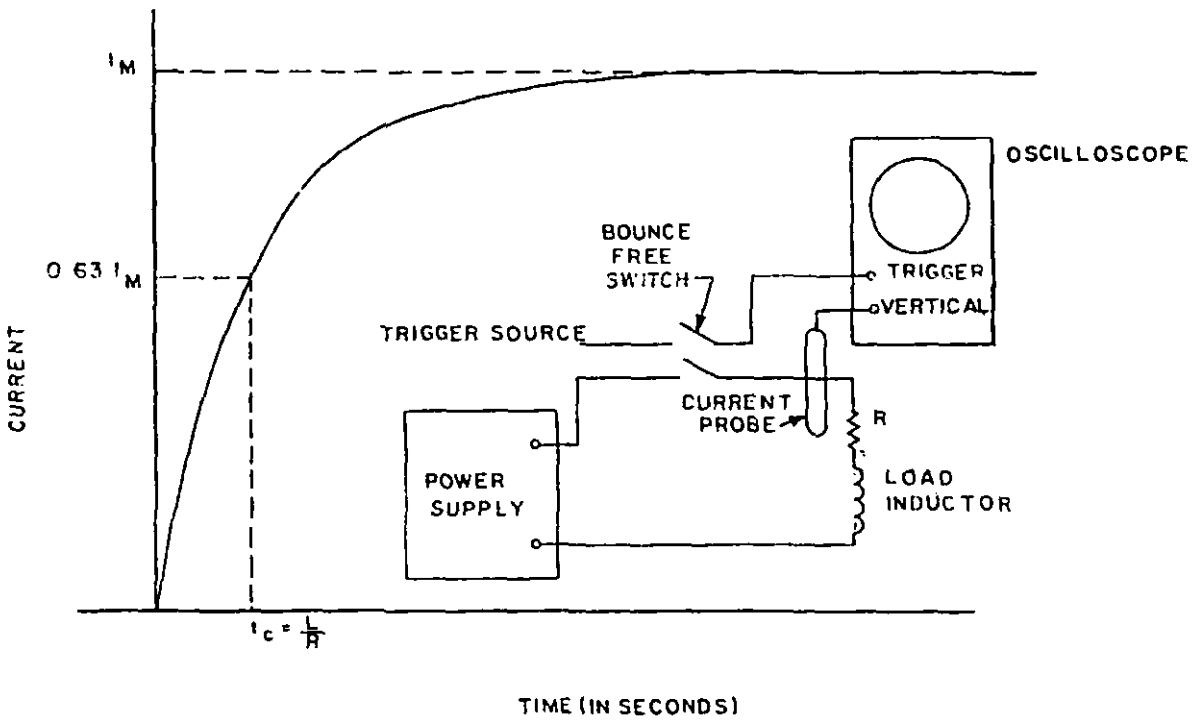


FIGURE 10. DC inductive load (inductive current rise time curve).

4.8.22.3.2 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).

4.8.22.4 Lamp load. Unless otherwise specified, the lamp load shall be performed with the 28 V dc power supply voltage. Relays shall be subjected to making 12 times the rated lamp load and breaking the rated lamp load. The duration of the 12 times inrush shall be 0.015 to 0.020 second, the total "on" time shall be 2 ±0.05 seconds and the "off" time shall be 7 ±2 seconds.

4.8.22.5 Low level and mechanical life. Relays shall be cycled 400,000 cycles. The first 100,000 cycles only are to be monitored and used for failure rate level determination. The minimum cycle time shall be 10X the sum of the maximum operate and release times for the relay under test. Each contact load shall be 10 to 50 microamperes at 10 to 50 mV (dc or peak ac). The coil shall be energized at rated voltage during 50 ±10 percent of each cycle. The remaining 300,000 cycles need not be monitored. 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.

4.8.22.6 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 ±1 V dc. During each cycle, the relay coil shall be energized for 29 ±3 seconds and deenergized for 1.5 ±0.5 seconds. 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. Monitoring shall be performed to provide either a continuous record of contact voltage drop or cause cessation of the test if the values of table XIII are exceeded. 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 prior to life test in accordance with 4.8.22.3. 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

4.8.23 Resistance to solvents (see 3.26). Relays shall be tested in accordance with method 215 of MIL-STD-202 except temperature of solvents a, b, and d 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: Two, using first solvent solution; and one specimen each, using second, third, and fourth solvent solutions. A total of five specimens shall be used.

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

4.8.24 Particle impact noise detection (PIND, when specified see 3.1 and 3.27). When specified, relays shall be tested as specified in appendix B.

4.8.25 Continuous current (see 3.28). This test shall be performed at the maximum temperature and altitude specified for the class of relay being tested (see 3.1). Other conditions of the test shall be in accordance with 4.7.26. 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 coils of types I and II relays shall be energized continuously for 97 hours. Type III relays shall be cycled for a minimum operating cycles specified (see 3.1), at a duty cycle as shown in 4.7.26.4 for resistive load. 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.

5. PACKAGING

5.1 Preservation. Preservation shall be level A, B, or C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Cleaning. Relays shall be cleaned in accordance with MIL-P-116, process C-1.

