MILITARY SPECIFICATION

* RELAYS, HYBRID AND SOLID STATE, TIME DELAY,

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 establishes the requirements for time delay relays that are a combination of hybrid microcircuits, solid state electronics with an integral electromagnetic relay or solid state output. Relays covered by this specification are intended for use in aerospace and associated ground support electrical and electronic systems and equipment (see 6.1).

1.2 Classification. Time delay relays covered by this specification shall be of the following types and classes, as specified (see 3.1 and 6.4.1):

Type

I	-	Time delay on operate.
IIA	-	Time delay on release (separate control and power terminals).
IIB	-	Time delay on release (true).
III	-	Interval timer.
IV	-	Repeat cycle timer.
V	-	Time sequence as specified (see 3.1).

Class

A	-	Hybrid (integral electromagnetic relay qualified to MIL-R-5757 or MIL-R-39016).
B	-	Hybrid (integral electromagnetic relay qualified to MIL-R-6106).
C	-	Solid state.
D	-	Hybrid (integral electromagnetic relay not qualified with contact ratings 5 amperes or lower).
E	-	Hybrid (integral electromagnetic relay not qualified with contact ratings 5 amperes or higher).

1.2.1 Ratings. Time delay relays with electromechanical relay output and with contact ratings 10 amperes or greater shall be class B or class E.

* 1.2.2 Military part number. The military part number shall consist of the letter M, the basic number of the specification and specification sheet, the assigned dash number, and a quality level (see 3.1).

EXAMPLE:

M	83726/5	-0001	X
Military designator	Specification sheet	Dash number	Quality level

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

FSC 5945

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

J-W-1177	-	Wire, Magnet, Electrical.
L-P-378	-	Plastic Sheet and Strip, Thin Gauge, Polylefin.
NN-P-71	-	Pallet, Material Handling, Wood, Stringer Construction, 2 Way and 4 Way (Partial).
QQ-S-571	-	Solder, Tin Alloy, Tin Lead Alloy & Lead Alloy.
QQ-S-781	-	Strapping, Steel, and Seals.
ZZ-R-765	-	Rubber, Silicone.
GGG-W-641	-	Wrench, Socket (and Sockets, Handles, and Attachments for Socket Wrenches, Hand).
PPP-B-566	-	Boxes, Folding, Paperboard.
PPP-B-601	-	Boxes, Wood, Cleated Plywood.
PPP-B-621	-	Boxes, Wood, Nailed and Lock-corner.
PPP-B-636	-	Boxes, Shipping, Fiberboard.
PPP-B-676	-	Boxes, Setup.

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MIL-I-10	-	Insulating Materials, Electrical, Ceramic, Class L.
MIL-M-14	-	Molding Plastics and Molded Plastic Parts, Thermosetting.
MIL-C-17	-	Cable, Radio Frequency, Flexible and Semirigid, General Specification for.
MIL-P-116	-	Preservation, Methods of.
MIL-P-997	-	Plastic Material, Laminated, Thermosetting, Electrical Insulation, Sheets, Glass Cloth, Silicone Resin.
MIL-W-5088	-	Wiring, Aerospace Vehicle.
MIL-E-5400	-	Electronic Equipment Airborne, General Specification for.
MIL-R-5757	-	Relay, Electromagnetic, General Specification For.
MIL-R-6106	-	Relay, Electromagnetic, (Including Established Reliability (ER) Types), General Specification For.
MIL-P-15037	-	Plastic Sheet, Laminated, Thermosetting, Glass Cloth, Melamine Resin.
MIL-P-15047	-	Plastic Material, Laminated Thermosetting Sheets, Nylon Fabric Base, Phenolic Resin.
MIL-F-15160/2	-	Fuse, Instrument, Power, and Telephone (Nonindicating), Style F02.
MIL-F-15160/3	-	Fuse, Instrument, Power, and Telephone (Nonindicating), Style F03.
MIL-S-19500	-	Semiconductor Devices, General Specification for.
MIL-M-38510	-	Microcircuits, General Specification for.
MIL-R-39016	-	Relays, Electromagnetic, Established Reliability, General Specification for.
MIL-G-45204	-	Gold Plating, Electro Deposited.
MIL-P-46133	-	Plastic Molding and Extrusion Material, Poly (aryl Sulfone Ether) Resin, Thermoplastic.
MIL-I-81023	-	Inductor, 28 V, D.C. Laboratory Test, General Specification for.

STANDARDS

FEDERAL

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

MILITARY

MIL-STD-129	-	Marking for Shipment and Storage.
MIL-STD-143	-	Standards and Specifications, Order of Precedence for the Selection of.
MIL-STD-147	-	Palletized Unit Loads Validated Oct 1974.
MIL-STD-202	-	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454	-	Standard General Requirements for Electronic Equipment.
MIL-STD-461	-	Electromagnetic Emission and Susceptibility, Requirements for the Control of Electromagnetic Interference.
MIL-STD-462	-	Electromagnetic Interference Characteristics, Measurement of.
MIL-STD-704	-	Aircraft Electric Power Characteristics.
MIL-STD-706	-	Power Supply Voltages, Regulated, DC within Electronic Equipment.
MIL-STD-883	-	Test Methods and Procedures for Microelectronics.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.
MIL-STD-1549	-	Common Termination System for Electrical and Electronic Parts.
MIL-STD-45662	-	Calibration Systems Requirements.
MS20659	-	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class 1.
MS25036	-	Terminal, Lug, Crimp Style, Copper Insulated, Ring Tongue, Bell Mouthed, Type II, Class 1.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

(See supplement 1 for list of associated specifications).

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

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 requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

* 3.1.1 Level X. For relays containing discrete components supplied to this level, all discrete components shall be Military Standard Parts, established reliability type of which all active devices shall be hermetically sealed to 1 x 10^{-8} cm^3/s and shall have been burned-in for 160 hours minimum. Relays containing hybrid type devices shall be screened to method 5008, class B, MIL-STD-883, exclusive of any electromechanical relay, and the active devices shall be glass passivated and shall have received 160 hours minimum of burn-in. Electromechanical relays contained in these relays shall be military qualified devices.

* 3.1.2 Level Y. The active components within the relays supplied to this specification may contain commercial discretes and/or hybrids provided they meet the military temperature range and are screened to method 5008, class B, MIL-STD-883. The active components (excluding electromechanical devices) shall have received 160 hours of burn-in minimum. The time delay relays shall be hermetically sealed and have passed 1 x 10^{-8} cm^3/s leak test.

* 3.1.3 Level W. The active components supplied within relays and supplied to this level may contain commercial nonhermetic parts. Time delay relays shall be screened at +25°C and shall have passed the seal tests as applicable in 4.7.3.

3.2 Qualification. Relays furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.5 and 6.3).

3.3 Materials. The materials shall conform to requirements specified herein. When a definite material is not specified, the selection of material shall be at the discretion of the relay manufacturer. Wherever practicable, the manufacturer shall select materials standards and specifications in accordance with MIL-STD-143. Materials selected shall be such that the relays will meet the performance requirements and product characteristics specified herein. After qualification, any change of parts or materials shall be submitted to the government qualifying activity for approval. Acceptance or approval of any constituent part or material shall not be construed as a guaranty of acceptance of the finished product.

3.3.1 Metals. Metals shall be of a corrosion-resistant type or shall be plated or treated to resist corrosion, except that zinc, cadmium, or unfused pure tin plating shall not be used, either internally or externally.

