INCH-POUND

MIL-PRF-32085
16 July 2001

PERFORMANCE SPECIFICATION

RELAYS, ELECTROMAGNETIC, 270 V DC, 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 electromagnetic relays with main contact ratings of 5 amperes and above at 270 V dc and auxiliary contacts and coil voltage as specified (see 3.1) for use in electrical applications. Relays covered by this specification are capable of meeting the electrical and environmental requirements when mounted directly to the structure of aircraft, missile, spacecraft, ship, and other primary vehicles or in ground support and shipboard equipment as well as when used within other subsystems such as electrical load management centers or power controllers. These relays have reliability ratings established on the basis of tests performed at +85°C or highest rated temperature (see 3.1) under the rated load conditions specified herein at a 90 percent confidence level for qualification and 60 percent confidence level for maintenance of qualification.

1.2 Part or Identifying Number (PIN). The PIN will 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 (FR) level (see table I) as shown in the following example:

M32085	/1	-001	L
Specification designator	Specification sheet number	Dash number	Failure rate level

1.3 FR level designation. The FR level designation is shown in table I and will be as specified in the individual specification sheet (see 3.1)

TABLE I. FR level designation.

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Defense Supply Center, Columbus, Post Office Box 3990, Columbus, OH 43216-5000, by using the 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 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those 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

DEPARTMENT OF DEFENSE

MIL-PRF-32085/1 - Relay, Electromagnetic, SPST, 270 Volt, 120 Ampere, Hermetically Sealed, Transient Suppressed DC Coil
MS20659 - Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class I, For 175°C Total Conductor Temperature

STANDARDS

FEDERAL

FED-STD-H28 - Screw Thread Standards for Federal Services.

DEPARTMENT OF DEFENSE

MIL-STD-202 - Test Method Standard Electronic and Electrical Component Parts.
MIL-STD-690 - Failure Rate Sampling Plans and Procedures.
MIL-STD-704 - Aircraft Electrical Power Characteristics.
MIL-STD-750 - Test Methods for Semiconductor Devices.
MIL-STD-790 - Standard Practice for Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications
MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks, are available from the Defense Automation and Production Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of 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)

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

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036-8002.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM D 470-93 - Standard Test Methods for Crosslinked Insulations and Jackets for Wire and Cable

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

ELECTRONICS INDUSTRIES ASSOCIATION (EIA)

EIA-557 - Statistical Process Control Systems.

(Application for copies should be addressed to Electronic Industries Association, 2500 Wilson Boulevard, Arlington, VA 22201-3834.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE-AS25036 - Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, Bell-Mouthed, Type II, Class 1 (For 105 Deg C Total Conductor Temperature)

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

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

3. REQUIREMENTS

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

3.2 Qualification. Relays furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified products list at the time of contract award (see 4.4 and 6.3). Authorized distributors which are approved to MIL-STD-790 distributor requirements by the QPL manufacturers are listed in the QPL. Qualification can be established by one of two methods:

a. Qualify to an established reliability level (Type ER) using the Weibull method and maintain FR level by continued testing to point of failure and plotting the failure point be established procedures (see appendix A). Maintenance of qualification shall be in accordance with periodic testing to group B and group C requirements. Initial qualification and maintenance of qualification shall be by the same method.

b. Qualify to an established reliability level (Type ER) using the exponential method of operating the relay for the cycles specified (see 3.1) following the qualification test program of table V. Maintenance of qualification shall be in accordance with periodic testing to group B and group C requirements. Initial qualification and maintenance of qualification shall be by the same method.

3.3 QPL system. The manufacturer shall establish and maintain a QPL system for parts covered by this specification. Requirements for this system are specified in MIL-STD-790 and MIL-STD-690 with details and exceptions specified in 4.2.1, 4.4.4, and 4.5. The confidence level for qualification is 90 percent and the confidence level for maintenance of qualification is 60 percent.

3.3.1 SPC. The contractor shall implement and use SPC in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with EIA-557 or an equivalent system as approved by the qualifying activity. The SPC program shall be documented and maintained as part of the overall product assurance program as specified in MIL-STD-790.

3.4 Materials. Materials used shall be fungus inert, 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 use of silicone (see 6.10) or silicone compounds for any purpose other than external gaskets or external encapsulating/filler material is prohibited. 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.

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

3.4.1.1 Plated finishes.

a. Pure tin plating is prohibited internally and externally (see 6.6.). Use of tin-lead finishes are acceptable provided that the minimum lead content is 3 percent. Other tin alloys are acceptable as approved by the qualifying activity.

b. Pure zinc plating is prohibited internally and externally.

c. Pure cadmium plating is prohibited internally and externally.

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

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

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

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

3.5.2 Enclosures.

3.5.2.1 Unsealed enclosure. Unsealed relays shall be totally enclosed for mechanical and dust protection and shall be explosion proof. The enclosure design shall be such that pressure differentials cannot exist between the inside and outside. Metal covers shall be provided with a means for grounding as specified.

3.5.2.2 Hermetically sealed enclosures. Hermetically sealed enclosures shall be dried, degassed, and backfilled with an atmosphere and sealed such that the requirements of this specification are met.

3.5.2.3 Environmentally sealed (nonhermetic enclosures). Environmentally sealed enclosures shall be constructed by any means other than that defined under hermetically sealed enclosure (see 3.5.2.2) to achieve the degree of seal specified (see 3.1).

3.5.3 Threaded parts. Unless otherwise specified (see 3.1), all threaded parts shall be in accordance with FED-STD-H28. Where practical, all threads shall be in conformity with the coarse thread series. The fine thread series shall be used only when beneficial to the application.

3.5.4 Installation clearances. Unless otherwise specified (see 3.1), no special installation tools shall be required for mounting or installation.

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

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

3.5.6.1 Stabilization of permanent magnets. 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.

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

3.5.6.3 Latching relays. Latching relays 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). Specified dropout value (voltage or current) and release time are not applicable to latching relays (see 6.1).

3.5.7 Circuit diagram. The circuit diagram as specified shall be a terminal view. Circuit symbols shall be in accordance with ANSI/IEEE 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.

3.5.8 Mounting means (see 3.1).

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

3.5.8.2 Mounting studs. Mounting studs shall be as specified (see 3.1). No rotation, loosening, or deformation of fixed portions shall occur because of material flow or any mechanical forces involved in installation or removal of the relay. The mounting studs shall withstand for 1 minute, without damage, the static values of pull and torque specified in table II.

TABLE II. Strength of mounting studs (static values of pull and torque.

Thread size	Force		Torque		Installation torque (recommended)	
	Pounds	Newtons	Inch-pounds	Newton-meters	Inch-pounds	Newton-meters
4-40 (.112 UNC)	7	31	10	1.13	7.5	0.85
6-32 (.138 UNC)	25	111	18	2.03	13.5	1.52
8-32 (.164 UNC)	35	155	37	4.18	27.8	3.14
10-32 (.190 UNF)	50	222	60	6.78	45.0	5.09
1/4-28 (.250 UNF)	60	266	100	11.3	75.0	8.48
5/16-24 (.312 UNF)	80	355	160	18.1	120.0	13.58
3/8-24 (.375 UNF)	115	511	275	31.1	206.3	23.33
7/16-20 (.438 UNF)	140	622	475	53.7	356.3	40.28

3.5.9 Terminals (electric). When applicable (see 3.1), no rotation or other loosening of a terminal, or any fixed portion of a terminal, shall be caused by material flow or shrinkage, or (for threaded terminals) any mechanical forces specified in table III involved in connection or disconnection, throughout the life of the relay.

3.5.9.1 Stud terminals (threaded). When applicable (see 3.1), stud terminals shall be supplied with hardware as specified. With the manufacturer supplied hardware in place, a minimum of three complete threads shall remain above the nut when it is backed off three complete turns from a position with all hardware tightened to the recommended installation torque (see table III).

TABLE III. Strength of threaded terminals (static value of pull and torque).

Thread size	Force		Maximum test torque		Installation torque (recommended)	
	Pounds	Newtons	Inch-pounds	Newton-meters	Inch-pounds	Newton-meters
4-40 (.112 UNC)	5	22	4.4	0.497	3.3	0.373
6-32 (.138 UNC)	30	133	10.0	1.130	7.5	0.847
8-32 (.164 UNC)	35	156	20.0	2.260	15.0	1.695
10-32 (.190 UNF)	40	180	32.0	3.615	24.0	2.712
10-24 (.190 UNC)	40	180	35.0	3.954	26.3	2.972
1/4-28 (.250 UNF)	50	222	75.0	8.474	56.3	6.361
5/16-24 (.312 UNF)	70	311	100.0	11.296	75.0	8.474
3/8-24 (.375 UNF)	100	445	150.0	16.948	112.5	12.710
7/16-20 (.438UNF)	100	445	150.0	16.948	112.5	12.710
1/2-20 (.500 UNF)	100	445	150.0	16.948	112.5	12.710

3.5.9.1.1 Stud terminal seat. For threaded terminals, each terminal shall have a terminal seat that shall provide the normal current-conducting path. The diameter of the seat shall be equal to, or greater than, the diameter across the corresponding lug designed for the particular current and stud or screw size, or never less than the area necessary to assure that the current density shall not exceed 1,000 amperes per square inch. The seat area does not include the cross-sectional area of the stud.

3.5.9.1.2 Strength of stud terminals. Stud terminals shall be designed to withstand the static value of pull and torque specified in table III (see 3.15).

3.5.9.2 Leadwire marking. Unless otherwise specified (see 3.1), leadwires shall be color coded in accordance with MIL-STD-1285.