5.1.1.2 Drying. Relays shall be dried in accordance with MIL-P-116.

5.1.1.3 Preservative application. Preservatives shall not be used.

5.1.1.4 Unit packs. Relays shall be individually unit packed in accordance with the methods of MIL-P-116 designated herein insuring compliance with the applicable requirements of that specification.

5.1.1.4.1 Hermetically sealed relays. Hermetically sealed relays shall be unit packed in accordance with method III. The unit container shall conform to variety 2 of PPP-B-566 or PPP-B-676, or PPP-B-636, class weather resistant.

5.1.1.5 Intermediate packs. Intermediate packs are not required.

5.1.2 Level B. The requirements for level B shall be as specified for level A except that submethod IA-8 of MIL-P-116 shall be substituted for submethod IC-8 and any variety of the unit, supplementary, and intermediate containers specified may be used (see 5.1.1.4.1).

5.1.3 Level C. The level C preservation of relays shall conform to the MIL-STD-2073/1 requirements for this level.

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A. Relays, preserved as specified in 5.1, shall be packed in wood boxes conforming to PPP-B-601, overseas type or PPP-B-621, class 2. Closure and strapping shall be in accordance with the applicable container specification except that metal strapping shall conform to QQ-S-781, type I, finish A. The requirements for level B packing shall be used when the total quantity of a stock numbered relay for a single destination does not exceed a packed volume of 1 cubic foot (0.0283 cubic meter).

5.2.2 Level B. Relays, preserved as specified in 5.1, shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirements. The requirements for box closure, waterproofing, and reinforcing shall be in accordance with method V of the PPP-B-636 appendix.

5.2.3 Level C. Relays, preserved as specified in 5.1, shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style optional, special requirements. Closures shall be in accordance with the appendix thereto.

5.2.4 Unitized loads. Unitized loads, commensurate with the level of packing specified in the contract or order, shall be used whenever total quantities for shipment to one destination equal 40 cubic feet (1.1328 cubic meters) or more. Quantities less than 40 cubic feet need not be unitized. Unitized loads shall be uniform in size and quantities to the greatest extent practicable.

5.2.4.1 Level A. Relays, packed as specified in 5.2.1, shall be unitized on pallets in conformance with MIL-STD-147, load type I, with a wood cap (storage aid 5) positioned over each load.

5.2.4.2 Level B. Relays, packed as specified in 5.2.2, shall be unitized as specified in 5.2.4.1 except that weather resistant fiberboard caps (storage aid 4) shall be used in lieu of wood caps.

5.2.4.3 Level C. Relays, packed as specified in 5.2.3, shall be unitized as specified in 5.2.4.2 except that the fiberboard caps shall be class domestic.

5.3 Marking. In addition to any special or other identification marking required by the contract (see 6.2), each unit, supplementary, intermediate and exterior container, and unitized load shall be marked in accordance with MIL-STD-129. The complete military or contractor's type or part number, as applicable (including the CAGE), shall be marked on each unit and supplementary pack in accordance with the identification marking provisions of MIL-STD-129.

5.4 Exterior containers. Exterior containers (see 5.2.1, 5.2.2, and 5.2.3) shall be of minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent practicable.

5.5 Packaging inspection. The inspection of these packaging requirements shall be in accordance with 4.7.3.

6. NOTES

(This section contains information of a general or explanatory nature that 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. Consult MIL-STD-1346 as to selection and application.

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

CAUTION: Transfer relay contacts shall not be used to ground load in one position and to 115-volt terminal in other position. Transfer relay contacts shall 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.

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.

6.1.2 Failure rate level. Failure rate 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.

6.1.3 Packaging provisions. The preservation, packing and marking specified herein are intended for direct shipments to the Government. However, at the option of the contractor or when so specified, the packaging provisions herein are also applicable for the preparation of relays for shipment from the parts contractor to the original equipment manufacturer.

6.2 Acquisition documents. Acquisition documents must specify the following:

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

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

c. Title, number, and date of the applicable specification sheet, and the PIN.

d. Levels of preservation and packing required (see 5.1 and 5.2).

e. If special or additional identification marking is required (see 5.3).

f. Marking requirements for failure rate level (see MIL-STD-690).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in applicable Qualified Products List (QPL) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the QPL is the Electronic Support Division AFLC, 2750 ABW/ES, Gentile Air Force Station, Dayton, Ohio 45444-5400; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC), Dayton, OH 45444. Application for qualification tests shall be made in accordance with provisions governing qualification SD-6 (see 6.3.1).

6.3.1 Provisions Governing Qualification, SD-6. Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.4 Conditions for use of level B preservation. When level B preservation is specified (see 5.1.2), this degree of protection should be used for the acquisition of relays for resupply worldwide under known favorable handling, transportation, and storage conditions.

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 before 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 permitted by table XIV. Table XIV shows metals and alloys (or plates) by groups which have common electromotive forces (EMF) within 0.05 volt when coupled with a saturated calomel electrode in sea-water at room ambient temperatures. All members of a group are considered as completely compatible, one with the other. Compatible couples between groups have been specified in table XIV based on a potential difference of 0.25 volt maximum. To simplify any arithmetic involved, table XIV shows, in addition to EMF against a calomel electrode, a derived "anodic index" with group 1 (gold) as 0 and group 18 (magnesium) as 175. Subtraction of a lower group anodic index gives the EMF difference in hundredths of a volt.