3.3.1.1 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metal 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 materials to provide similar or suitable abutting surfaces is permitted. Dissimilar metals shall be as defined in 6.5 through 6.5.4, inclusive. In hermetic seals, the 0.25 volt difference between the header material and the housing material is not applicable. The use of dissimilar metals separated by suitable insulating material is also permitted. This paragraph does not prohibit the use of dissimilar metals within hermetically sealed enclosures. Metals and finishes shall meet the environmental requirements of this specification.

3.3.1.2 Magnet wire. Magnet wire shall conform to J-W-1177, except when wire not covered by J-W-1177 is required due to physical size or temperature range consideration; then a suitable wire may be substituted, as evidenced by meeting the performance requirements of this specification.

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

3.3.1.4 Magnesium. The use of magnesium or magnesium alloys is prohibited.

* 3.3.2 Nonmetals. Nonmetals, including protective finishes shall be moisture resistant, nontoxic, arc resistant, flame resistant, and self extinguishing, shall not support fungus growth, and shall not be adversely affected by weathering in aircraft, missile, and spacecraft fluids at the specified temperature (see 3.1). The manufacturer shall submit certification to the Government qualifying activity that materials will not support fungus growth (see requirement 4 of MIL-STD-454).

* 3.3.2.1 Plastic material. Potting material, or similar materials used inside the relay package over nonhermetically sealed components shall be subject to approval by the qualifying activity for levels W and Y. Potting materials or similar materials shall not be used internally for X level relays. Plastic material shall conform to MIL-M-14 and MIL-P-46133 for molded material, MIL-P-997, MIL-P-15037, and MIL-P-15047 for laminated material. Other types of plastic materials possessing superior characteristics may be used, provided the manufacturer submits acceptable evidence to the activity responsible for qualification that such material meets the performance requirements of MIL-M-14, MIL-P-997, MIL-P-15037, MIL-P-15047 or MIL-P-46133, whichever is applicable. In addition to these specifications and the requirements of 3.3.2, the plastic material shall not support combustion, give off noxious gases in harmful quantities, give off any gases in quantities sufficient to cause explosion of sealed housing, give off any gases in a sealed housing that will cause contamination of the contacts or other parts of the component, or form current-carrying tracks when subjected to arcing conditions encountered when any of the tests in this specification are performed.

3.3.2.2 Ceramic. Ceramic insulating material shall conform to grade L422 (or better) of MIL-I-10. All external ceramic surfaces shall be glazed in accordance with MIL-I-10.

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

* 3.4 Design and construction. Relays shall be of the design, construction, weight, and physical dimensions specified (see 3.1). Relays shall be designed for operation in aerospace and shipboard applications in hermetically sealed packages utilizing -55°C to +125°C temperature range parts to meet MIL-STD-704, MIL-STD-706, and MIL-E-5400 requirements. Relays for ground support equipment may be encapsulated, sealed or hermetically sealed. Relays shall operate to specification over temperature, any mounting position, for continuous duty at rated voltage and current. Relays with adjusting features shall be so designed that the setting of the adjustment shall not be altered by any specified test.

3.4.1 Selection of military specifications and standards. Specifications and standards for all parts, materials, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with MIL-STD-143, as applicable, except as provided in 3.4.1.1.

* 3.4.1.1 Standard parts. Standard parts including mounting and terminal hardware (i.e., screws, lockwashers, etc.) (MS and AN) shall be used wherever practicable. Nonstandard parts may be used, provided they possess suitable properties and a standard part is not available.

* 3.4.2 Integral electromagnetic relay (class A and B relays). The integral electromagnetic relay (mounting means excepted) used in hybrid relays covered by this specification shall have been tested and qualified to the following specifications, as applicable (see 3.1): For X level relays, the internal electromechanical relay shall be reliability level M selected from MIL-R-39016 or MIL-R-6106.

Class	
A	MIL-R-5757 or MIL-R-39016
B	MIL-R-6106

* 3.4.3 Electronic components (not applicable to level W). Electronic components shall be selected in accordance with MIL-E-5400. All active components shall be hermetically sealed or sealed in a hermetic package. Microcircuits shall be MIL-M-38510 and shall be screened to method 5004, class B of MIL-STD-883; hybrid electronics shall be in accordance with method 5008, class B, of MIL-STD-883; and semiconductors shall be screened to JAN TX level. All other components shall be established reliability, where available. After qualification, any change to parts or material shall be submitted to the government qualifying activity for approval.

3.4.4 Case. The case shall be of sufficient mechanical strength to withstand the normal abuse incurred in handling, transit, storage, and installation without malfunction or distortion of parts.

3.4.4.1 Grounding. The case shall not be part of the electrical circuit but it may be part of the magnetic circuit. The case, or permanent attachments thereto, shall provide a means of electrical grounding (see requirement 1 of MIL-STD-454).

3.4.4.2 Threaded parts. All threaded parts shall be in accordance with FED-STD-H28. Where practical, all threads shall conform to the coarse thread series. The fine thread series shall be used only for applications that might show definite advantage through their use. Where a special diameter-pitch combination is required, the thread shall be of American National Form and of any pitch between 16 and 36 which is used in the fine thread series.

3.4.5 Installation clearances. Adequate clearance shall be provided for installation of terminals and mounting hardware. Clearance for socket wrenches shall be governed by GGG-W-641. Special installation tools shall not be required.

3.4.6 Terminals (electrical). Terminals shall be in accordance with the following and as specified (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 any mechanical forces specified in table I involved in connection or disconnection, throughout the life of the relay. Unless otherwise specified (see 3.1), terminals shall be marked or be adequately described by the circuit diagram in accordance with MIL-STD-1285 and figure 1.

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

Thread size	Force in pounds	Torque in pound-inches
4-40	5	4.4
6-32	30	10.0
8-32	35	20.0
10-32	40	32.0
10-24	40	35.0
1/4-28	50	75.0
5/16-24	70	100.0
3/8-24	100	150.0
7/16-20	100	150.0
1/2-20	100	150.0

3.4.6.1 Stud terminals (threaded). Unless otherwise specified (see 3.1), stud terminals shall be supplied with two flat washers, one nut, and one split ring type lockwasher. A minimum of three complete threads shall remain above the nut when it is backed off three complete turns from a position with all parts tightened in place.

3.4.6.1.1 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 MS20659 or MS25036 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.

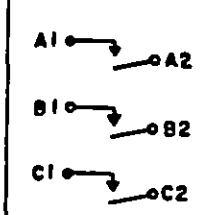
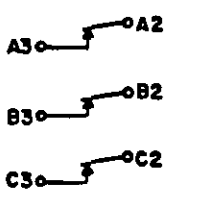
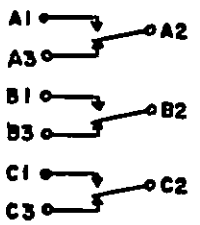
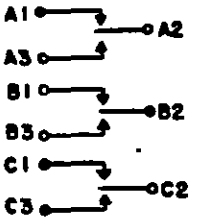
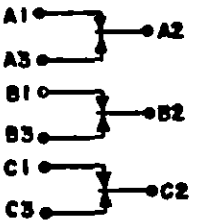
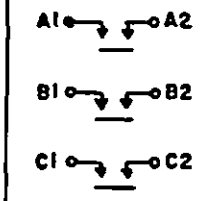
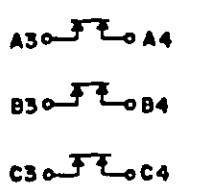
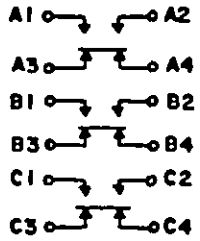
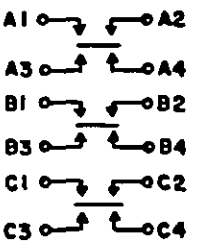
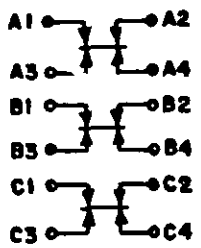
3.4.6.1.2 Strength of stud terminals. Stud terminals shall be designed to withstand the static value or pull and torque specified in table I (see 3.37).