3.5.9.3 Terminal covers and barriers. Unless otherwise specified (see 3.1), the relay shall be provided with adequate covering or separation of terminal parts to provide protection against inadvertent shorting, grounding, or contact by personnel. Barriers may be removable or may be integral with removable covers. Terminal covers and barriers shall be designed to meet performance requirements applicable to the relay. The enclosure(s) shall be so designed that when the terminal cover is removed, the relay shall be capable of operating without adjustment.

3.6 In-process inspection (see 4.6.1).

3.6.1 Diode in-process screening (applicable to relays with diodes; see 3.1 and 4.6.1.1). Perform in-process screening as specified. In-process inspection is not required when JANTX diodes or diodes screened to JANTX are used. Waiver of in-process screening requires qualifying activity approval. JANTX diodes and diodes screened to JANTX do not require a waver.

3.7 Seal (see 4.7.2).

3.7.1 Hermetic seal. The leakage rate shall not exceed 1×10^{-6} atmospheric cubic centimeters per second of air. For relays of 2 cubic inches volume or less, the leakage rate shall not exceed 1×10^{-8} atmospheric cubic centimeters per second of air.

3.7.2 Environmental seal. The leakage rate shall be as specified (see 3.1).

3.8 Dielectric withstanding voltage (DWV) (see 4.7.3). There shall be no leakage current in excess of 1.0 milliamperes (mA). When dielectric withstanding voltage is performed following a load or endurance test specified in 4.7.15 (life), the dielectric test voltage may be reduced to 75 percent of the sea level value shown in table VIII, but not less than 1,000 volts.

3.9 Insulation resistance (IR) (see 4.7.4). Unless otherwise specified (see 3.1) the IR shall be 100 MΩ or more.

3.10 Electrical characteristics (see 4.7.5). The following tests as specified in 3.10.1 through 3.10.6 inclusive, shall comprise the electrical characteristics tests. Unless otherwise specified, electrical characteristics shall be 100 percent inspected and performed in the order as shown below. For the purposes of this specification, dropout value (voltage or current), hold value (voltage or current), and release time are not applicable to latching relays. For latching relays, pickup value (voltage or current) is equivalent to latch/reset voltage and operate time is equivalent to latch/reset time and shall be performed on each coil (see 6.1).

3.10.1 Coil resistance (see 4.7.5.1). The coil resistance shall be as specified (see 3.1).

3.10.2 Contact voltage drop or contact resistance (see 4.7.5.2). Unless otherwise specified (see 3.1), the initial contact voltage drop shall not exceed 0.125 volt maximum. Relays with auxiliary contacts which are rated at 2 amperes or less shall have a contact resistance value no greater than 0.05 ohm prior to load-endurance (life) cycling test and 0.15 ohm after load endurance cycling (life) test when tested as specified in 4.7.5.2.1.

3.10.3 Specified pickup or latch/reset, hold, and dropout values (voltages) (see 4.7.5.3). The specified pickup or latch/reset, hold, and dropout values (voltages) shall be as specified (see 3.1). Specified hold and dropout values (voltages) are not applicable to latching relays (see 3.1).

3.10.4 Operate and release time (see 4.7.5.4). The operate and release time or latch/reset shall be as specified (see 3.1). Unless otherwise specified (see 3.1), in multipole relays, during each of the operate and the release time measurements, the difference between the first moving contact to make and the last moving contact to make shall not exceed 3 ms for main contacts and 1 ms for auxiliary contacts. This shall be exclusive of contact bounce. Release time is not applicable to latching relays.

3.10.4.1 Break before make (see 4.7.5.4.1). Unless otherwise specified, moving contacts within a multipole relay shall show no evidence of any open contact closing before all closed contacts have opened (see 3.1) and the arc between closed contacts has extinguished for all rated loads of the device. This applies to either state of the relay.

3.10.5 Contact bounce (see 4.7.5.5). Unless otherwise specified, the duration of the contact bounce shall not exceed 3.0 ms for main contacts and 1.0 ms for auxiliary contacts, 1.0 ms.

3.10.6 Coil transient suppression (applicable to relays with internal coil suppression) (see 4.7.5.6). Coils of relays shall not generate a back EMF greater than that specified (see 3.1).

3.11 Thermal shock (see 4.7.6). The requirements specified pickup or latch/reset, hold, and dropout values (voltages) (see 3.10.3), and operate and release time (see 3.10.4) shall be met at each temperature extreme. Following the temperature excursions, there shall be no cracking, peeling, or flaking of the finish; DWV at sea level atmospheric pressure shall meet the requirements of 3.8.

3.12 Shock (specified pulse) (see 4.7.7). Unless otherwise specified (see 3.1), there shall be no opening of closed contacts in excess of 10 µs and there shall be no closure or bridging of open contacts in excess of 1 µs and no evidence of mechanical or electrical damage.

3.13 Vibration (see 4.7.8). Unless otherwise specified, there shall be no opening of closed contacts in excess of 10 µs and there shall be no closure or bridging of open contacts in excess of 1 µs and no evidence of mechanical or electrical damage.

3.14 Acceleration (unless otherwise specified, see 3.1 and 4.7.9). 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. Unless otherwise specified (see 3.1), there shall be no opening of closed contacts in excess of 10 µs and there shall be no closure or bridging of open contacts in excess of 1 µs and no evidence of mechanical or electrical damage.

3.15 Terminal strength (see 4.7.10). 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.

3.16 Magnetic interference (4.7.11). Unless otherwise specified, the specified pickup and/or dropout values (voltages) shall meet the requirements specified in 3.10.3.

3.17 Salt spray (see 4.7.12). 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.

3.18 Overload (see 4.7.13). The voltage drop across closed contacts shall be less than or equal to 10 percent of the applied load voltage and the voltage across open contacts shall be 90 percent or more of the applied load voltage. The case-to-ground fuse shall remain electrically continuous. Unless otherwise specified, the terminal temperature rise shall not exceed +75°C. (Monitoring of terminal temperature rise applicable to qualification only). Relays indicating a failure that can not be verified during a failure verification procedure may be returned to test. Failure verification procedures must be approved by the qualifying activity.

3.19 Rupture (see 4.7.14). The relay shall be made to make and break it's specified rupture current for the specified number of cycles (see 3.1). Welding of contacts, failure to make, carry, or break the specified rupture current (see 3.1) shall constitute a failure. The case to ground fuse shall remain electrically continuous. Unless otherwise specified, the terminal temperature rise shall not exceed +75°C. (Monitoring of terminal temperature rise applicable to qualification only). Relays indicating a failure that can not be verified during a failure verification procedure may be returned to test. Failure verification procedures must be approved by the qualifying activity.

3.20 Life (see 4.7.15). Unless otherwise specified (see 3.1), the contact monitoring level for the equipment detecting misses, shall be set to less than or equal to 100 ohms for main contacts and less than or equal to 3 ohms for auxiliary contacts. Unless otherwise specified, the contact voltage drop or static contact resistance following cycling shall be no greater than twice the initial specified value. The case to ground fuse shall remain electrically continuous. There shall be no mechanical or electrical failure. Welding of contacts, failure to make, carry, or break any rated load shall constitute a failure. For Weibull method testing, the measurements, that normally occur at the specified life (see 3.1) using the exponential method, shall occur at the specified number of cycles (see 3.1) and integer multiple thereof. The relays shall be returned to test until failure. Unless otherwise specified, the terminal temperature rise shall not exceed +75°C. (Monitoring of terminal temperature applicable to qualification only.)

Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test.

3.21 Mechanical life (see 4.7.16). After cycling, the DWV and IR shall not exceed the limits as specified (see 3.1) and the operate and release time shall not exceed 120 percent of the limits specified (see 3.1). There shall be no mechanical or electrical failure. Welding of contacts, failure to make, carry or break the load, or failure of the fuse connected between case and load system ground or neutral shall constitute a failure. Relays indicating failure, but not verified as failures in accordance with a failure verification procedure approved by the qualifying activity, may be returned to test. During post life tests, failure of a diode shall constitute a failure.

3.22 Resistance to solvents (see 4.7.17). The marking shall remain legible.

3.23 Continuous current (see 4.7.18). There shall be no damage such as loosening of terminals, or any deterioration of performance beyond the limits specified (see 3.1). Unless otherwise specified, the terminal temperature shall not exceed +160°C. (Monitoring of terminal temperature rise applicable to qualification only.)

3.24 Sand and dust (applicable to unsealed relays) (see 4.7.19). There shall be no evidence of damage sufficient to impair the operation of the relay.

3.25 Humidity (applicable to unsealed, environmentally sealed, and hermetically sealed relays with potted wire leads) (see 4.7.20). Relays shall not exhibit a leakage current in excess of 100 mA with a potential of 330 V rms applied between the terminals and other exposed metal parts.

3.26 Ozone (applicable to unsealed, environmentally sealed, and hermetically sealed relays with potted wire leads) (see 4.7.21). The relay shall exhibit no cracking of materials or other damage which will adversely affect subsequent performance of the relay.

3.27 Low temperature operation (see 4.7.22). There shall be no damage to the relay, loosening of terminals, cracking or flaking of glass insulation, or of the hermetic seal. Following the test and at the specified low temperature, the specified pickup value (voltage), dropout value (voltage), and contact voltage drop shall meet the requirements of 3.10.3 and 3.10.2 respectively, and shall continue to meet the specified pickup and dropout value (voltage) requirements until the relay returns to room temperature. Relays which contain permanent magnets in the magnetic circuit shall, in addition to the above test, be subjected to the demagnetizing effect of a sudden application of maximum coil voltage for one operation at the beginning of the second 24-hour period.

3.28 Reverse polarity (when specified, see 3.1 and 4.7.23). Relays shall be tested at each contact rating specified. Bi-directional units shall be tested in accordance with 4.7.15 and 4.7.23. Fifty percent of the cycles shall be performed in each direction. Any of the following occurrences shall constitute a failure:

a. Failure to make or break the load.

b. Blowing of the fuse connected between case and load system ground.

c. Failure to meet group A2 tests at specified intervals.

d. Terminal temperature exceeding the specified limit (see 3.1). (Monitoring of terminal temperature required only during qualification testing.)