6.6.1 Groups. Table XIV sets up 18 primary groups. It may be noted that neither the metallurgical similarity or dissimilarity of metals is the parameter for selection of compatible couples. All members within a group, regardless of metallurgical similarity, are considered inherently nonsusceptible to galvanic action, when coupled with any member within the group; for example, such dissimilar metals as platinum and gold. Similarly, such basically dissimilar alloys as austenitic stainless steel, silver-solder, and low brass (all members of group 5) are inherently nonsusceptible when coupled together.

6.6.2 Compatibility graphs. Permissible couple series are shown in table XIV by the graphs at the right. Members of groups connected by lines will form permissible couples. A 0 indicates the most cathodic member of each series, a 0 an anodic member, and the arrow indicates the anodic direction.

6.6.3 Selection of compatible couples. Proper selection of metals in the design of equipment will result in fewer intermetallic contact problems. For example, for sheltered exposure, neither silver nor tin require protective finishes. However, since silver has an anodic index of 15 and tin 65, the EMF generated as a couple is 0.50 volt, which is not allowable by table XIV. In this case, other metals or plates will be required. It should be noted that, in intermetallic couples, the member with the higher anodic index is anodic to the member with the lower anodic index and will be susceptible to corrosion in the presence of an electrolytic medium. If the surface area of the cathodic part is significantly greater than that of the anodic part, the corrosive attack on the contact area of the anodic part may be greatly intensified. Material selection for intermetallic contact parts, therefore, should establish the smaller part as the cathodic member of the couple, whenever practicable.

6.6.4 Plating. When base metals intended for intermetallic contact form couples not allowed by table XIV, they are to be plated with those metals which will reduce the potential difference to that allowed by table XIV.

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.

TABLE XIV. Compatible couples (see 6.6). 1/

Group no.	Metallurgical category	EMF (volt)	Anodic index (0.01 V)	Compatible couples
1	Gold, solid and plated; gold-platinum alloys; wrought platinum (most cathodic)	+0.15	0	
2	Rhodium plated on silver-plated copper	+0.05	10	
3	Silver, solid or plated; high silver alloys	0	15	
4	Nickel, solid or plated; monel metal, high nickel-copper alloys	-0.15	30	
5	Copper, solid or plated; low brasses or bronzes; silver solder; German silver; high copper-nickel alloys; nickel-chromium alloys; austenitic corrosion-resistant steels	-0.20	35	
6	Commercial yellow brasses and bronzes	-0.25	40	
7	High brasses and bronzes; naval brass; Muntz metal	-0.30	45	
8	18 percent chromium type corrosion-resistant steels	-0.35	50	
9	Chromium, plated; tin, plated; 12 percent chromium type corrosion-resistant steels	-0.45	60	
10	Tin-plate; terneplate; tin-lead solder	-0.50	65	
11	Lead, solid or plated; high lead alloys	-0.55	70	
12	Aluminum, wrought alloys of the duralumin type	-0.60	75	
13	Iron, wrought, gray, or malleable; plain carbon and low alloy steels, armco iron	-0.70	85	
14	Aluminum, wrought alloys other than duralumin type; aluminum, case alloys of the silicon type	-0.75	90	
15	Aluminum, case alloys other than silicon type; cadmium, plated and chromated	-0.80	95	
16	Hot-dip-zinc plate; galvanized steel	-1.05	120	
17	Zinc, wrought; zinc-base die-casting alloys; zinc, plated	-1.10	125	
18	Magnesium and magnesium-base alloys, case or wrought (most anodic)	-1.60	175	

1/ Compatible couples: Potential difference of 0.25 volt maximum between groups.

6.8 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 hermeticity of a hermetically sealed relay.

Bifilar winding: Two or more windings with the wire of each winding alongside the other, matching turn for turn; may be either inductive or noninductive.

Bistable (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).

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.

Contacts: The current carrying parts of a relay that open or close electrical circuits.

Contact, closed: A normally closed contact with the relay deenergized is a closed contact. A normally open contact with the relay operated is a closed contact.

Contact, open: A normally closed contact with the relay operated is an open contact. A normally open contact with the relay deenergized is an open contact.

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

Contact bifurcated: A forked or branched, contacting member so formed or arranged, as to provide dual contacting.

Contact bounce: Intermittent opening of contacts after initial closure due to contact impact.

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 reached before any contact change occurs.

Normally closed contacts: Those contacts that are closed with the relay deenergized.

Normally open contacts: Those contacts that are open with the relay deenergized.

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.

Operation, relay: A relay operation is defined as when a relay changes from an initial condition to the prescribed condition. For example, normally open to closed or vice versa. Therefore, a relay operation is one-half of a cycle.

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.

Relay, differential: A double input relay which is actuated by the polar signal resulting from the algebraic addition of dual inputs.

Relay, null-seeking: A relay of double throw configuration and a stable center-off position. Either side of the double throw contact can be activated by and for the duration of the polar actuating signal.

Relay, sensitive: A relay that operates on low input power commonly defined as 100 milliwatts or less.

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.

Saturation: The condition attained in a magnetic material when an increase in magnetizing (coil) current produces no appreciable increase in flux.

Sensitivity: Pickup value expressed in terms of milliwatts (or watts).

Silicone: Any of a group of semi-inorganic polymers based on the structural unit R_2 SiO, 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.