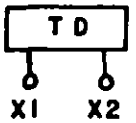
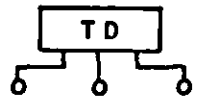
3.4.6.2 Solder-lug, socket plug-in, printed-wiring, and wire lead terminals.

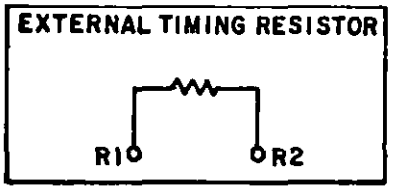
3.4.6.2.1 Solder-lug terminals. Unless otherwise specified (see 3.1), solder-lug terminals may be of any shape, and shall be capable of being readily soldered. Solder-lug terminals shall be designed to accommodate two #20 stranded wires with 19 strands for relays rated for 2 amperes and less, and two wires, each rated to carry the maximum rated current of the relay, for relays rated above 2 amperes (refer to MIL-W-5088 for current carrying capability of wire). Input terminals to the time delay circuitry shall be designed to accommodate two #20 stranded wires with 19 strands. Unless otherwise specified (see 3.1), solder-lug terminals shall not be gold plated.

3.4.6.2.2 Socket plug-in terminations. Socket plug-in terminations shall conform to the arrangements or dimensions necessary for proper mating with the associated connectors or sockets as specified (see 3.1). The mounting arrangement of the relay and its corresponding socket shall be so designed that the entire weight of the relay will be suspended and the stability of its mounting will be provided by an auxiliary mounting means other than the electrical terminals of the socket. Relays with plug-in terminals shall have electrical and environmental tests of section 4 performed with the appropriate or specified socket or connector assembled to the relay.

3.4.6.2.3 Printed-wiring. Printed-wiring terminals shall be spaced in multiples of 0.050 inch (1.27 mm) for compatibility with printed-wiring grid spacing.

CONTACT ARRANGEMENTS, SYMBOLS AND TERMINAL MARKING (SEE NOTE)					
	SINGLE THROW		DOUBLE THROW		
	FORM "A"	FORM "B"	FORM "C"	FORM "K" SPDT	FORM "M"
	NORMALLY OPEN	NORMALLY CLOSED	(TWO POSITION)	3 POS CENTER OFF	3 POS CENTER ON
SINGLE BREAK					
	FORM "X"	FORM "Y"	FORM "Z"	FORM "KK"	FORM "MM"
DOUBLE BREAK					
NOTE: CONTACTS ARE SHOWN WITH COIL(S) DE-ENERGIZED.					

SIGNAL INPUT	SEPARATE CONTROL
	



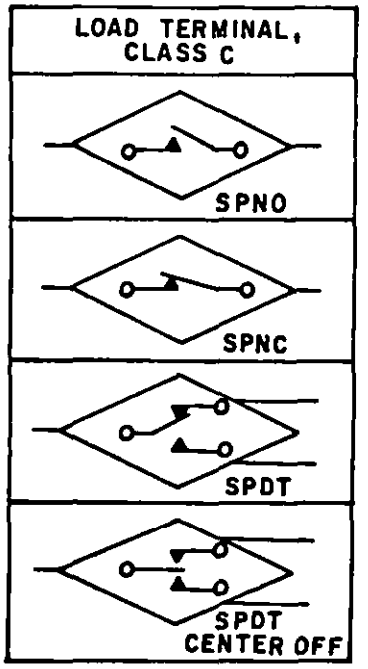


FIGURE 1. Terminal markings.

3.4.6.2.4 Strength of solder-lug, socket, plug-in, printed wiring, and wire lead terminals. The relay terminals shall be designed to withstand the applicable terminal strength performance procedure specified in 3.37.

3.4.6.3 Common termination system (CTS). Relays with removable and insertable terminals shall be designed in accordance with MIL-STD-1549.

3.4.6.4 Terminal finish. Finish of terminals shall provide a good electrical contact and meet the performance requirements specified herein. All terminals used for external soldered connections shall be tin plated or coated with composition Sn40 to Sn70 solder conforming to QQ-S-571 to facilitate soldering. Socket plug-in terminals shall be gold plated in accordance with MIL-G-45204, type II, class I.

3.4.7 Mounting means (see 3.1).

3.4.7.1 Socket. Socket plug-in relays shall be so designed that the weight of the relay will be supported and the stability of the mounting will be provided by means other than the terminals.

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

3.4.7.3 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 (see 3.37). Unless otherwise specified (see 3.1), each stud shall be supplied with two flat washers, one nut, and one lockwasher. For direct Government orders, the hardware shall be assembled on the stud.

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

Thread size	Force in pounds	Torque in pound-inches
4-40	5	10
6-32	25	18
8-32	35	37
10-32	50	60
1/4-28	60	100
5/16-24	80	160
3/8-24	115	275
7/16-20	140	475

3.4.8 Dimensions and weight. Relay physical dimensions and weight shall be as specified (see 3.1).

3.4.9 Solder. Solder shall have a minimum softening point 55°C above the maximum temperature rating for the relay. Wherever suitable for the purpose, compositions Sn70, Sn60, and Sb5, conforming to QQ-S-571, shall be used. Solder of other compositions may be used, provided they possess superior characteristics and meet the requirements of this specification.

3.4.9.1 Soldering processes. Soldering shall be so executed that both a positive electrical and strong mechanical connection is assured. Electrical joints shall be mechanically secured before soldering and shall not depend upon solder for mechanical strength.

* 3.5 Performance. The relays shall meet the performance requirements and product characteristics of this specification and of the applicable specification sheets (see 3.1), when tested at -55°C, +25°C, and +125°C for levels X and Y, and at +25°C for level W where applicable.

3.5.1 Inspection of product. When relays are inspected and tested as specified in 4.3 and 4.7.1, they shall conform to requirements for materials, design, construction, physical dimensions, weight, item marking and workmanship as specified (see 3.1, 3.3, 3.46, and 3.47).

* 3.5.2 Screening. Relays shall be tested as specified in 4.7.2. Quality levels X and Y shall be tested at -55°C, +25°C and +125°C. Quality level W shall be tested at +25°C.

3.6 Solderability (not applicable to plug-in relays). When relays are tested as specified in 4.7.33.2.4, the dipped portion of the terminals shall conform to the inspection criteria of method 208 of MIL-STD-202.

3.7 Seal.

* 3.7.1 Nonhermetically-sealed relays and hermetically-sealed (potted) relays (i.e., relays that employ metal-to-metal, metal-to-glass, or metal-to-ceramic sealing but are filled with potting rather than gas). When relays are tested as specified in 4.7.3.1, there shall be no evidence of leakage.

* 3.7.1.1 Nonhermetically-sealed relays. When relays are tested as specified in 4.7.3.1.1, there shall be no evidence of leakage.