3.29 Voltage transients (see 4.7.24). Transient voltages at the source side of the main contacts shall conform to the limits specified in 5.3.2 of MIL-STD-704 when interrupting rated loads.

3.30 Marking.

3.30.1 JAN and J marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of specifications. Accordingly, items acquired to and meeting all of the criteria specified herein and in applicable specification 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 immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the “JAN” or “J” may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein and 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 specifications, the manufacturer shall remove the military part number and the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration No. 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark “J”.

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

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

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

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

d. Source code.

e. Lot symbol (optional).

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

g. Coil resistance.

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

i. Circuit diagram (see 3.5.7).

j. Terminal marking (when applicable, see 3.1 and 3.5.7).

3.30.3 FR level substitution. With procuring activity approval, relays qualified to lower (better) failure rates, may be substituted for higher FR parts. For example, a relay qualified to FR level "R" (0.01 percent/10,000 cycles) may be substituted for a FR "P" (0.1 percent/10,000 cycles) relay. Relays shall not be remarked unless specified in the contract or order.

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

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

3.32 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. VERIFICATION

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

a. Qualification inspection (see 4.4).

b. Verification of qualification (see 4.5).

c. In-process, conformance inspection, and periodic inspections (see 4.6).

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

4.2.1 SPC. The manufacturer shall establish and maintain an SPC program as described in 3.3.1. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.

4.2.2 Traceability requirements. The manufacturer shall establish and maintain a procedure whereby lot date codes incorporate traceability. This procedure shall be approved by the qualifying activity. Traceability shall apply, as a minimum, to the following:

a. Header-contact subassembly with the lot number (as applicable).

(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 spring(s).

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

(5) Magnets (when applicable).

b. Motor subassembly with the lot number (when applicable).

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

(5) Magnets (when applicable).

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

4.2.3 ESDS protection program. This requirement is applicable to all manufacturers who handle ESDS component parts and/or materials in the relay manufacturing and/or testing process. 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, cleaning, preservation, packaging, and quality assurance. A model ESD control program is available from the qualifying activity and may be used as a guideline document. Further guidance for ESD control is available from the EOS/ESD Association and the EIA.

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

4.3.1 Power supply. Unless otherwise specified herein, the power supply shall have no more than 10 percent regulation at 110 percent of the specified test load current. A dc power supply shall have no more than 5 percent ripple voltage.

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

4.3.3 Load conditions during tests. The coil(s) of the relay under test shall have one side connected to the coil power supply ground. All tests during which the contacts are loaded and being cycled, except DWV, 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 100 mA. 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 Methods of examination and test. Application of coil power to relays under test shall be such that plus polarity is applied to the color coded terminal when applicable; or to the lower numbered terminal when color coding is not used. Testing of latching relays shall be repeated with the relay in each operated position.

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

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

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. Variables measurements are acceptable.

4.4.1 Sample size. The number of relays to be subjected to qualification inspection shall be as

specified in table IV. 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 IV.

4.4.2 Inspection routine. Sample units shall be subjected to qualification inspection outlined in table IV in the order shown, except that groups Q2 through Q8 inclusive may be conducted concurrently. All sample units shall be subjected to the inspections of Q1. These sample units shall then be divided into seven groups as specified in table IV and subjected to the inspection specified for their particular group.

4.4.3 Failures. Failures in excess of those in table IV, except for Q4, shall be cause for refusal to grant qualification approval. For the exponential method, the number of failures shall not exceed the number in Q4. For the Weibull method, determine if the failure rate meets the minimum requirements for qualification as specified in A.3.1.

4.4.4 FR qualification. FR qualification shall be in accordance with the Weibull method or exponential method (see appendix A). 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".

4.5 Verification of qualification. Every 6 months the manufacturer shall provide verification of qualification to the qualifying activity. Continuation of qualification is based on meeting the following requirements. Variables measurements are acceptable.

a. MIL-STD-790 program.

b. Design of the relay has not been modified.

c. Lot rejection does not exceed 10 percent of the lots submitted to group A, or one lot, whichever is greater.

d. Periodic group B and group C inspection.

e. FR levels.

TABLE IV. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
Q1				
Visual and mechanical inspection	3.1 and 3.32	4.7.1		
DWV	3.8	4.7.3		
IR	3.9	4.7.4	All sample units	0
Electrical characteristics	3.10	4.7.5		
Visual and mechanical inspection (external) (dimensional check on two sample units only)	3.1 and 3.32	4.7.1		
Seal	3.7	4.7.2		
Q2				
Voltage transients	3.29	4.7.24		
Thermal shock	3.11	4.7.6		
Resistance to solvents	3.22	4.7.17		
Shock (specified pulse)	3.12	4.7.7	1	0
Vibration (sinusoidal)	3.13	4.7.8.1		
Vibration (random) (when specified)	3.13	4.7.8.2		
Acceleration (when specified)	3.14	4.7.9		
Terminal strength	3.15	4.7.10		
DWV	3.8	4.7.3		
IR	3.9	4.7.4		
Electrical characteristics	3.10	4.7.5		
Seal	3.7	4.7.2		
Q3				
Rupture 1/	3.19	4.7.14		
DWV	3.8	4.7.3		
IR	3.9	4.7.4		
Electrical characteristics	3.10	4.7.5	1	0
Visual inspection (external)	3.1 and 3.32	4.7.1		
Seal	3.7	4.7.2		
Q4				
Overload (highest resistive load)	3.18	4.7.13		
Life 4/	3.20	4.7.15		
DWV	3.8	4.7.3		
IR	3.9	4.7.4	2/ 3/	1
Electrical characteristics	3.10	4.7.5		
Visual inspection (external)	3.1 and 3.32	4.7.1		
Seal	3.7	4.7.2		
Q5				
Low temperature operation	3.27	4.7.22		
Mechanical life	3.21	4.7.16		
Salt spray	3.17	4.7.12	1	0
DWV	3.8	4.7.3		
IR	3.9	4.7.4		
Electrical characteristics	3.10	4.7.5		
Visual inspection (external)	3.1 and 3.32	4.7.1		

See footnotes at end of table.

TABLE IV. Qualification inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
Q6				
Sand and dust	3.24	4.7.19		
DWV	3.8	4.7.3	1	0
IR	3.9	4.7.4		
Electrical characteristics	3.10	4.7.5		
Q7				
Continuous current	3.23	4.7.18		
DWV	3.8	4.7.3		
IR	3.9	4.7.4	1	0
Electrical characteristics	3.10	4.7.5		
Visual inspection (external)	3.32	4.7.1		
Seal	3.7	4.7.2		
Q8				
Ozone	3.26	4.7.21		
Electrical characteristics	3.10	4.7.5	1	0
Seal	3.7	4.7.2		

1/ If rupture is not specified (see 3.1), this group shall be omitted from the qualification program.
2/ For Weibull FR qualification, perform life test on a minimum of 10 units per specified load to failure followed by DWV, IR, and the electrical characteristics.
3/ For exponential method qualification, sample sizes for qualification shall be established based upon a 90 percent confidence level in accordance with table A-V.
4/ The sample size shall be equally divided among the specified contact ratings and shall be of sufficient size to test a minimum of one relay per contact rating with rated loads on all contacts. When there are more samples than loads, the remaining loads shall be assigned in sequence beginning with the highest dc rated loads.

4.6 In-process, conformance, and periodic inspections.

4.6.1 In-process inspection (see 3.6).

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

4.6.2 Conformance inspection . Conformance inspection shall consist of group A inspection.

4.6.2.1 Inspection and production lot.

4.6.2.1.1 Inspection lot. An inspection lot shall consist of all the relays of the same specification sheet, manufactured under essentially the same process and conditions during a manufacturing period of one month maximum. The manufacturer shall define and document the period for an inspection lot. For purposes of lot formation, all terminal types and mounting configurations may be combined.

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

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

4.6.2.2.1 Sampling plan. The tests in A1, A2, and A3 shall be performed on a production lot basis on 100 percent (except as noted) of the product supplied under this specification. Relays that do not meet specification requirements of these groups shall be removed from the lot.

4.6.2.2.2 Rejected lots. Relays that do not meet the requirements of the tests in A1 and A3 shall be rejected and shall be removed from the lot. For relays prohibited from hermetic seal rework (see 3.1), if more than 5 percent of the relays are discarded during A2 testing, the production lot shall be rejected and not offered for reinspection.

TABLE V. Group A inspection. 1/

Inspection	Requirement paragraph	Test method paragraph	Inspection requirements
A1			
Vibration (sinusoidal)	3.13	4.7.8.1	100 percent
Vibration (random) 2/	3.13	4.7.8.2	
A2 3/			
DWV	3.8	4.7.3	
IR	3.9	4.7.4	100 percent
Electrical characteristics	3.10	4.7.5	
A3			
Visual and mechanical inspection (external) 4/	3.1, 3.4, 3.32	4.7.1	100 percent
Seal	3.7	4.7.2	

1/ Test groups shall be performed in the order shown.
2/ Random vibration shall be performed when specified (see 3.1).
3/ Testing sequence is optional, except that DWV shall precede IR.
4/ Minor defects, such as marking may be reworked.
5/ For relays designed with evacuation ports, the seal test may be performed as a final assembly operation prior to performing group A inspection, provided this test is performed on all of the relays.