Time, contact bounce: The time interval from initial closure of a contact to the end of bounce during pickup and dropout.

Time, operate: The time interval from coil energization to initial closure of the last open contact. Unless otherwise stated, it does not include contact bounce time.

Time, release (not applicable to latching relays): The time interval from coil deenergization to initial closure of the last open contact. Unless otherwise stated, it does not include bounce time.

Time, transfer: 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.

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.

Voltage rated coil: The coil voltage at which the relay is to operate and meet all specified electrical, mechanical and environmental requirements.

Caution note: The use of any coil voltage less than the rated voltage will compromise the operation of the device.

6.9 Part or Identifying Number (PIN): The PIN should be structured in accordance with 1.2.

6.10 Subject term (key word) listing.

All welded
Electromagnetic
Established reliability
Hermetically sealed
Low level contact rating

APPENDIX A

GUIDELINES FOR CLEANING AND SMALL PARTICLE INSPECTION

10. SCOPE

10.1 Scope. The following processes, requirements, and methods of examination are offered as guidelines for performing the internal visual inspection and cleaning of relays prior to canning. These guidelines may be used both by the supplier in preparing his internal procedures and by the audit team in reviewing a supplier's procedures. This information is not intended to provide all possible requirements, processes and test methods for internal inspections and cleaning. They are merely guidelines and should be used as such by the supplier and the audit team. Actual inspection procedures and criteria shall be in accordance with the supplier's process as approved by the qualifying activity. This appendix is not a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENT

20.1 Government standard.

FED-STD-209 - Clean Room and Work Station Requirements, Controlled Environment.

30. GENERAL GUIDELINES

30.1 Examination for contamination. Visually examine the following areas using the guidelines defined in detailed explanation of inspection guidelines (see 40).

a. Contact assembly, contact surfaces, stationary and movable contacts, and springs.

b. Coil, pole piece, armature, and header.

40. DETAILED EXPLANATION OF INSPECTION GUIDELINES

The suppliers procedures shall contain the following inspection points as a minimum and shall contain criteria for acceptance and/or rejection.

40.1 Moving contact assembly and springs. Inspect the moving contact assembly for proper installation and position. Any springs must clear all adjacent parts for both positions of the armature. Support brackets for the moving contact assembly shall be free of cracks and fractures (20 to 30X).

40.2 Contact surfaces (fixed and movable). Inspect surfaces for scratches or burrs in contact mating area and cracked or peeling plating.

Inspect mating contact surfaces for proper alignment for both positions of the armature. Inspect all contact areas for fibrous materials and other contaminants (20 to 30X). Inspect underside of contact supports for tool marks (20 to 30X) (see 40.6b). Inspect contact terminals for weld splatter (20 to 30X).

40.3 Coil. Inspect coil for the following:

a. Evidence of poor weld on each coil lead wire.

b. Weld splatter at coil terminals (20 to 30X).

c. Proper lead coil dress. Ensure clearance to all moving surfaces. Coil leads should not be kinked and should not be stretched tight from coil to coil lead post (20 to 30X), i.e., adequate stress relief shall exist. Length should not be excessive.

d. Nicks in the coil lead wire due to the stripping of the insulation (20 to 30X).

e. Coil assembly for loose or frayed tape wrapping or insulation.

40.4 Armature and pole piece. Inspect armature and pole piece gap for weld splatter and contamination (20 to 30X).

40.5 Header. Inspect header (20 to 30X) for the following:

a. Unacceptable tool marks.

b. Glass seals.

c. Weld splatter.

d. Cracked or peeling plating.

e. Proper alignment of header and frame.

40.6 Inspection guidelines.

a. Weld splatter or weld expulsion balls observed under 20 to 30X magnification shall be acceptable if capable of withstanding a probing force as specified applied using an approved, calibrated force gauge. User may apply a maximum force as specified during precap inspection. Each suspect weld splatter or weld ball shall be probed only one time by the user during precap.

b. Detrimental marks, burrs, or scratches made by tooling during assembly are not acceptable.

c. Cracks in the header pin glass seals shall be deemed acceptable or unacceptable in accordance with the inspection criteria in accordance with the applicable specification.

d. Loose insulation strands from coil wrap, bobbin, and other insulators are not acceptable. Insulation strands that are an integral part and extension of the coil wrap or coil lead insulation are acceptable unless they are of sufficient length or location that they can interfere with the normal actuation and operation of the relay.

50. CLEANING

50.1 Cleaning. Cleaning and small particle inspection shall be performed in accordance with supplier processes as approved by the qualifying activity. FED-STD-209 provides additional guidelines for limiting the amount of contamination introduced into the air in the room by closely controlling the personnel, operations, and materials inside the facility.

a. Cleaning shall be performed in a class 100 environment in accordance with FED-STD-209. Storage trays, transport trays, and covers shall be glass, nonmagnetic stainless steel, or glazed ceramic. Other materials which do not attract or generate particles may be used for storage trays, transport trays and covers if approved by the qualifying activity.

b. Relays with permanent magnets shall be demagnetized, if they can be remagnetized and stabilized after canning. The relays shall be demagnetized using a suitable device.

c. Ultrasonic cleaning.

Note: Caution: Fluid used in the ultrasonic cleaner and in the small particle inspection system must be filtered finer than 1 mil to preclude contamination.