3.7.2 Hermetically-sealed relays. When relays are tested as specified in 4.7.3.2 or 4.7.3.3 as applicable, there shall be no leakage in excess of the applicable value specified in the following:

Net sealed gas volume	Maximum allowable leakage
Greater than 2 cubic inches- - - -	1×10^{-6} atm cm^3/s per cubic inch of net sealed gas volume.
2 cubic inches or less - - - - - -	1×10^{-8} atm cm^3/s.

3.8 Insulation resistance. When relays are tested as specified in 4.7.4, the insulation resistance shall be not less than 1,000 megohms. Following resistance to soldering heat, thermal shock, shock, vibration (high frequency), acceleration, moisture resistance, and after all life tests, the insulation resistance shall be not less than 500 megohms.

3.9 Dielectric withstanding voltage. When tested as specified in 4.7.5, relays shall withstand the test voltage specified without damage, and there shall be no leakage current in excess of 1.0 milliampere (mA) nor evidence of damage due to arcing (air discharge), flashover (surface discharge), or breakdown (puncture discharge).

3.10 Contact (output) voltage drop (or resistance). When relays are tested as specified in 4.7.6, unless otherwise specified (see 3.1) the contact (output) voltage drop shall not exceed the applicable values specified in table III. When applicable, the contact resistance shall be as specified (see 3.1).

TABLE III. Contact voltage drop.

Class	Before life test		After life test	
	Average reading	Max. individual reading	Average reading	Max. individual reading
	volts, dc	volts, dc	volts, dc	volts, dc
A, D - - -	0.100	0.100	0.200	0.200
B, E - - -	0.150	0.175	0.175	0.200
C - - - -	1.5	2.5	1.5	2.5

3.11 Leakage current (class C relays). When relays are tested as specified in 4.7.7, the leakage current shall not exceed the maximum value specified (see 3.1).

3.12 Input current. When relays are tested as specified in 4.7.8, the input and control current, if applicable, exclusive of the output load shall not exceed the value specified (see 3.1).

3.13 Waveform distortion (class C, ac relays). When tested as specified in 4.7.9, the output waveform distortion shall not exceed the limits specified (see 3.1).

3.14 DC offset voltage (class C, ac relays). When relays are tested as specified in 4.7.10, the dc offset voltage shall not exceed the value specified (see 3.1).

3.15 Current range (class C, ac relays). When tested as specified in 4.7.11, unless otherwise specified, the dc offset voltage and waveform distortion shall not exceed specified values for all load current between 1 percent and 100 percent of relay rating.

3.16 Zero crossover (class C, ac relays). When tested as specified in 4.7.12, relay turn-on shall occur at the zero voltage crossover ±6 volts, and relay turn-off shall occur at the zero current crossover ± rated load x 10^{-2} (maximum). The relay shall turn-off at the opposite half-cycle from turn-on.

3.17 Bias current (when applicable) (class C relays). When relays are tested as specified in 4.7.13, the bias current shall not exceed the value specified (see 3.1).

3.18 Maximum deactuation voltage (class C relays). When relays are tested as specified in 4.7.14, the maximum deactuation voltage shall not be greater than that specified (see 3.1).

3.19 Transients (see 4.17.15).

3.19.1 Voltage (surge). When tested as specified in 4.7.15.1, the relay shall withstand the application of transient voltage without damage or effect on the delay period (beyond specified tolerances) within the timing cycle specified (see 3.1).

3.19.2 Susceptibility (spike). When tested as specified in 4.7.15.2, the relay shall not malfunction or be damaged. Following the test, the timing cycle and recycle time shall be as specified in 3.20 and 3.21, respectively.

3.19.3 Susceptibility, extraneous voltage (applicable to type IIA). When tested as specified in 4.7.15.3, the relay shall not operate over the specified temperature range (see 3.1) when 25 percent of the nominal control voltage (see 3.1) is applied to the control terminals.

3.19.4 Self-generated (spike). When the relay is tested as specified in 4.7.15.4, it shall not generate transient voltages in excess of those specified (see 3.1).

3.20 Timing cycle. When relays are tested as specified in 4.7.16, all switching circuits shall make positive contact or open as applicable. The timing cycle, period, interval, or sequence shall be within the tolerance specified (see 3.1). There shall be no momentary change in output state if the input voltage is removed prior to the end of the timing cycle. For type IIA relays, the relay shall not operate or remain operative when the control voltage is applied and the operate voltage removed.

3.21 Recycle time. When tested as specified in 4.7.17, the relay shall repeat normal operation and the timing cycle shall be as specified in 3.20.

3.22 Reverse polarity (dc operated relays). When tested as specified in 4.7.18, the relay shall not operate, start timing, or be damaged. Following the test, the timing cycle and recycle time shall be as specified in 3.20 and 3.21, respectively (at 23°C only).

3.23 *Electromagnetic interference.* When tested as specified in 4.7.19, the relay shall not create nor be susceptible to electromagnetic interference in excess of the limits specified in MIL-STD-461, class ID.

3.24 Crosstalk (when specified, see 3.1). When relays are tested as specified in 4.7.20, the attenuation shall be a minimum of 20 dB, unless otherwise specified.

3.25 Capacitance (when specified, see 3.1). When relays are tested as specified in 4.7.21, the capacitance shall not exceed the values specified (see 3.1).

3.26 Continuous current. When tested as specified in 4.7.22, relays shall remain operative and there shall be no damage. Following the test, the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time shall be as specified in 3.8, 3.9, 3.10, 3.20 and 3.21, respectively.

3.27 Coil life (class D and E relays). When tested as specified in 4.7.23, relays shall remain operative and there shall be no damage. Following the test, the insulation resistance, dielectric withstanding voltage, timing cycle, and recycle time shall be as specified in 3.8, 3.9, 3.20 and 3.21, respectively.

3.28 Mechanical life (endurance at reduced load) (class E relays). The relay shall be capable of operating at 25 percent of rated resistive load for four times the minimum operating cycles for relays under 25 amperes contact rating (resistive) and two times the specified minimum operating cycles for relays 25 amperes and over. When the relays are tested as specified in 4.7.24, relays shall remain mechanically and electrically operative. There shall be no indication of mechanical resonance due to the frequency of energizing voltage. Following the test, the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle and recycle time shall be as specified in 3.8, 3.9, 3.10, 3.20 and 3.21, respectively.

3.29 Resistance to soldering heat (not applicable to plug-in relays). When tested as specified in 4.7.25 there shall be no damage to the relay, and the insulation resistance, dielectric withstanding voltage, timing cycle at 23°C, and recycle time shall be as specified in 3.8, 3.9, 3.20 and 3.21, respectively.

3.30 Salt spray (corrosion). When subjected to the salt spray test of 4.7.26, and following washing in cold running tap water and drying for 6 hours at 65°C, the relay shall show no evidence of corrosion sufficient to impair the operation of the relay. Following this test, the timing cycle and recycle time shall be as specified in 3.20 and 3.21.

3.31 Thermal shock. When tested as specified in 4.7.27, there shall be no damage to the relay, loosening of terminals, or cracking or flaking of glass insulation (other than crazing or chipping of the glass meniscus). Following the test, the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time shall be as specified in 3.8, 3.9, 3.10, 3.20, and 3.21, respectively.