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

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

4.6.3.1.1 Sampling plan. A minimum of one sample shall be selected from each inspection lot.

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

TABLE VI. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Life 1/	3.20	4.7.15
DWV	3.8	4.7.3
IR	3.9	4.7.4
Electrical characteristics	3.10	4.7.5
Visual inspection	3.1, 3.32	4.7.1

1/ Sample units shall be tested in a predetermined sequence as defined by the manufacturer and approved by the qualifying activity. All loads specified in the applicable specification sheet shall be represented. All loads need not be represented in a six month maintenance period but shall be represented within two six month maintenance periods.

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

4.6.3.2.1 Sampling plan. Every 36 months, group C inspection shall be performed as specified in table VII.

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

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

4.6.3.3 Noncompliance. During group B and group C inspections, when a failure exceeds the allowable number of failures, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure within 5 working days. The manufacturer shall prepare to take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has been taken, group B and group C inspection shall be repeated on additional sample units (all tests, or the tests which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group B or group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the qualifying activity and the cognizant inspection activity within 5 working days.

TABLE VII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection
C1 (every 36 months)			
Voltage transients	3.29	4.7.24	
Thermal shock	3.11	4.7.6	
Shock (specified pulse) 3/	3.12	4.7.7	
Vibration 3/	3.13	4.7.8	
Terminal strength	3.15	4.7.10	3
DWV	3.8	4.7.3	
IR	3.9	4.7.4	
Electrical characteristics	3.10	4.7.5	
Visual inspection (external)	3.1, 3.32	4.7.1	
Seal	3.7	4.7.2	
C2 (every 36 months)			
Rupture 1/ 2/	3.19	4.7.14	
DWV	3.8	4.7.3	2
IR	3.9	4.7.4	
Electrical characteristics	3.10	4.7.5	
Visual inspection (external)	3.1, 3.32	4.7.1	
Seal	3.7	4.7.2	
C3 (every 36 months)			
Overload (highest resistive load)	3.18	4.7.13	
Life/	3.20	4.7.15	
DWV	3.8	4.7.3	
IR	3.9	4.7.4	2
Electrical characteristics	3.10	4.7.5	
Visual inspection (external)	3.1, 3.32	4.7.1	
Seal	3.7	4.7.2	
C4 (every 36 months)			
Low temperature operation	3.27	4.7 22	
Mechanical life	3.21	4.7.16	
Salt spray	3.17	4.7.12	2
DWV	3.8	4.7.3	
IR	3.9	4.7.4	
Electrical characteristics	3.10	4.7.5	
Visual inspection (external)	3.1, 3.32	4.7.1	
C5 (every 36 months)			
Sand and dust	3.24	4.7.19	
DWV	3.8	4.7.3	2
IR	3.9	4.7.4	
Electrical characteristics	3.10	4.7.5	
C6 (every 36 months)			
Continuous current	3.23	4.7.18	
DWV	3.8	4.7.3	
IR	3.9	4.7.4	2
Electrical characteristics	3.10	4.7.5	
Visual inspection (external)	3.32	4.7.1	
Seal	3.7	4.7.2	

1/ If rupture is not specified (see 3.1), this group shall be omitted from the maintenance program.
2/ Rupture testing loads and contacts shall be rotated every three years.
3/ Each mounting configuration to which a manufacturer is qualified will be represented during the normal continuous periodic testing period. It will usually take more than one periodic testing period to achieve testing of all of the applicable mountings.

4.7 Methods of inspection.

4.7.1 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, 3.4, and 3.32).

4.7.2 Seal (see 3.7). Relays shall be tested in accordance with 4.7.2.1 or 4.7.2.2, as applicable. In case of dispute, method 1014 of MIL-STD-883, test condition B shall govern.

4.7.2.1 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 at the option of the manufacturer, 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: 1×10^{-8} atm cm^3/s of air.

(3) Measurements after test: Not applicable.

(4) Method 1014 of MIL-STD-883, test condition B (gross leak test not required).

4.7.2.2 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, 4.7.2.2a or 4.7.2.2b may be used. The following details shall apply.

a. Method 1014 MIL-STD-883:

(1) Test condition A1 or test condition A2.

(2) Measurements after test: Perform a gross leak test in accordance with method 112 of MIL-STD-202, test condition A, test condition B, or test condition 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 (gross leak test not required).

4.7.2.3 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 material, or molecular sieve material. This test shall be permitted only if the following requirements are met.

a. A 5 mil 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 method 112, MIL-STD-202, test condition D, except the specimen shall be observed from the instant of immersion for 1 minute minimum to 3 minutes maximum.

.7.2.3.1 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.

4.7.2.3.2 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.

4.7.3 DWV (see 3.8). Relays shall be tested as specified in 4.7.3.1 and in accordance with 4.7.3.2. Testing in accordance with 4.7.3.2 is not required for group A , group B, or group C2 testing.

4.7.3.1 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 VIII.

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

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

d. Attributes data is acceptable.

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

a. Mounting method: Normal mounting means.

b. Test condition: Test condition C.

c. Tests during subjection to reduced pressure: As specified in table VIII, except test voltage shall be 700 V rms.

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

e. Attributes data is acceptable.

TABLE VIII. Dielectric withstanding voltage (50/60 Hz).

Voltage parameters				Points of application for test voltage parameters
System voltage 2/	Sea level		Altitude 80,000 feet 1/ 3/ Test voltage, rms (1 minute)	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 latching relays Between contacts poles in the energized and deenergized positions (applicable to multipole relays)
	Test voltage, rms (1 minute) 3/	Test voltage, rms (2-5 seconds) 3/ 4/ (Manufacturer only)		
28 V dc 5/	1,050	1,250	500	
115 V ac 5/	1,250	1,500	500	
115/200 V ac 5/	1,500	1,800	700	
115/200 V ac 5/	1,500	1,800	700	

1/ Or altitude as specified (see 3.1). When altitude above 80,000 feet is specified, the dielectric withstanding voltage is performed at 80,000 feet.
2/ If coil and contacts are rated for different voltages, each shall be tested to case in accordance with its respective system voltage. However, the test between coil and contact terminals shall be in accordance with the higher of the two system voltages.
3/ The test potential shall be applied or reduced at a minimum rate of change of 250 volts (V) per second. The test time shall begin once the specified test voltage has been reached.
4/ For performing quality conformance inspection on production samples, the 2-5 second automated test may be used by the manufacturer only in lieu of the one-minute manual test. The one-minute test is mandatory for qualification inspection or when defects are discovered in production inspection.
5/ Applicable to auxiliary contacts only.

4.7.4 Insulation resistance (IR) (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. Unless otherwise specified, the following details shall apply:

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

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

c. Attributes data is acceptable.

4.7.5 Electrical characteristics (see 3.10).

4.7.5.1 Coil resistance (see 3.10.1). Relay coils shall be tested in accordance with method 303 of MIL-STD-202.

4.7.5.2 Contact voltage drop (see 3.10.2). 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 voltage, not to exceed nominal rated system voltage. 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 and post life, 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 seconds ±.5 second.

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 life: Current and voltage shall be the same as the life test.

4.7.5.2.1 Contact resistance. This test is applicable to relays which have auxiliary contact ratings of 2 amperes or less as specified in 3.10.2. Relays shall be tested in accordance with method 307 of MIL-STD-202. The following details shall apply:

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

b. Test current shall be 100 mA for all contacts except those rated for low level. For low level, the current shall be 10 mA maximum.

c. The open-circuit test voltage shall be nominal rated system voltage.

d. Points of measurements:

(1) Between all normally closed mated contacts.

(2) Between all normally open mated contacts, with the coil energized with rated voltage (or current). The relay shall be operated with no load applied to the contacts.

e. Number of activations prior to measurement - None.

f. Number of test activations - Three.

g. Number of measurements per activation - One in each contact position.

4.7.5.3 Specified pickup or latch/reset, hold, and dropout values (voltages) (see 3.10.3). Specified pickup or latch/reset, hold, and dropout values (voltage) shall be measured as specified in 4.7.5.3.1, 4.7.5.3.2, 4.7.5.3.3, or 4.7.5.3.4. Unless otherwise specified (see 3.1), for qualification 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. During the test all contacts shall not change state (break or remake) while the coil is energized at or above the specified pickup or latch/reset value (voltage); when the coil voltage is lowered

to any value at or above specified hold value (voltage); or when the coil voltage is reduced from the specified dropout value (voltage) to zero. It is permissible to perform specified pickup or latch/reset, hold, and dropout values (voltages) using step function voltage changes as specified in 4.7.5.3.1 or 4.7.5.3.2, 4.7.5.3.3, and 4.7.5.3.4. Due to the fact that slow ramping will overheat relay coils and vary specified pickup or latch/reset, hold, and dropout values (voltages), the step function method shall be the governing method in cases of dispute. For qualification, and group C inspections testing, specified pickup or latch/reset, hold, and dropout values (voltages) shall be measured at minimum, ambient, and maximum temperatures specified (see 3.1).

4.7.5.3.1 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. It is permissible to perform specified pickup value (voltage) using a step function voltage change as follows and as illustrated on figure 1. In addition to step function changes in voltage levels as depicted on figure 1, rapid voltage ramps, rapidly increasing small incremental steps, and combination of step functions and ramps may be used to achieve the specified pickup, hold, and dropout values (voltages) sequencing.

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

b. Apply rated coil voltage.

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

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

e. Step down to zero voltage.

4.7.5.3.2 Specified latch/reset value (voltage) (applicable to latching relays only). Before measuring the specified pickup value (voltage), establish that all contacts are in their last energized mode for latching relays 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. It is permissible to perform maximum pickup (latch/reset) value (voltage) using a step function as follows and as illustrated on figure 1.

a. Step up to specified latch value (voltage) for latching 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 step-down to zero.

c. Step up to specified value (voltage) for latching 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.