(1) Clean relay trays and covers. Clean a sufficient quantity of trays and covers for storage and transport of relays, cans, and other parts for the remainder of required cleaning. Store in class 100 environment in accordance with FED-STD-209.

(2) Ultrasonically clean relays, can and any other parts and subassemblies that constitute the final assembly. Immediately after cleaning, store the parts in covered trays in a class 100 environment in accordance with FED-STD-209.

d. Vacuum clean parts in a class 100 environment. Using a pressure gun and filtered air/gas through a static eliminator, blow filtered air/gas on the parts, holding the parts in front of a vacuum inlet to trap loosened particles. Immediately store cleaned parts in the cleaned, covered trays.

CAUTION: Nozzles used to blow filters and relays during cleaning shall not be the safety siphon type.

60. SMALL PARTICLE INSPECTION

a. Perform small particle cleaning on relays, cans and any other internal parts and subassemblies that constitute the final assembly.

(1) Obtain freon from pre-filtered supply.

(2) Assemble a pre-cleaned flask, vacuum pump, filter holder, pre-cleaned 0.80 micron maximum filter, and pre-cleaned funnel. Fill funnel with pre-filtered freon and turn vacuum pump on. Repeat until flask is filled.

(3) Fill "pressurized container" with cleaned freon from step 2 above.

(4) Clean filter by blowing both surfaces with destaticized air. Using the pressurized container, wash both sides of the filter with clean filtered freon. Observe filter under 30X magnification: If any particles .001 inch (0.03 mm) or larger are observed, repeat the cleaning process until satisfactory results are obtained. The cleaned filter shall be used in the following step b.

b. Small particle inspection.

(1) Place filter holder and cleaned filter on a clean empty flask under funnel.

(2) Air blow all parts to be cleaned using destaticized air/gas. Place parts in funnel.

(3) Using a flask of filtered freon, pour the freon into the funnel, covering the parts to be cleaned. Cover funnel. Agitation of the freon around the part is recommended or using a pre-filtered freon, spray freon over parts into the funnel and cover funnel.

(4) Turn vacuum pump on. When all the freon has passed through the filter, turn vacuum pump off.

(5) Remove filter and examine under 30X magnification.

(6) If one or more particles .001 inch (0.03 mm) or larger are present on the filter, repeat steps 1 through 5 until results are satisfactory.

70. PROCESSING OF CLEANED RELAYS

a. Place cleaned parts in cleaned covered trays in preparation for canning the relays.

b. Can relays in class 100 clean area.

Note: If the can or cover is subsequently removed for any reason, pre-can visual inspection shall be repeated and this cleaning procedure shall be repeated.

c. Remagnetize and stabilize the relays if applicable.

d. If relays are required to be removed from the class 100 clean area, place a gummed clean label over the evacuation hole (if applicable) before removing from clean area.

e. Relays shall be manufactured, assembled and tested in controlled areas. After final cleaning, all processes and assembly performed on the relay while in a delidded configuration shall be accomplished on a class 100 laminar flow bench or in an area meeting the requirements of a class 100 clean room as defined in FED-STD-209. If a final cleaned relay leaves the flow bench or clean room, relay shall be lidded and evacuation hole(s) shall be covered by a method approved by the qualifying activity. Additional provisions shall be incorporated as required in all areas to prevent the generation and entry of particulate contamination into parts and assemblies. Additional provisions shall also be made as required in all areas to remove particulate contamination from the parts and assemblies. The supplier shall maintain records which verify that the required levels of cleanliness are maintained in all assembly and sealing areas.

80. REWORK

80.1 Rework. Relays that require rework or readjustment after capping, but prior to any welding of the enclosure, may be reworked or readjusted provided the examination and cleaning of 40 through 70 are repeated after the rework or readjustment.

APPENDIX B

PARTICLE IMPACT NOISE DETECTION (PIND)

10. SCOPE

10.1 Scope. The purpose of this test is to detect the presence of free moving particulate contaminants within sealed cavity devices. This test method is specifically directed toward relays and other devices where internal mechanism noise makes rejection exclusively by threshold level impractical. The test provides a nondestructive means of identifying those devices containing particles of sufficient mass that, upon impact with the case, excite the transducer. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS. This section is not applicable to this appendix.

30. EQUIPMENT

30.1 Equipment. The equipment required for the particle impact noise detection (PIND) test shall consist of the following (or equivalent). PIND instruments are available which incorporate items a through h (see figure 11).

a. An oscilloscope capable of 500 kHz response minimum, and a sensitivity of 20 mV/cm for visual display of the particle noise.

b. An audio system with speaker to monitor the audio signal from the PIND electronics. If headphones are used, the system shall provide safeguards against loud noise bursts.

c. A vibration shaker and driver assembly to accommodate the weight of the payload. The payload consists of the DUT (device under test), (PIND) transducer, the transducer isolator, preamplifier (when included), co-test shock mechanism (when included), a portion of the transducer cable and its restraints. The shaker and driver assembly shall be capable of providing essentially sinusoidal motion at:

(1) Condition A: 5g peak at 27 Hz in 3 axes.