3.32 Low temperature operation. When tested as specified in 4.7.28, there shall be no damage to the relay, loosening of terminals, cracking or flaking of glass insulation (other than crazing or chipping of the glass meniscus) or of the hermetic seal. Following the test and at the specified low temperature, timing cycle, recycle time and contact voltage drop shall meet the requirements of 3.20, 3.21, and 3.10, respectively, and shall continue to meet timing cycle and recycle time requirements until the relay returns to room temperature.

3.33 Shock (specified pulse). When tested as specified in 4.7.29, relays shall meet the following requirements, as applicable:

Class A, B, D, and E relays - - -	Unless otherwise specified (see 3.1), there shall be no closing of open contacts nor opening of closed contacts in excess of 10 microseconds (μs).

All relays- - - - - - - - - - - - -	Following the test, there shall be no structural failure, and the timing cycle and recycle time shall be as specified in 3.20 and 3.21, respectively.

3.34 Vibration, high frequency. When tested as specified in 4.7.30, relays shall meet the following requirements, as applicable:

Class A, B, D, and E relays - - -	Unless otherwise specified (see 3.1), there shall be no closing of open contacts nor opening of closed contacts in excess of 10 microseconds (μs).
All relays- - - - - - - - - - - - -	Following the test, the insulation resistance, dielectric withstanding voltage, contact (output) voltage drop (or resistance), timing cycle, and recycle time shall be as specified in 3.8, 3.9, 3.10, 3.20, and 3.21, respectively.

3.35 Acceleration (class A, B, D, and E relays). When tested as specified in 4.7.31, the contacts shall remain in the deenergized condition with no input voltage, and the timing cycle and recycle time shall be as specified in 3.20 and 3.21, respectively.

3.36 Resistance to solvents. When relays are tested as specified in 4.7.32, the marking shall remain legible.

3.37 Strength of terminals and mounting studs.

3.37.1 Strength of threaded terminals and mounting studs. Relays having threaded stud type terminals or stud type mounting shall be tested to determine compliance with terminal strength design requirements specified in 3.4.6.1.2 and 3.4.7.3. When relay terminals are tested as specified in 4.7.33.1, the terminals shall not loosen or rotate, nor shall there be any other damage such as cracking or flaking of glass insulator other than crazing or chipping of the glass meniscus. There shall be no deterioration of relay performance beyond limits specified (see 3.1).

3.37.2 Strength of solder-lug, plug-in, and wire-lead terminals. When relay terminals are tested as specified in 4.7.33.2, there shall be no loosening or breakage of terminals, cracking or flaking of glass insulators other than crazing or chipping of the glass meniscus, or any other damage that would affect relay performance beyond specified limits.

3.38 Moisture resistance (nonhermetically-sealed relays). When relays are tested as specified in 4.7.34, there shall be no evidence of breaking, cracking, chipping, or loosening of the terminals. Immediately after step 6 of the final cycle, the insulation resistance shall be not less than 100 megohms. After the 24-hour drying period, the insulation resistance, dielectric withstanding voltage, timing cycle, and recycle time shall be as specified in 3.8, 3.9, 3.20 and 3.21, respectively.

3.39 Overload (see 4.7.35.1).

3.39.1 Class D and E relays. When relays are tested as specified in 4.7.35.1.2 and 4.7.35.1.3, there shall be no electrical failure, such as contact sticking, welding or failure to make or break the specified overload current. Blowing of the fuse connected between case and load system ground or neutral shall constitute failure. Following the test, the timing cycle and recycle time shall be as specified in 3.20 and 3.21, respectively.

3.39.2 Class C relays (when specified). When relays are tested as specified in 4.7.35.1.1, there shall be no electrical failure. Following the test, the timing cycle and recycle time shall be as specified in 3.20 and 3.21, respectively.

3.40 Life. When relays are tested as specified in 4.7.35.2, there shall be no phase-to-phase arcing; contacts shall not fail to make 1/, carry, or break the load; and the case-to-ground fuse shall remain electrically continuous. Following each life test, the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time shall be as specified in 3.8, 3.9, 3.10, 3.20 and 3.21, respectively. Class A and B time delay relays shall be tested at highest rated system voltage and resistive load current rating. Use of a qualified electromechanical relay with equivalent ratings will be evidence of meeting life requirements at other ratings. Class C, D, and E relays shall be tested at each contact load specified. Terminal temperature rise shall not exceed 75°C.

3.41 Vibration scan. When subjected to one cycle of vibration scan as specified in 4.7.36, there shall be no contact chatter in excess of 10 microseconds.

3.42 Minimum current (classes D and E). When relays are tested as specified in 4.7.35.3, there shall be no mechanical or electrical failures. The contact voltage drop shall not exceed the values specified in 4.7.35.3.

3.43 Rupture (class E). When relays are tested as specified in 4.7.35.4, there shall be no electrical failure, such as contact welding or failure to make or break the specified rupture current. Blowing of the fuse connected between case and load system ground or neutral shall constitute failure.

* 3.44 Time-current relay characteristics at 25°C (class E relays when specified, see 3.1). When relays are tested as specified in 4.7.35.5, there shall be no evidence of contact welding or sticking and the contact voltage drop shall meet the requirements of 3.10.

3.45 Low level (when specified, see 3.1). When relays are tested as specified in 4.7.35.6, the dynamic contact resistance shall not exceed 100 ohms more than once per 200,000 operations (cumulative). There shall be no mechanical failures nor erratic operation.

3.46 Marking. Unless otherwise specified (see 3.1), relays shall be marked in accordance with method I of MIL-STD-1285 and shall include as a minimum the following information:

a. Part number (see 3.1).

b. Date code.

c. Source code or manufacturer's name.

d. Contact rating.

e. Circuit diagram (see 3.4.6).

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

4. QUALITY ASSURANCE PROVISIONS

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

1/ "Fail to make" shall be defined as a voltage drop across the contacts or output exceeding 10 percent of full rated voltage.

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662.

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

a. Materials inspection (see 4.3).

b. Qualification inspection (see 4.5).

c. Quality conformance inspection (see 4.6).

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table IV used in fabricating the relays, are in accordance with the applicable referenced specifications prior to such fabrication.

TABLE IV. Materials inspection.

Material	Requirement paragraph	Applicable inspection
Plastic	3.3.2.1	MIL-P-997, MIL-P-15037, MIL-P-15047, MIL-M-14
Ceramic	3.3.2.2	MIL-I-10
Integral electromagnetic relay	3.4.2	MIL-R-5757 or MIL-R-39016 for class A; MIL-R-6106 for class B
Microcircuits, semiconductors	3.4.3	MIL-M-38510, MIL-S-19500

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

4.4.1 Power supply. Unless otherwise specified herein, the power supply shall have no more than 10 percent regulation at twice the specified load current. A dc power supply shall have no more than 5 percent voltage ripple. An ac power supply shall be within 1 percent of the specified frequency and shall be sinusoidal with a form factor between 0.95 and 1.25. When specified (see 3.1), the ac or dc power supply shall be capble of simulating the normal and abnormal power conditions described in MIL-STD-704.

* 4.4.2 Temperatures. Quality levels X and Y relays shall be tested at an ambient temperature of -55°C, +25°C, and +125°C, quality level W at an ambient temperature of 25°C ±2°C, and the quality conformance inspection (see 4.6), may be conducted at the specified temperatures. Temperatures are ambient and not case.

4.4.3 Wire. In any of the specified load tests (see 4.7.35), each individual wire shall be a minimum of 3 feet in length and of an applicable size conductor (copper) for use in free air as listed in MIL-W-5088 determined by the rated resistive load of the relay. If the relay rating does not coincide with wire size, the next larger diameter wire shall be used.