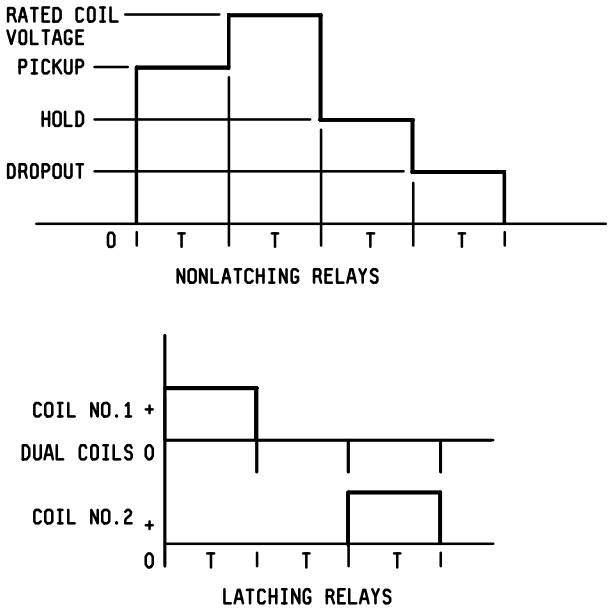


FIGURE 1. Pickup or latch/reset, hold, and dropout sequencing.

4.7.5.3.3 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). All contacts shall not change state. It is permissible to perform this test using the step function voltage program described in 4.7.5.3.1 and on figure 1.

4.7.5.3.4 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. It is permissible to perform this test using the step function voltage program described in 4.7.5.3.1 and on figure 1.

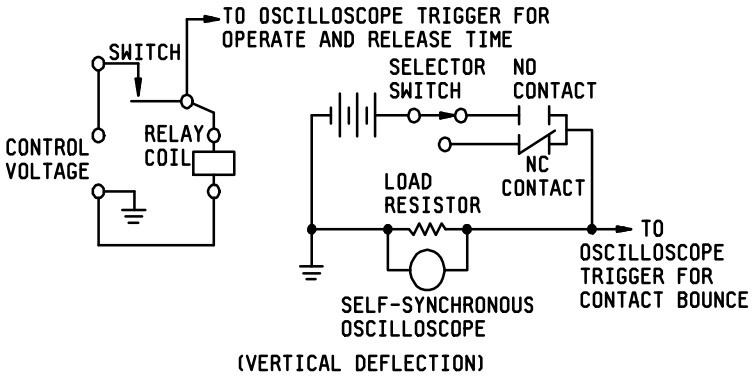


FIGURE 2. Operate and release time circuit.

4.7.5.3.5 High temperature pickup voltage (see 3.10.3). The relay shall be subjected to an operating test at the maximum ambient temperature specified (see 3.1). The voltage applied to the coils shall be the maximum specified. The duration of the test shall be 1 hour. The relays shall be energized

continuously. Contacts shall not be loaded during this test. Within 30 seconds following this period, and with the relay maintained at the test temperature, the pickup voltage shall be within the limit specified (see 3.1).

4.7.5.4 Operate and release time (see 3.10.4). 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 V dc maximum at 10 mA maximum. The circuit shown on figure 2, or equivalent, shall be used. The operate and release time shall be exclusive of contact bounce or contact stabilization time. Timing measurements shall be made on all contact sets. Release time is not applicable to latching relays. Electronic instrumentation or other suitable means may be used for group A inspection. Determination of compliance to the simultaneously switching requirement shall be made by comparing the highest time to the lowest time of the poles as measured for operate and release time. The procedure for measurement shall be approved by the qualifying activity and shall be done as a part of qualification inspection only.

4.7.5.4.1 Break before make (see 3.10.4.1). A circuit approved by the qualifying activity shall be used to monitor contact position.

4.7.5.5 Contact bounce (see 3.10.5). Contact bounce shall be measured on each contact set using an oscilloscope or other acceptable means approved by the qualifying activity. The trace shall show contact switching at operate and release and appropriate timing markers when using an oscilloscope. Rated voltage shall be applied to the coil. Contacts shall be loaded with 6 V dc maximum at 10 mA maximum. After life test, 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 ms or greater. The circuit shown on figure 2, or equivalent, shall be used.

4.7.5.6 Coil transient suppression (applicable to relays with internal coil suppression) (see 3.10.6). The coil shall be connected as shown on figure 3 or by an equivalent test circuit and tested as specified below.

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

a. The switching relay shall be a mercury wetted contact switching relay or a solid state relay. E is rated operating voltage for the relay under test. The switching relay is operated from a source voltage independent of E. The oscilloscope shall have a rise time of 20 nanoseconds or less. The horizontal (time) deflection scale shall be set at .5 ms to 1 ms per division (.5 ms/cm to 1 ms/cm), and the vertical (voltage) deflection to such that the vertical gain provided accuracy in reading. For 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 capable of delivering the rated coil voltage with no limiting resistor or potentiometer used to regulate the line voltage. (Having low source impedance representing a typical application is more important than having the exact rated voltage.)

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

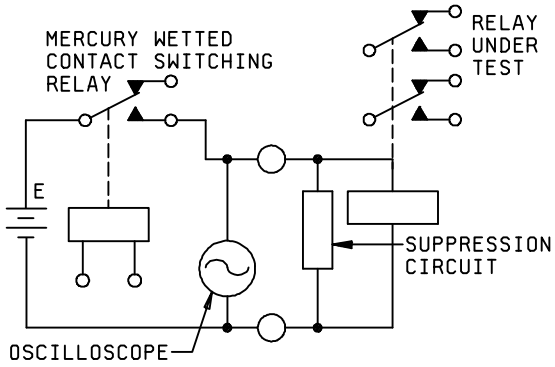
(1) The reading shall be observed on the oscilloscope or other equivalent electronic test

instrumentation. The magnitude of the induced voltage transient shall be noted. A typical trace is presented on figure 4.

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

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

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



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

FIGURE 3. Coil transient suppression test circuit.

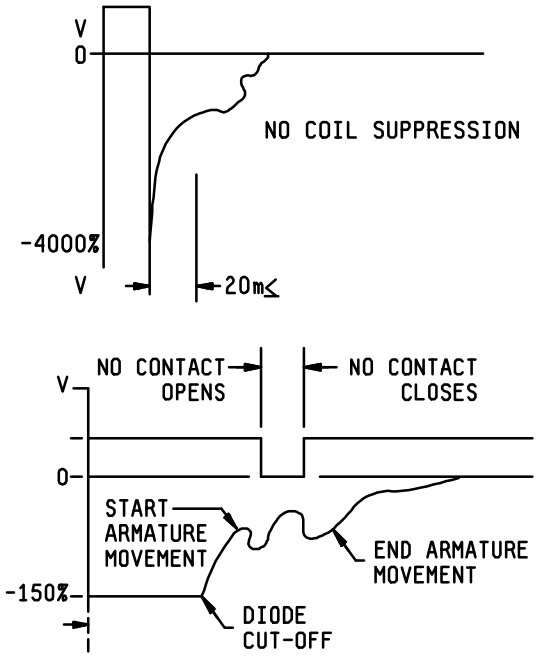


FIGURE 4. Typical transient voltage.

4.7.6 Thermal shock (see 3.11). Relays shall be tested in accordance with method 107 of MIL-STD-202. The following details and exception shall apply.

a. Mounting method: 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.

c. Measurements at each temperature extreme during step 1 and step 3 of the fifth cycle at the end of each temperature exposure and with the relays still in the conditioning chamber, the specified pickup or latch/reset, hold, dropout values (voltages), and operate and release time shall be measured as specified in 4.7.5.3 and 4.7.5.4, 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 DWV and IR shall then be measured as specified in 4.7.3.1.

4.7.7 Shock (specified pulse) (see 3.12). 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: For relays having flanges or studs, mounting shall be by the flanges or studs. For relays without flanges, mounting shall be by plugging into sockets or other suitable means approved by the qualifying activity.

b. Test condition: Test condition A, test condition B, or test condition 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 ms and no false closure or bridging of open contacts occurs in excess of 1 ms.

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

4.7.8 Vibration (see 3.13).

4.7.8.1 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. Mounting method: As specified in 4.7.7a.

b. Electrical load conditions: For qualification and group C inspections, relays shall be tested with the coil energized for 2 hours at rated voltage and with the coil deenergized for 2 hours, in each of the three mutually perpendicular (x, y, and z) directions. (For latching relays, relays shall be

tested with the coils deenergized, 2 hours with the latch coil last energized, and 2 hours with the reset coil last energized in each of the 3 mutually perpendicular relay axes). Contacts shall be loaded as specified in 4.7.8.1d.

c. Test condition: Unless otherwise specified (see 3.1), 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 kHz to 3 kHz.

d. Tests during vibration: As specified in 4.7.7e.

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

f. Unless otherwise specified (see 3.1), for group A testing, only one cycle shall be performed over the frequency range of 10 Hz to 3 kHz. 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.

4.7.8.2 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. Mounting method: As specified in 4.7.7a.

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 (x, y, and z) directions. Latching relays shall be tested with the coils deenergized; 15 minutes with the latch coil last energized and 15 minutes with the reset coil last energized. When applicable to group A inspection, the test time shall be 3 minutes for each state described above. Contacts shall be monitored as specified in 4.7.8.2d.

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

d. Tests during vibration: As specified in 4.7.7e.

e. Examination after test: As specified in 4.7.8.1e.

4.7.9 Acceleration (unless otherwise specified) (see 3.1 and 3.14). Relays shall be tested in accordance with method 212 of MIL-STD-202. The following details and exceptions shall apply.

a. Mounting method: As specified in 4.7.7a.

b. Test conditions: Unless otherwise specified (see 3.1), test condition A, 30 G's. (Acceleration shall be applied in each direction along three mutually perpendicular axes of the specimen. One axis shall be in the direction most likely to cause malfunction.) In each direction, the coil shall be 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 4.7.7f.