(2) Condition B: 5g peak at 27, 40, and 100 Hz in optimum axis.

d. PIND transducer, calibrated to a peak sensitivity of -77.5 ±3 dB are 1 volt per microbar at a point within the frequency range of 150 - 160 kHz.

e. A sensitivity test unit (STU) (see figure 12) for periodic assessment of the PIND system performance. The STU shall consist of a transducer with the same tolerances as the PIND transducer and a circuit to excite the transducer with a 250-microvolt ±20 percent pulse. The STU shall produce a pulse of about 20 mV peak on the oscilloscope when the transducer is coupled to the PIND transducer with attachment medium.

f. PIND electronics, consisting of an amplifier with a gain of +60 ±2 dB centered at the frequency of peak sensitivity of the PIND transducer to amplify the transducer signal to a usable level for audio detection and oscilloscope display. The noise at the output of the amplifier shall not exceed 10 mV peak.

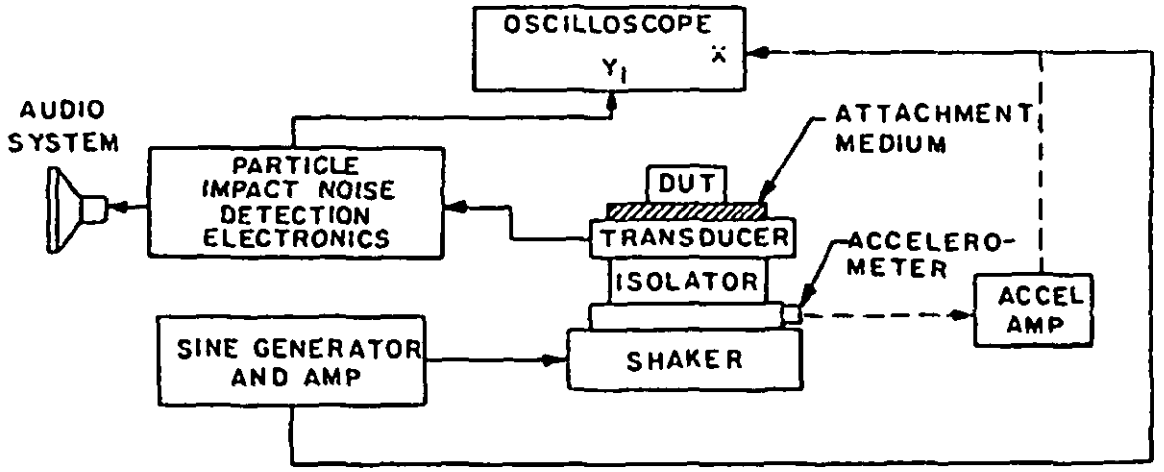
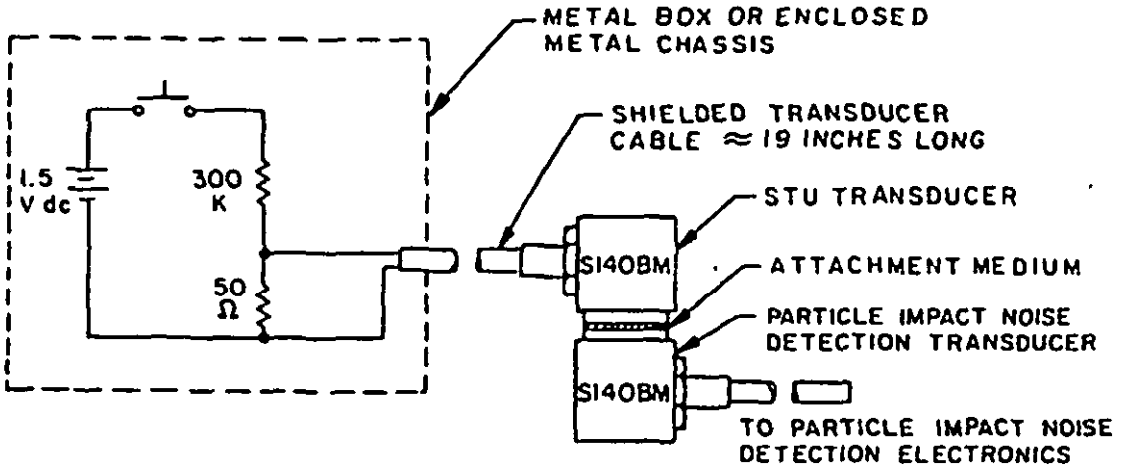


FIGURE 11. Typical particle impact noise detection system.



NOTES:
1. Pushbutton switch: Mechanically quiet, fast make, and gold contacts. E.G. T2 SN4 microswitch.
2. Resistance tolerance 5 percent noninductive.
3. Voltage source can be a standard dry cell.
4. The coupled transducers must be coaxial during test.
5. Voltage output to STU transducer 250 μV, ±20 percent.
6. A function generator with a 250 μV ±20 percent square wave output, at 150 kHz nominal with 50Ω output, impedance may be substituted for enclosed metal chassis.

FIGURE 12. Typical sensitivity test unit.

g. Co-test shock mechanism consisting of the integral co-test shock mechanism of 30.1c above (when included) capable of imparting shock pulses of at least 200g peak to the DUT, and shall be capable of providing a pulse duration not exceeding 1 millisecond. If the integral co-test shock system is used, the shaker vibration may be interrupted or perturbed for a period of time not to exceed 250 ms from initiation of the shock pulse.