4.4.4 Terminal lugs. Wire shall be terminated with an applicable size and type of terminal lug according to MS20659 or MS25036, or other currently approved military specification.

4.4.5 Attitude. Unless otherwise specified, the qualification inspection (see 4.5), shall be conducted with the relay mounted in the position most likely to cause malfunctioning. This position shall be shown or otherwise noted in test papers.

4.4.6 Altitude-temperature tests. Unless otherwise specified, the relay under test shall be surrounded by a metal enclosure, the surface of which is established at the specified high temperature. The enclosure inner shall have an emissivity between 0.7 and 1.0 for the test temperature employed. The air within the test enclosure shall be still and held at the specified altitude. The relay may be mounted by its *normal mounting means on a metal plate maintained at the temperature of the chamber* walls.

4.4.7 Mounting relays for ambient temperature tests (class D relays). When the relays are subjected to the tests specified in 4.7.35.3 and 4.7.23 (minimum current and coil life, respectively), they may be mounted on a heat sink in accordance with the following:

a. Each relay may be attached by its normal mounting means to .062 (1.57 mm) inch thick minimum, flat aluminum plate heat sink. The heat sink shall be designed to place every relay in the center of its own square space whose total surface area (both sides) is eight times the outside surface area of the relay, excluding mounting. Relays without mounts shall be held to the heat sink with a metal strap .250 (6.35 mm) inch wide by 0.015 inch (0.38 mm) maximum thickness. The heat sink assembly shall be suspended by twine or other nonheat conducting material in a plane parallel to the normal air flow in the oven. The leads shall not constitute a heat sink.

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

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample relays produced with equipment and procedures normally used in production.

4.5.1 Sample size. The number of relays to be subjected to qualification inspection shall be as specified in table V.

4.5.2 Inspection routine. Sample relays shall be tested as specified in table V in the order shown, as applicable for each relay.

4.5.3 Failures. Two or more failures shall be cause for refusal to grant qualification approval.

4.5.4 Retention of qualification. To retain qualification, the contractor shall forward a report at 12-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

a. A summary of the results of the tests performed for inspection of product for delivery, group A, indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

b. The results performed for periodic check tests (groups B and C, when applicable), including the number and mode of failures. The test report shall include results of all periodic check tests performed and completed during the 12-month period. If the test results indicate nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 12-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time that the inspection data indicates noncompliance of the product to meet the requirements of this specification.

In the event that no production occurred during the 3 reporting periods, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the relay. If during 6 consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative relay to testing in accordance with the qualification inspection requirements.

4.6 Quality conformance inspection.

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

4.6.2 Inspection lot. An inspection lot shall consist of all relays covered by a single specification sheet, produced under essentially the same conditions within a period not to exceed 1 month, and offered for inspection at one time.

4.6.2.1 Group A inspection. Group A inspection shall consist of the inspections specified in table VI.

4.6.2.1.1 Sampling plan. All production relays shall be subjected to group A inspection specified in table VI, testing sequence is optional, except output voltage drop (see 4.7.6) leakage current (see 4.7.7), maximum deactuation voltage (see 4.7.14), timing cycle (see 4.7.16), and recycle time (see 4.7.17) shall be required anytime after burn-in (see 4.7.37).

4.6.2.1.2 Failure criteria. Relays which have failed to pass group A inspection may be reworked or have parts replaced to correct the defects resubmitted for acceptance.

4.6.3 Periodic inspection. Periodic inspection shall consist of groups B and C inspections.

4.6.3.1 Group B inspection. Group B inspection shall consist of the tests specified in table VII, and shall be performed in the order shown.

4.6.3.1.1 Sampling plan. Two relays shall be selected at random from every 500 units, or for every 6-month period, whichever occurs first. Samples selected shall have passed group A inspection. If there is no production during the 6-month period, four relays shall be tested during the next 6-month period; six relays if there is no production for 18 months, etc.

4.6.3.1.2 Failure criteria. When one or more relays fail to pass group B inspection, further acceptance shall be withheld until the cause of failure is determined. In the event of a single isolated failure on group B testing, and if the relay in question satisfactorily completed 50 percent of the specified minimum cycles on the particular load being tested, the manufacturer may, at his option, have three additional relays selected for the same group B testing. If all three relays pass, the lot shall be accepted and production and acceptance testing resumed. In the event of an additional failure on the three samples, acceptance shall be withheld and corrective action will be necessary. After corrective action has been taken, production and acceptance testing may be resumed. For production reasons, group A tests may be continued pending the investigation of group B failures.

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

4.6.3.2 Group C inspection.

4.6.3.2.1 Sampling plan. Every 36 months the number of sample units specified in table VIII shall be subjected to the tests specified in table VIII in the order shown. No failures shall be permitted.

TABLE V. Qualification inspection.

	Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected				
				Class				
				A	B	C	D	E
	Group I							
*	Screening	3.5.2	4.7.2	All	All	All	All	All
	Visual and mechanical:							
	Internal	3.1,3.3,3.4	4.3, 4.7.1	All	All	All	All	All
	External	3.5.1,3.46, 3.47	4.7.1	1	1	1	1	1
	Solderability	3.6	4.7.33.2.4	3	3	3	3	3
	Seal	3.7	4.7.3	All	All	All	All	All
	Insulation resistance	3.8	4.7.4	All	All	All	All	All
	Dielectric withstanding voltage	3.9	4.7.5	All	All	All	All	All
	Contact (output) voltage drop or resistance	3.10	4.7.6	All	All	All	All	All
	Leakage current	3.11	4.7.7	-	-	All	-	-
	Input current	3.12	4.7.8	All	All	All	All	All
	Waveform distortion (ac relays)	3.13	4.7.9	-	-	All	-	-
	DC offset voltage (ac relays)	3.14	4.7.10	-	-	All	-	-
	Current range (ac relays)	3.15	4.7.11	-	-	All	-	-
	Zero crossover (ac relays)	3.16	4.7.12	-	-	All	-	-
	Bias curent (when applicable)	3.17	4.7.13	-	-	All	-	-
	Maximum deactuation voltage	3.18	4.7.14	-	-	All	-	-
	Transients	3.19	4.7.15	All	All	All	All	All
	Timing cycle	3.20	4.7.16	All	All	All	All	All
	Recycle time	3.21	4.7.17	All	All	All	All	All
	Reverse polarity (dc operated)	3.22	4.7.18	All	All	All	All	All
	Group II							
	Electromagnetic interference	3.23	4.7.19	2	2	2	2	2
	Crosstalk (when specified)	3.24	4.7.20	2	2	2	2	2
	Capacitance (when specified)	3.25	4.7.21	2	2	2	2	2
	Continuous current	3.26	4.7.22	2	2	2	2	2
	Coil life	3.27	4.7.23	-	-	-	2	2
	Mechanical life	3.28	4.7.24	-	-	-	-	1
	Resistance to soldering heat (not applicable to socket plug-in relay)	3.29	4.7.25	2	2	2	2	2
	Salt spray	3.30	4.7.26	2	2	2	2	2
	Seal	3.7	4.7.3	2	2	2	2	2
	Group III							
	Thermal shock	3.31	4.7.27	2	2	2	2	2
	Low temperature operation	3.32	4.7.28	1	1	1	1	1
	Shock (specified pulse)	3.33	4.7.29	2	2	2	2	2
	Vibration, high frequency	3.34	4.7.30	2	2	2	2	2
	Acceleration	3.35	4.7.31	1	1	-	1	1
	Resistance to solvents	3.36	4.7.32	4	4	4	4	4
	Strength of terminals and mounting studs	3.37	4.7.33	1	1	1	1	1
	Moisture resistance (nonhermetically sealed)	3.38	4.7.34	2	2	2	2	2
	Seal	3.7	4.7.3	All	All	All	All	All