4.7.10 Terminal strength (see 3.15). 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.

4.7.10.1 Pull test (all terminal types). Terminals shall be tested as specified in test condition A, the force shall be as specified in 3.5.9.1.2.

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

TABLE IX. Pull force.

Terminal diameter		Pull force
(inches)	(mm)	(pounds)
0.035 - 0.047	.80 - 1.19	5 ±0.5
0.023 - 0.0349	.58 - .886	3 ±0.3
Less than 0.023	.58	2 ±0.2

4.7.11 Magnetic interference (see 3.16). The relay under test and eight similar relays shall be mounted in the same physical orientation by nonmagnetic means, as shown on figure 5. Unless otherwise specified, grid-spaced relays shall be mounted so that all terminals are positioned in the closest possible grid pattern. The spacing between terminals and tops of adjacent terminals shall be as shown on figure 5. Specified pickup or latch/reset, hold, and dropout values (voltages) shall be measured on the relay under test as specified in 4.7.5.3 with the coils of the eight outer relays energized at rated voltage (the magnetic polarity of each relay shall be similarly oriented.) This measurement shall be repeated with the coils of the eight outer relays deenergized.

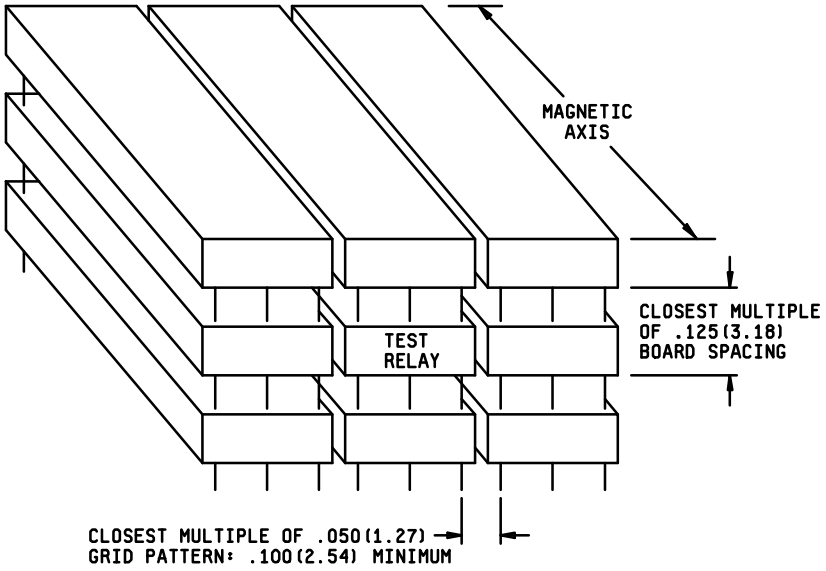


FIGURE 5. Mounting arrays for adjacent similar relays.

4.7.12 Salt spray (see 3.17). 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: B.

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

4.7.13 Overload (see 3.18). Unless otherwise specified (see 3.1), the relay shall make and break its overload for 50 operations with a duty cycle as shown in table X at the maximum system voltage (open circuit). For double-throw relays, separate overload cycles shall be performed for the normally open and for the normally closed contacts. The monitoring equipment shall automatically hold the relay under test in the state in which the failure occurs (energized or deenergized) and the contact voltage shall be removed. Following cycling, the electrical continuity of each case-grounding fuse shall be checked.

TABLE X. Duty cycles (seconds).

Load	Duty cycle	
	On	Off 1/
Inductive	0.5 ±.05	3.0 ±0.1
Motor	2/ 0.35 ±.09	2.0 ±0.1
Resistive 3/	1.5 ±1.0	1.5 ±1.0
Overload	0.20 ±.05	20 ±1.0
Rupture	0.30 ±.05	20 ±1.0

1/ "OFF" time may be decreased at the option of the manufacturer.
2/ Duration of the specified inrush current shall be 0.012 second ±0.002 second minimum, after which it shall be reduced to its rated motor load for the remainder of the "ON" period.

4.7.14 Rupture (see 3.19). The relay shall make and break its rated rupture current for the number of cycles specified (see 3.1) with a duty cycle as shown in table X at the maximum system voltage (open circuit). The rupture cycles will occur at the end of "normal" load cycling as described in 4.7.15. For double-throw relays, separate overload cycles shall be performed for the normally open and for the normally closed contacts. The monitoring equipment shall automatically hold the relay under test in the state in which the failure occurs (energized or deenergized) and the contact voltage shall be removed. Following cycling, the electrical continuity of each case-grounding fuse shall be checked.

4.7.15 Life (see 3.20). Unless otherwise specified (see 3.1), relays shall be cycled to failure for the Weibull method or the specified number of cycles (see 3.1) for the exponential method with contacts loaded in accordance with 4.7.15.1 through 4.7.15.3 inclusive, as applicable and with a duty cycle in accordance with table X. The testing sequence (cycle interval lengths at which group A2 measurements are made) shall be specified by the manufacturer and approved by the qualifying activity prior to qualification testing. Units not meeting requirements of group A2 electrical measurements at specified intervals will be considered failed. Each relay case shall be connected to system ground through a single normal-blow fuse rated at the greater of 100 mA or 5 percent of load current. The ambient temperature of the interior of the test chamber shall be +125°C or highest rated temperature (see 3.1). Contact resistance shall be monitored during 40 percent minimum of each "on" and each "off" period. The monitoring equipment shall automatically hold the relay under test in the state in which the failure occurs (energized or deenergized) and the contact voltage shall be removed. Unless otherwise specified, all contacts in each sample unit shall switch identical loads. Following cycling, the electrical continuity of each case-grounding fuse shall be checked. When the Weibull method is used to determine the failure rate, electrical continuity of each-case grounding fuse shall be checked at the specified number of cycles (see 3.1) and each integer multiple thereof.

4.7.15.1 Resistive load. The relay shall be subjected to the minimum operating cycles in a noninductive, resistive circuit; the current being maximum rated resistive loads specified (see 3.1) at each rated system voltage. Resistors used for loads shall have an L/R ratio not exceeding 1×10^{-4}. Current shall be rated resistive current as specified (see 3.1).

4.7.15.2 Motor load. Unless otherwise specified (see 3.1), the relay shall be subjected to the minimum operating cycles for making six times the rated motor load at rated system voltage and carrying, breaking the rated motor load.

4.7.15.3 Inductive load. Current shall be rated current. A suitable resistor may be placed in the circuit to obtain rated steady-state current flow. The relay shall be subjected to the minimum operating cycles with inductive loads for the rated current and voltage using the duty cycle of table X. Unless otherwise specified, the L/R value shall be 5 milliseconds. Appropriate inductive loads shall be used as approved by the qualifying activity. Unless otherwise specified (see 3.1), 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 6.

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 load resistance in ohms, and
t is the time in seconds for current to reach 63 percent of its final value.

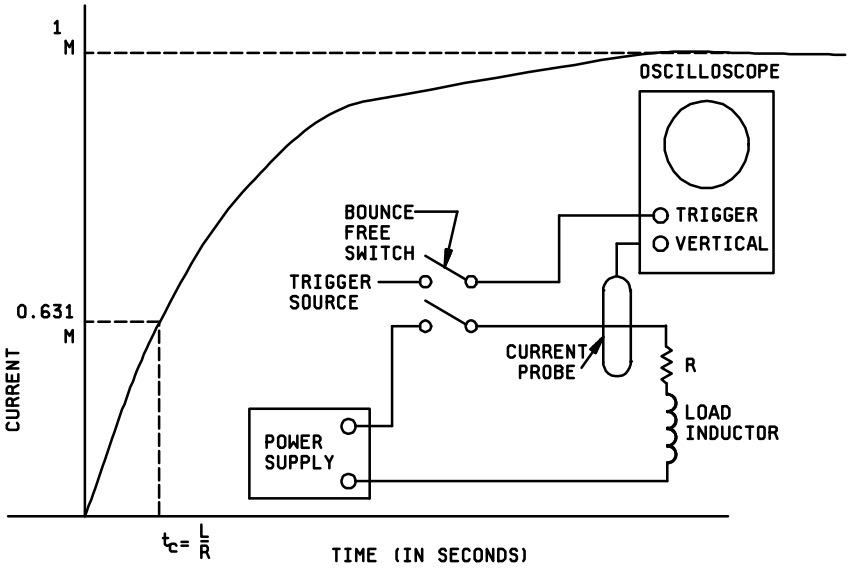


FIGURE 6. DC inductive load (inductive current rise time curve).

4.7.16 Mechanical life (see 3.21). Relays shall be cycled the specified number of cycles (see 3.1) at room ambient temperature. The minimum cycle time shall be 10X the sum of the maximum specified (see 3.1) operate and release times for the relay under test. For latching relays, the minimum cycle time shall be 10 (2X operate time). Each contact load shall be maximum 10 percent of rated voltage and

current. The coil shall be energized at rated voltage during 50 percent ±10 percent of each cycle. Mechanical life cycles shall not be used for failure rate determination or maintenance.

4.7.17 Resistance to solvents (see 3.22). Relays shall be tested in accordance with method 215 of MIL-STD-202 except temperature of solvent a, solvent b, and solvent 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: One sample shall be tested with each solvent solution. For qualification inspection, samples in excess of the available number of solvents shall be exempt from test. For group C testing, two additional samples shall be selected. The additional samples may be electrical rejects from group A2.