Note: When co-test shock capabilities are not available, the DUT shall be pre-shocked per 40.4.1b.

h. Isolator material between the PIND transducer and the vibration shaker and driver when required to reduce background noise. The isolator shall have no resonance within the test frequency range.

i. Attachment medium. The attachment medium used to attach the DUT to the PIND transducer shall be either a viscous acoustic couplant or double-faced tape. A mechanical holding fixture that can be shown to produce no noise signature may also be used, in conjunction with acoustical couplant (if necessary) for large packages.

j. Special mounting adapters for devices which have irregular surfaces (see 40.5)

40. PROCEDURE

40.1 Test equipment setup. The test equipment shall be set up in a low noise area. Noise in this context refers not only to that audible noise which would normally interfere with listening but also power line noise, radiated R.F. noise or high frequency acoustic noise (150 - 160 kHz). Commercial equipment shall be connected as described in the operations manual. Otherwise, assembled PIND equipment shall be connected as shown on figure 11.

a. Audio output volume shall be adjusted to a comfortable noise level output.

b. Shaker drive frequency shall be adjusted in accordance with 40.3.

c. Shaker drive amplitude shall be adjusted in accordance with 40.3 and mounting adapter (if any) shall be in place.

d. Oscilloscope vertical deflection primary beam sensitivity (displaying PIND electronics output) shall be 20 millivolts/centimeter. Oscilloscope horizontal deflection shall be adjusted to 4 cm and shall obtain drive from the sine generator/amplifier accelerometer, or a time base (2 ms/cm) triggered from the accelerometer output.

40.2 Test equipment checkout. The test equipment checkout shall be performed daily or prior to the start of, and at the completion of, daily PIND testing with results recorded. Failure of the system to meet checkout requirements shall require retest of all devices tested subsequent to the last successful system checkout.

40.2.1 Shaker drive system checkout. The drive system shall achieve the shaker frequency and the shaker amplitude specified in 40.3. The drive system shall be calibrated so that the frequency settings are within ±8 percent and the amplitude vibration settings are within ±10 percent of the nominal values. If a visual displacement monitor is affixed to the transducer, it may be used for amplitudes between .04 and .12 inch (1.02 and 3.05 mm). An accelerometer may be used over the entire range of amplitudes and shall be used below amplitudes of .040 inch (1.02 mm).

40.2.2 Detection system checkout. With the shaker deenergized, the STU transducer shall be mounted face-to-face and coaxial with the PIND transducer using the recommended attachment medium. The STU shall be activated several times to verify low level signal pulses visually on the oscilloscope (approximately 20 millivolt peak or 10 millivolt peak above system noise). If a commercial instrument is used, follow the manufacturer's detection system checkout procedure. With the approval of the qualifying activity, an alternate calibrated noise generator may be used to perform the system checkout. In this case, the calibrated generator is tested in accordance with this procedure to demonstrate that oscilloscope traces are achieved to result in rejection.

Note: Not every application of the STU will produce the required amplitude but the majority of applications will do so.

40.2.3 System noise verification. For proper system operation, no extraneous noise can be permitted to exist in the system. During proper operation, the normal system noise, as observed on the oscilloscope, will appear as a fairly constant band and must not exceed 10 millivolts zero to peak. Extraneous noise is defined as noise in the system other than the permissible background noise that is present with no device on the transducer. Such noise can be due to a number of sources which must be eliminated or their effects guarded against, since those nonsignal noise spikes can appear as signals on the indicators. Common sources of noise are florescent lighting, heater elements, soldering irons and other switching transients, line transients and, especially, less than optimum installation and support of the transducer cabling. The latter source normally may be eliminated by redressing the cable, tightening or cleaning the connector at the transducer, or even replacing the transducer or transducer cable. To verify that no extraneous noise exists in the system, observe the oscilloscope while turning on the shaker at the designated frequency and amplitude. This noise is usually present as pulses which remain in a fixed position on the oscilloscope trace. If extraneous noise is observed, correct the problem by shielding or other precautions, such as those suggested above and rerun the entire noise check.

40.3 Test parameters. The following test parameters shall be applied to each DUT. If it has been demonstrated that one or more of these parameters are damaging to a given part type, the test shall be performed as defined by the parts detailed specification. Test parameters shall be documented in the report.

40.3.1 Vibration frequency:

Condition A: 27 Hz, 3 axes.

Condition B: 27 Hz, 40 Hz, and 100 Hz, optimum axis.

40.3.2 Vibration amplitude. Conditions A and B: 5g.

40.3.3 Shock level. Conditions A and B: 200g peak, 1 ms, maximum.

40.4 Test sequence. The condition A or B (as applicable) test sequence shall be applied to each DUT as follows.

40.4.1 Condition A sequence.

a. Vibration 5 seconds at 27 Hz.

b. Co-test shock (three pulses).

Note: When co-test shock capability does not exist, the DUT shall be pre-shocked with 2 pulses in each of 3 axes at 200g peak, 1 ms (maximum), using equipment and techniques as defined by method 213 of MIL-STD-202, and step b may be omitted.

c. Vibration 5 seconds at 27 Hz.

d. Repeat test in the two other orthogonal axes.

e. Accept or reject.