TABLE V. Qualification inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected				
			Class				
			A	B	C	D	E
Group IV							
Overload	3.39	4.7.35.1	-	-	2	2	2
Life	3.40	4.7.35.2	2	2	1/	1/	1/
Vibration scan	3.41	4.7.36	1	1	-	1	1
Seal	3.7	4.7.3	2	2	2	2	2
Group V							
Minimum current	3.42	4.7.35.3	-	-	-	2	2
Rupture	3.43	4.7.35.4	-	-	-	-	2
Seal	3.7	4.7.3	-	-	-	2	2
* Time-current relay characteristics at 25°C (class E relays, when specified)	3.44	4.7.35.5	-	-	-	-	2
Low level (when specified)	3.45	4.7.35.6	-	-	-	2	2

1/ One sample unit required for each load rating.

TABLE VI. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected				
			Class				
			A	B	C	D	E
* Screening	3.5.2	4.7.2	All	All	All	All	All
Seal	3.7	4.7.3	All	All	All	All	All
Insulation resistance	3.8	4.7.4	All	All	All	All	All
Dielectric withstanding voltage	3.9	4.7.5.1	All	All	All	All	All
Contact (output) voltage drop or resistance	3.10	4.7.6	All	All	All	All	All
Leakage current	3.11	4.7.7	-	-	All	-	-
Input current	3.12	4.7.8	All	All	All	All	All
Waveform distortion (ac relays)	3.13	4.7.9	-	-	All ac	-	-
DC offset voltage (ac relays)	3.14	4.7.10	-	-	All ac	-	-
Current range (ac relays)	3.15	4.7.11	-	-	All ac	-	-
Zero crossover (ac relays)	3.16	4.7.12	-	-	All ac	-	-
Bias curent (when applicable)	3.17	4.7.13	-	-	All	-	-
Maximum deactuation voltage	3.18	4.7.14	-	-	All	-	-

TABLE VI. Group A inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected				
			Class				
			A	B	C	D	E
Reverse polarity (dc relays)- - - - - -	3.22	4.7.18	All dc	All dc	All dc	All dc	All dc
Timing cycle - - - - - -	3.20	4.7.16	All	All	All	All	All
Recycle time - - - - - -	3.21	4.7.17	All	All	All	All	All
Inspection of product 1/	3.1, 3.3, 3.4, 3.5.1, 3.46 and 3.47	4.3, 4.7.1	All	All	All	All	All

1/ Physical dimensions shall be measured on two sample units per lot.

TABLE VII. Group B inspection.

Inspection	Requirement paragraph	Test paragraph
Input current - - - - - - - - - - - - - -	3.12	4.7.8
Reverse polarity (dc operated relays)- - - - - - - - -	3.22	4.7.18
Transients- - - - - - - - - - - - - - - -	3.19	4.7.15
Thermal shock - - - - - - - - - - - - - -	3.31	4.7.27
* Vibration, scan - - - - - - - - - - - - -	3.41	4.7.36
Life (classes as applicable) 1/:		
Resistive - - - - - - - - - - - - - -	3.40	4.7.35.2
Inductive - - - - - - - - - - - - - -	3.40	4.7.35.2
Lamp- - - - - - - - - - - - - - - - -	3.40	4.7.35.2
Motor current (ac or dc)- - - - - - -	3.40	4.7.35.2
Seal- - - - - - - - - - - - - - - - - -	3.7	4.7.3

1/ Each time group B is run on two relays, only one type of life test shall be run. Resistive load shall be run at the highest voltage rating specified, ac or dc, the first time group B tests are run after initial qualification. The second time group B tests are run, the inductive load rating shall be run at the highest voltage rating specified, ac or dc, and so on in the order shown. After each type of current load has been run at the highest voltage rating, the sequence shall start over using the lowest specified voltage rating, ac or dc. It is intended that all loads specified (see 3.1) shall have been run at least once at both maximum and minimum specified voltage between the time of initial qualification and requalification and between all subsequent requalifications. If the lamp rating is equal to or less than 0.1 times the resistive load rating, the lamp load test need not be run.

TABLE VIII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph
Subgroup 1 (2 relays)		
Electromagnetic interference	3.23	4.7.19
Continuous current	3.26	4.7.22
Moisture resistance (nonhermetically-sealed relays)	3.38	4.7.34
Subgroup 2 (2 relays)		
Overload (classes D and E)	3.39.1	4.7.35.1.2 and 4.7.35.1.3
Life (classes as applicable):		
Resistive, dc (1 relay)	3.40	4.7.35.2
Resistive, ac (1 relay)	3.40	4.7.35.2
Seal	3.7	4.7.3
Subgroup 3 (2 relays)		
Resistance to soldering heat (not applicable to plug-in relays)	3.29	4.7.25
Salt spray (corrosion)	3.30	4.7.26
Thermal shock	3.31	4.7.27
Shock (specified pulse)	3.33	4.7.29
Vibration, high frequency	3.34	4.7.30
Acceleration (class A, B, D, and E relays)	3.35	4.7.31
Strength of terminals and mounting studs 1/	3.37	4.7.33
Seal	3.7	4.7.3

1/ Additional sample units may be required for different terminal designs.

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

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

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

4.7 Methods of inspections.

NOTE: As used herein, "coil" on classes A, B, D, and E relays may be used interchangeably for "input" on class C relays; and "contacts" on classes A, B, D, and E relays may be used interchangeably for "output" on class C relays.

4.7.1 Visual and mechanical inspection. Relays shall be inspected to verify that the materials, design and construction, physical dimensions, weight, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.5.1, 3.47 and 3.48).

* 4.7.2 Screening (see 3.5). Relays shall be screened as specified below, in the order shown. The quality level shall be W, Y, or X as specified (see 3.1).

* 4.7.2.1 High temperature storage (stabilization bake). Relays of quality levels X and Y shall be tested in accordance with method 1008 of MIL-STD-883. Unless otherwise specified, test condition B and a time duration of 24 hours minimum shall apply.

* 4.7.2.2 Temperature cycling. Relays of quality levels X and Y shall be tested in accordance with method 1010 of MIL-STD-883, test condition B. The following details shall apply:

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

b. End-point measurements and inspections: None.

* 4.7.2.3 Load conditioning. Not to exceed specified maximum limits, relays shall be cycled by applying a step function voltage to the input; the input shall be energized at zero or rated input voltage. The load shall be maximum rated current, without auxiliary heat sink, and each output circuit shall be loaded with the maximum rated resistive current at the highest rated voltage, for 3 hours, at a rate no less than 1 nor more than 30 operations per second. When applicable (see 3.1), the bias shall be applied at the rated value. The relay shall be turned off 10 percent of the time and turned on 90 percent of the time. For SPDT and DPDT relays, cycling shall be 50 percent turned on and 50 percent turned off; or for 1.5 hours of test, 10 percent on and 90 percent off, and 90 percent on and 10 percent off for 1.5 hours of test.