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

4.7.18 Continuous current (see 3.23). This test shall be performed at the maximum temperature and altitude specified (see 3.1). Other conditions of the test shall be in accordance with 4.7.15. During the first 3 hours of this test, the relay coil shall not be energized. Normally closed contacts shall be loaded with the highest rated resistive load. At the end of the 3 hour period with no change in the ambient conditions, the pickup voltage of the relays shall be determined and shall be within the limit specified. During the next portion of the test, the relay coils shall be energized continuously for 97 hours. The coil voltage shall be the maximum specified. Contacts that are in the closed position when the relay coil is energized shall carry the rated resistive current at any convenient voltage. Immediately following the operating period and with the relay still at the specified temperature, the relay shall be tested to determine that the energized function is completed when pickup voltage is applied. The relay shall sustain no visible damage such as loosening of terminals or loss of seal. Terminal temperature rise shall be monitored throughout the test and shall not exceed +75°C.

4.7.19 Sand and dust (applicable to unsealed relays) (see 3.5.2.1 and 3.24). Relays shall be tested in accordance with method 110 of MIL-STD-202. The following details and exceptions shall apply. Procedure: Step 1, step 3, and step 4 except that when the temperature is raised and maintained for 6 hours, the temperature to which it is raised shall be the maximum specified for the relay being tested. The sand and dust velocity through the test chamber shall be between 100 ft/min to 500 ft/min.

4.7.20 Humidity (applicable to unsealed, environmentally sealed, and hermetically sealed relays with potted wire leads) (see 3.25). Relays with MS20659 or SAE-AS25036 terminal lugs attached when applicable, shall be subjected to humidity test in accordance with method 106 of MIL-STD-202. Except step 7a and step 7b are not applicable. During the cycling test, a potential of 330 V dc shall be applied between terminals and other exposed metal parts. The current leakage shall not exceed 100 mA at any time during this test. After the relay has been removed from humidity, it shall be dried for approximately 6 hours in a circulating air oven at approximately 65°C. The relay shall meet the requirements of 3.25.

4.7.21 Ozone (applicable to unsealed, environmentally sealed, and hermetically sealed relays with potted wire leads) (see 3.26). The relay shall be placed in an enclosure and subjected for a period of 2 hours at room temperature to ozone having a concentration of from 0.010 percent to 0.015 percent by volume. At the end of the test period, the sample shall be examined for signs of ozone deterioration. A satisfactory method of producing and testing the required ozone concentration is described in ASTM D470 - 93.

4.7.22 Low temperature operation (see 3.27). The relay shall be subjected to the low temperature specified (see 3.1), for a period of 48 hours. At the end of this period, and with the relay at the low temperature, the specified pickup voltage, specified dropout voltage, and contact voltage drop shall be measured as specified in 4.7.5.2 and 4.7.5.3, except that a 30 minute preconditioning is not required. (These tests shall be accomplished in the sequence listed and in a minimum amount of time to prevent significant heating of the coil.) The relay shall then be tested intermittently for pickup and dropout voltage until it attains room temperature. Relays which contain permanent magnets in the magnetic circuit, shall, in addition to the above tests, be subjected to the demagnetizing effect of the cold coil energized with maximum voltage specified. During the low temperature test, after approximately 24 hours, these relays shall be operated by the sudden application of maximum coil voltage for one operation. Latch relays and center-off relays containing permanent magnets shall be operated in both directions with coil energized, for a period not exceeding 2 seconds, so no appreciable heating will occur. All units subjected to this demagnetizing effect shall be tested in accordance with the specified high temperature pickup voltage (see 4.7.5.3.5), at the conclusion of this test.

4.7.23 Reverse polarity (see 3.28). The relay shall make and break it's normal rated loads and it's rated overload and rupture currents in both polarities as described in 4.7.15.

4.7.24 Voltage transients (see 3.29). Transient voltages shall be measured on the source side of each set of main contacts using an oscilloscope or other means approved by the qualifying activity. Voltages measured during load interruption on the source side shall conform to the limits specified on figure 6 and figure 12 of MIL-STD-704 for normal and abnormal operation respectively. Transient voltages measured when interrupting rated overload current shall not exceed 350 V dc for 50 ms. The relay shall be connected to the source through diodes or other suitable means necessary to insure that transient energy is not dissipated by the source, but rather by the device under test and the load circuitry.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. Relays conforming to this specification are intended for use in electronic and communication equipment. Their principal areas of application are aircraft, missiles, spacecraft, and ground-support electronic and communication equipment (see 1.1). This does not preclude the use of these relays in other military applications. Relays covered by this specification are intended to be able to operate satisfactorily in military systems under the following demanding conditions operating temperature range of -40°C to +85°C; penetration from cutting sand and dust conditions; and corrosion in salt water environments. These requirements are verified under a qualification system.

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

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.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

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

c. Packaging requirements (see 5.1).

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

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification Information pertaining to qualification of products may be obtained from the Defense Supply Center Columbus (DSCC/VQP), Post Office Box 3990, Columbus, OH 43216-5000.

6.4 Shelf life. Relays conforming to this specification should be designed for a minimum of 7 years shelf life, following which the relays should be satisfactory for intended use without further conditioning.

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 appropriate corrosion protection, intermetallic coupling information is provided in MIL-STD-889 (Dissimilar Metals).

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

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

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

Table XI. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and compounds	Lead and compounds	Toluene
Carbon tetrachloride	Mercury and compounds	1,1,1 - Trichloroethane
Chloroform	Methyl ethyl ketone	Trichloroethyene
Chromium and compounds	Methyl isobutyl ketone	Xylenes
Cyanide and compounds	Nickel and compounds	

6.10 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.

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 bounce: Internally caused intermittent and undesired opening of closed contacts, or closing of open contacts.

Contact release time: Time from initial de-energization of the relay coil to the first opening of a closed contact prior to bounce.

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.

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.

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

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

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.

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

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

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.

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

6.11 Subject term (keyword) listing.

Exponential
Hermetically sealed
Nonhermetic enclosures
Weibull
Latching
Nonlatching

APPENDIX A

QUALIFICATION USING THE WEIBULL OR EXPONENTIAL METHOD

A.1 SCOPE

A.1.1 Scope. This appendix provides the computation for the device failure rate and provides acceptable limits for the correlation coefficient and distribution slope using Weibull methods. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS

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

A.2.2 Government documents.

A.2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those 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).

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-690 - Failure Rate Sampling Plans and Procedures.
MIL-STD-790 - Standard Practice for Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks, are available from the Defense Automation and Production Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

A.3. Weibull FR qualification method. Weibull qualification is subject to the following details:

a. Procedure I - Qualification at the initial FR level. Using the Weibull method upon the qualification life data obtained from the samples cycled until failure as specified in table IV the manufacturer may initially qualify their product to any of the FR levels shown in table A-I and associated load life rating (see A.3.1).

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 qualification. The sampling plan specified for group B inspection shall apply (see 4.6.3.1). The data from group B inspection life testing shall be accumulated along with prior qualification and group B life test data for each load rating. Weibull reliability analysis is performed upon the total accumulated life data for each load rating

(see 4.7.15). In the event that the analysis no longer supports the FR level and associated number of cycles, the failure rate of the product shall be increased one level or the product removed from the QPL. Noncompliance corrective action shall be in accordance with 4.6.3.3.

A.3.1 Weibull FR level computation. For each rated contact load type, the sample units specified in group Q4 of table IV shall be cycled until failure. If one unit fails within the first one-half percent (0.5%) of the rated life, it shall be considered an infant mortality. Another unit from the same lot shall be substituted in its place for life testing. If more than one unit is considered to be an infant mortality, refer to noncompliance corrective actions in accordance with 4.6.3.3 The failure points shall be plotted on commercially available Weibull paper or plotted using Weibull analysis software. From the plots, the distribution slope (β-Beta), the characteristic life (θ-Theta), and correlation (linearity) coefficient shall be determined. Data from periodic inspections shall be accumulated and added to the initial qualification data. The recomputed values of Theta, Beta, and correlation coefficient must support the qualification distribution model as specified herein. For each specified life rating, the average FR may be calculated using the equation shown in figure A-1. For qualification, the FR shall be calculated using the 90 percent confidence limit values for Beta and Theta. For qualification and maintenance of qualification, the correlation (linearity) coefficient shall be 0.8 minimum, and the distribution slope (Beta) must be 1.5 minimum. The 60 percent confidence limit values for Beta and Theta may be used for FR calculations for maintenance of qualification. In the event that the periodic inspection data does not support the qualification distribution model, (Beta < 1.5, correlation coefficient < 0.8, decreased Theta) designation at the L level will be issued until such time the corrective action and retest (approved by the qualifying activity) demonstrates that the qualification failure distribution model can be supported.

Weibull Analysis Example:

A manufacturer wants to rate their relay for 50,000 cycles with a 3 percent failure rate per 10,000 cycles. Therefore, ten randomly selected relays are tested as required by table IV. Table A-I illustrates the time to failure for each of the ten units under test, listed in order from lowest to highest failure time.

TABLE A-I. Ranked times to failure.

Sample number	Rank order (i)	X (Median rank in %)	Y (Cycles to failure age in 10,000 cycles)
6	1	6.70	62.6
3	2	16.32	75.0
10	3	25.94	90.0
8	4	35.57	118.8
2	5	45.19	121.9
4	6	54.81	125.9
7	7	64.43	162.8
5	8	74.06	175.2
9	9	83.68	187.5
1	10	93.30	240.0

The first item to examine is if there is if the correlation coefficient 0.8. This is to determine if the test information indicates there is a trend in the number of failures as compared to the number of cycles the relay has been operated. Utilizing the correlation function:

$$Correlation\ coefficient = r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

$$= \frac{82{,}159 - \frac{500 * 1{,}359.7}{10}}{\sqrt{\left(32{,}639 - \frac{(500)^2}{10}\right)\left(212{,}423 - \frac{(1359.7)^2}{10}\right)}}$$

$$= \frac{82{,}159 - 67{,}985}{\sqrt{(32{,}639 - 25{,}000)(212{,}423 - 184{,}878)}} = \frac{14{,}174}{14{,}506} = 0.98$$

Therefore, with the correlation factor being 0.98 it can be concluded there is a definite correlation between failures and number of operations.