40.4.2 Condition B sequence. Apply 40.4.1, steps a, b, and c to the DUT in its optimum axis as defined by the detailed specification. Repeat the test at 40 Hz and 100 Hz. Accept or reject.

40.5 Mounting requirements. For condition A, the DUT shall be mounted such that it is ultimately tested in 3 orthogonal axes, one of which represents the normal mounting configuration for the device. For condition B, the DUT shall be mounted in the optimum axis as specified by the detail specification for minimizing inherent device noise. When special fixturing is required for unusual package configurations, such fixtures shall have the following properties:

a. Low mass.

b. High acoustic transmission (aluminum alloy 7075 works well).

c. Full transducer surface contact, especially at the center.

d. Maximum practical surface contact with test part.

e. No moving parts.

f. Suitable for attachment medium mounting.

Leads on the parts shall be dressed, as necessary, so they will not strike each other or the transducer during vibration. Long or thin cross section leads shall be observed for signs of resonance, indicated by motion exceeding 3 or 4 diameters. Such resonance may give extraneous noise during test even though the leads do not strike each other. In these cases, the leads may have to be shortened (if permitted by the application) or special fixturing or frequency changes may be required.

40.6 Test monitoring. To avoid false indications, the DUT shall be inspected for any attached foreign matter or leads which are touching each other. The DUT shall be mounted on the center of the transducer using attachment medium or, if necessary, a mounting adapter or holding fixture. To provide maximum signal transmissibility with a viscous couplant, a sufficient amount of couplant shall be used and the DUT shall be firmly mounted so that any excess couplant can be squeezed out. When double-faced tape is used, it shall be changed at the start of a test group and after 25 units or less thereafter. Devices shall be put on and removed from the attachment medium with a slight twisting motion. Device

orientation for each package type shall be as specified in 40.5. The vibration frequency and the vibration amplitude shall be set at the level specified in 40.3. Both detection systems shall be monitored for evidence of loose particles. Any device which gives a particle indication shall be considered a reject. Particle indications can occur in either detection system as follows:

a. Visual indication of high frequency spikes which exceed the normal constant background white noise level and the DUT inherent noise level.

   Note: The repeatable periodic inherent noise signature of electromechanical devices must be fully characterized to avoid false indications of failure and to avoid the masking of particles (see figure 13).

b. Audio indication of clicks, pops, or rattling which is different from the noise signature of the DUT or the constant background noise present with no DUT on the transducer.

c. If there is no indication of particles prior to co-test shock or 5 seconds after co-test shock, the device is acceptable. When pre-shock is used in place of co-test shock, there shall be no particle indications during the 10 seconds of vibration.

40.7 Co-test shock application (when applicable). The operation of the co-test shock mechanism shall be in accordance with procedures supplied by the equipment manufacturer. In systems that disable the detector during the co-test shock, the period of time from shock pulse to reinitiation of detection shall not exceed 100 milliseconds.

40.8 Additional test cycles. If additional cycles of testing on a lot are specified, the entire test procedure (equipment setup and checkout mounting, vibration, and co-shocking) shall be repeated for each retest cycle. Reject devices from each test cycle shall be removed from the lot and shall not be retested in subsequent lot testing.

40.9 Failure criteria. Any noise bursts as detected by either of the two detection systems (see 40.6) exclusive of DUT inherent noise or background noise during the monitoring periods shall be cause for rejection of the device. Rejects shall not be retested, except for retest of all devices in the event of test system failure as provided for 40.2.

50. SUMMARY

50.1 Summary. The following details shall be specified in the applicable detail specification or procurement documentation.

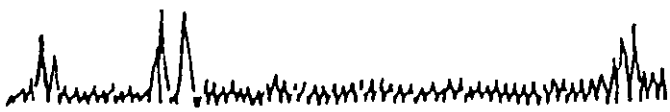
a. Lot acceptance/rejection criteria (if applicable).

b. Vibration, conditions A or B.

   Note: Unless otherwise specified, condition A shall apply. When condition B is required the optimum (required) axis of vibration shall be specified.

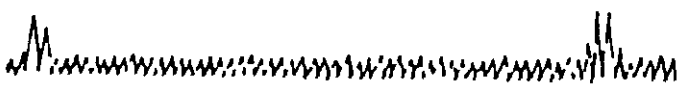
c. Co-test shock level and duration, if other than as defined herein.

NOTE: Acceptance criteria: Each unit tested shall meet the acceptance.



SHAKER NOISE

Timebase adjusted to locate shaker reversal noise bursts at end of oscilloscope trace. Test unit not mounted.



INHERENT MECHANICAL NOISE

Synchronized spike may appear at different locations on timebase for each unit under test.

PARTICULATE NOISE

Nonsynchronized spikes of any magnitude appear randomly and may disappear as test progresses. Unit is rejectable.

EXCESSIVE MECHANICAL NOISE

Synchronized tract masks more than 50 percent of oscilloscope trace. Unit is rejectable.

FIGURE 13. Representative oscilloscope traces.

CONCLUDING MATERIAL

Custodians:
Army - ER
Navy - EC
Air Force - 85

Review activities
Navy - AS
Air Force - 11, 99
NASA - NA
DLA - ES

Preparing activity:
Air Force - 85

(Project 5945-0785-01)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
3. DOCUMENT TITLE		

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON
c. ADDRESS (Include Zip Code)	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340

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