For the Weibull distribution function, it is necessary to estimate the percentage of relays failing before each failure cycle (median ranks). Using table A-II determine the estimated percentage.

TABLE A-II. Median rank table (in percent).

Rank order (i)	Sample size (N)									
	1	2	3	4	5	6	7	8	9	10
1	50.00	29.29	20.63	15.91	12.94	10.91	9.43	8.30	7.41	6.70
2		70.71	50.00	38.64	31.47	26.55	22.95	20.21	18.06	16.32
3			79.37	61.36	50.00	42.18	36.48	32.13	28.71	25.94
4				84.09	68.53	57.82	50.00	44.04	39.35	35.57
5					87.06	73.45	63.52	55.96	50.00	45.19
6						89.09	77.05	67.87	60.65	54.81
7							90.57	79.79	71.29	64.43
8								91.70	81.94	74.06
9									92.54	83.68
10										93.30

The cycles to failure versus median ranks shall be plotted (in percent on Weibull graph paper using the x-y coordinates). See figure A-1 and table A-III for an example.

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TABLE A-III. X-Y coordinates for Weibull plots.

Sample number	Rank order (i)	X-coordinate cycles to failure (10,000 cycles)	Y-coordinate median rank (percent)
6	1	62.6	6.70
3	2	75.0	16.32
10	3	90.0	25.94
8	4	118.8	35.57
2	5	121.9	45.19
4	6	125.9	54.81
7	7	162.8	64.43
5	8	175.2	74.06
9	9	187.5	83.68
1	10	240.0	93.30

The resultant graph is illustrated in figure A-I. As shown in the figure, a best fit through the data points shall be drawn. The slope of the line, β, and the characteristic life, θ shall be estimated.

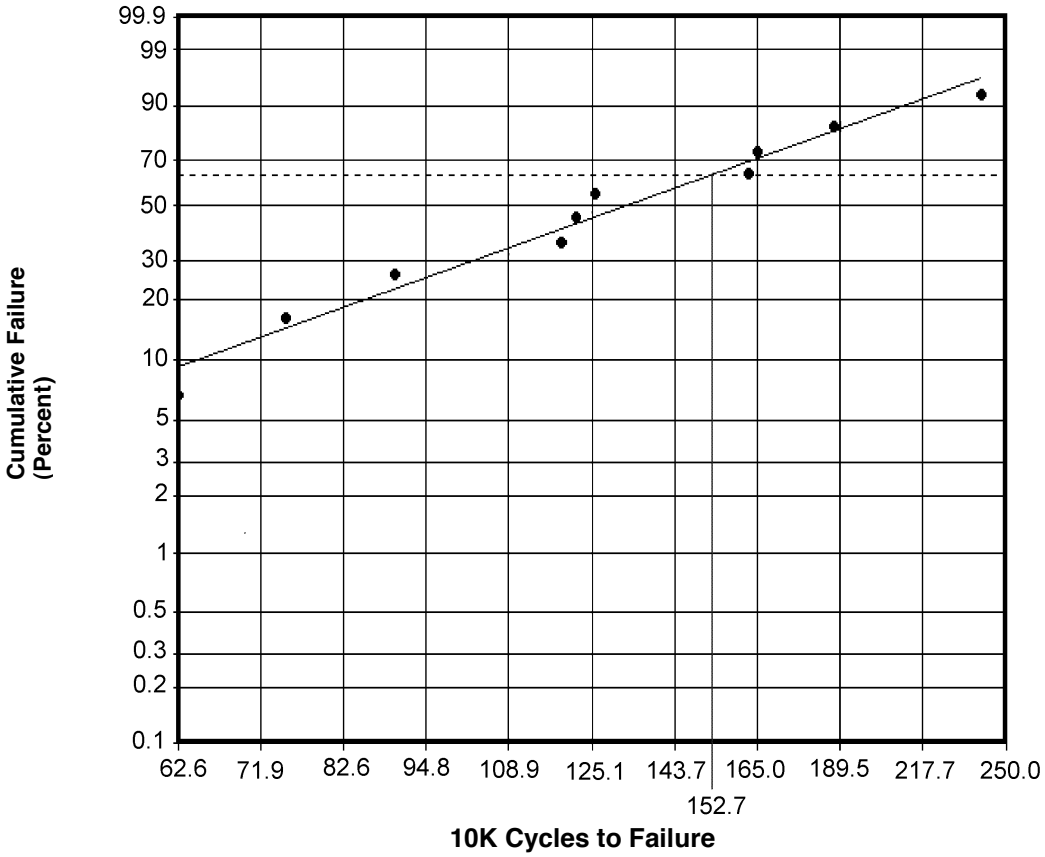

Figure A-1: Weibull FR Level Computation

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The calculation of β is given by the equation: $\beta = \frac{\Delta Y}{\Delta X}$

Where: $\Delta X = \ln t_2 - \ln t_1$

$$\Delta Y = \ln\ln\left(\frac{1}{1-F(t_2)}\right) - \ln\ln\left(\frac{1}{1-F(t_1)}\right)$$

From the example,

$t_2 = X_2 = 250{,}000$ cycles

$t_1 = X_1 = 62{,}600$ cycles

$F(t_2) = Y_2 = 97^{th}$ percentile of the cumulative distribution function (CDF) = .97

$F(t_1) = Y_1 = 9^{th}$ percentile of the CDF = .09

$$\Delta X = \ln(250{,}000) - \ln(62.6{,}000) = 12.43 - 11.04 = 1.38$$

$$\Delta Y = \ln\ln\left(\frac{1}{1-.97}\right) - \ln\ln\left(\frac{1}{1-.09}\right) = \ln\ln(33.33) - \ln\ln(1.10) = 1.25 - (-2.36) = 3.62$$

Therefore,

$$\beta = \frac{3.62}{1.38} = 2.61$$

The characteristic life (Theta) is estimated from the graph at the intercept of the plotted line and the 63.2% CDF value by dropping a vertical line to the x-axis. In the example, the characteristic life of the product is 152,700 cycles.

$$FR_{\%/10K} = \left[\frac{T^{(\beta-1)}}{\theta^{\beta}}\right] * 10^{6} = \left[\frac{50{,}000^{(2.61-1)}}{152{,}700^{2.61}}\right] * 10^{6} = 1.08\ \%/10K\ cycles$$

Where:
β = Distribution slope (Beta)
θ = Characteristic life (Theta)
T = Rated Life

For the purposes of qualification and maintenance of qualification, the average failure rate during rated life shall be determined with a 90 percent and 60 percent confidence level, respectively. The failure rate for the confidence levels are calculated below:

$$FR_{@\,90\%} = 1.08\% * 2.304 = 2.48\ \%/10K\ cycles$$

$$FR_{@\,60\%} = 1.08 * 0.916 = 0.99\ \%/10K\ cycles$$

TABLE A-IV. Failure rate.

Failure rate	
Letter designation	%/10,000 cycles
L	3.0
M	1.0
P	0.1
R	0.01

A.3.2 Exponential FR qualification method. Exponential qualification is subject to the following details:

A.3.2.1 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. If there is no production, see 4.5. The manufacturer shall preselect the sampling plan to be used during the maintenance period from table A-III. 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. Noncompliance corrective action shall be in accordance with 4.6.3.3.

A.3.2.2 FR level determination. Determination of FR levels shall be based upon data from all completed life 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 group B 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 group B conformance inspection conditions. These relay types must be reviewed and approved by the qualifying activity prior to being considered as acceptable relays for use in FR level determination.

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A.3.2.3 FR level computation. For this computation, a sample unit which fails at any given cycle shall be classed as a failure for all subsequent measurements. However, the contractor, at his option, may physically remove failed sample units from the test. If a failed sample unit is not removed, the cycles accumulated subsequent to its failure shall not be counted toward the cumulative component cycles shown on record form.

TABLE A-V. Requirements for qualification and extension of qualification to lower (better) failure rate levels (90 percent confidence level).

FR level symbol	Qualified FR (% / 10,000 cycles)	Cumulative unit cycles in millions					
		1/ C = 0	C = 1	C = 2	C = 3	C = 4	C = 5
L	3.0	0.767	1.30	1.77	2.23	2.66	3.09
M	1.0	2.30	3.89	5.32	6.68	7.99	9.27
P	0.1	23.0	38.9	53.2	66.8	79.9	92.7
R	0.01	230.0	389.0	532.0	668.0	799.0	927.0

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

TABLE A-VI. 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				
			C 1/ = 1	C = 2	C = 3	C = 4	C = 5
L	3.0	6 months	.673	1.03	1.39	1.75	2.10
M	1.0	6 months	2.02	3.10	4.18	5.25	6.30
P	0.1	12 months	20.2	31.0	41.8	52.5	63.0
R	0.01	24 months	202	310	418	525	630

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

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

Review activities:
Navy - AS
Air Force – 99

Preparing activity:
DLA - CC

(Project 5945-1130)

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 block1s 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-32085	**2. DOCUMENT DATE** (YYMMDD)

3. DOCUMENT TITLE
Relays, Electromagnetic, 270 V dc, Established Reliability, General Specification for

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 (Incl. Area Code) (1) Commercial (2) DSN (If applicable)	7. DATE SUBMITTED (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME Defense Supply Center, Columbus ATTN: VAT	b. TELEPHONE (Include Area Code) (1) Commercial (614) 692-0542 (2) DSN 850-0542
c. ADDRESS (Include Zip Code) Post Office Box 3990 Columbus, OH 43216-5000	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (J-330) 8725 John J. Kingman Road, Suite 4235 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888