* 4.7.2.4 Interim (pre-burn-in) electrical parameters (when specified). Relays of quality levels X and Y shall be tested as specified in method 5008 of MIL-STD-883.

* 4.7.2.5 Burn-in test. Relays shall be tested in accordance with method 1015 of MIL-STD-883. The following details and exceptions shall apply:

a. Test duration of 160 hours.

b. Test condition as specified (see 3.1).

c. Test temperature: For X and Y screened relays 125°C ambient minimum. For W screened relays +25°C ambient minimum.

d. Test mounting: Normal mounting means.

e. As specified in 4.7.2.4 and 4.7.2.6.

f. Not applicable.

g. Time measurements completed: As specified in 4.7.2.4.

* 4.7.3 Seal (see 3.7). Relays shall be tested in accordance with 4.7.3.1, 4.7.3.2, or 4.7.3.3 as applicable.

* 4.7.3.1 Nonhermetically-sealed relays (see 3.7.1). Relays shall be tested in accordance with method 112 of MIL-STD-202. The following details shall apply:

a. Test-condition letter D, unless otherwise specified (see 3.1).

b. Measurement after test: None.

* 4.7.3.1.1 Nonhermetically-sealed and hermetically-sealed (potted) relays (alternate method) (see 3.7.1.1). Relays shall be tested as follows:

a. Prior to installing a gasket on the relay header (if a gasket is used), the relay shall be totally immersed in a container of "tap" water. (The term "tap" water as used here means ordinary drinking water that has not been altered in any way, such as by the addition of any other substance, distilling, etc.). The part of the relay closest to the surface of the water shall be a minimum of 1 inch (25.4 mm) below this surface.

b. The container and water-covered relay shall then be placed in a vacuum chamber. The chamber shall be sealed. The chamber pressure shall be reduced from room ambient to 1 inch (75,000 feet) +0.0 -0.2 inch of mercury within 5 minutes, and shall be maintained at this level for 30 minutes minimum. The chamber pressure shall be increased to room ambient within 1 minute, and shall be maintained at room ambient pressure for 30 minutes, minimum. The foregoing shall constitute one cycle. The relay shall remain fully immersed in the water during the cycle.

c. Within a maximum of one-half hour after the cycle, each relay shall be removed from the water and dried by shaking, wiping, or blowing with contaminant-free air or gas, but not by any form of heating or baking.

d. Within a maximum of one-half hour after drying, each relay shall pass the insulation resistance and dielectric withstanding voltage tests.

* 4.7.3.2 Relays sealed with a gas containing a tracer. Relays sealed with a gas containing a tracer 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 gas containing a helium tracer (90 percent dry gas and 10 percent helium). Silcone oil shall not be used.

(2) Leakage rate sensitivity: 1×10^{-8} atm cm^3/s.

(3) Measurements after test: Not applicable.

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

* 4.7.3.3 Relays sealed with a gas not containing a tracer. Relays sealed with a gas not containing a tracer shall be tested in accordance with method 1014 of MIL-STD-883. At the option of the manufacturer, either a or b may be used. The following details shall apply.

a. Method 1014 of MIL-STD-883:

(1) Test condition A_1 or A_2.

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

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

4.7.4 Insulation resistance (see 3.8). Relays shall be tested in accordance with method 302 of MIL-STD-202 with the relay in the energized and deenergized condition. The following details shall apply:

a. Test-condition letter B.

b. Points of measurement: Unless otherwise specified (see 3.1), between all mutually isolated terminals and between all terminals and the case.

c. Electrification time: 30 seconds, minimum.

4.7.5 Dielectric withstanding voltage (see 3.9). Relays shall be tested as specified in 4.7.5.1 and, when applicable (see 3.1), in accordance with 4.7.5.2. These tests shall be performed with relays in energized and deenergized condition.
NOTE: To avoid unnecessary failures, test voltages shall not be applied indiscriminately.

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

a. Magnitude of test voltage and nature of potential: As specified in table IX.

b. Duration of application of test voltage: As specified in table IX.

c. Points of application of test voltage: As specified in 4.7.4b.

TABLE IX. Dielectric withstanding voltage test details.

Test voltage (volts, rms)						
At atmospheric pressure 1/				At reduced barometric pressure (1 minute) 2/		System 4/ voltage (see 6.4.2)
Qualification 2/ inspection (1 minute)		Quality conformance inspection 3/				
Class		Class		Class		
A-B-D-E	C	A-B-D-E	C	A-B-D-E	C	
1,000	1,000	1,250	1,000	500	500	28 dc
1,250	1,000	1,500	1,000	500	500	115 ac
1,500	1,000	1,800	1,000	700	500	115/200 ac 5/

1/ When the dielectric withstanding voltage test is performed following the life test specified in 4.7.35.2, the test voltage may be reduced to 75 percent of the applicable value specified, but not less than 1,000 volts.
2/ The test potential shall be applied or reduced at a maximum rate of change of 250 volts per second.
3/ For performing quality conformance inspection, a 2-5 second test at 120 percent of the 1 minute voltage may be used in lieu of the 1-minute test; however, the 1-minute test is mandatory if defects are discovered in production inspection.

4/ 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.

5/ For relays rated above 200 volts, the test potential for 1 minute shall be twice rated voltage plus 1,000 volts, with a minimum of 1,500 volts. The test potential for 2-5 seconds shall be 20 percent higher than the 1-minute test voltage. The test voltage at maximum specified altitude shall be 50 percent of the 1-minute value with a minimum of 750 volts, rms.

4.7.5.2 Temperature-altitude dielectric. Relays shall be tested in accordance with methods 105 and 301 of MIL-STD-202. This test applies only to relays for use above 50,000 feet altitude. The relay shall be brought to a stabilized condition at the high temperature, high altitude pressure specified (see 3.1). When in the above condition, the tests of 4.7.5.1 shall be performed.

4.7.6 Contact (output) voltage drop (or resistance) (see 3.10).

4.7.6.1 Contact resistance (class A and D relays). Relays shall be tested in accordance with method 307 of MIL-STD-202. The following details and exception shall apply:

a. Method of connection: For relays with wire-lead terminals, this measurement shall be made 1/8-inch maximum from the emergence of the lead from the relay.

b. Test current and voltage: Contacts shall be loaded with 30 mV maximum (dc or peak ac) at 10 mA maximum.

c. Test current and voltage after high level life tests: Contacts shall be loaded up to rated current and rated voltage.

d. Points of measurement: All mated contacts in their closed position; the coil shall be energized with rated voltage if necessary to effect contact closure.

e. Number of activations prior to measurement: None.

f. Number of test activations: Three (no contact voltage shall be applied during contact transfer).

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

4.7.6.2 Contact voltage drop (class B and E relays). The contact voltage drop across the relay contacts shall be measured at the points to which external circuits are normally connected. Normally closed and normally open contacts shall be measured separately. Relay contacts which are rated 25 amperes (resistive) and over shall carry rated resistive current at the primary rated ac or dc voltage. Relay contacts rated under 25, but over 2 amperes shall carry rated resistive current at 6 V dc. When specified after the load tests, the contact voltage drop shall be measured at the terminals corresponding to the tested contacts. The contacts shall be caused to break and then make the test current before each of 10 consecutive measurements. Coil voltage shall be as specified. Individual readings and the average value of 10 consecutive readings shall meet the requirements of 3.10 and not exceed the values specified in table IX. In performing the contact voltage drop tests on plug-in relays, and in the event of a reading that exceeds the maximum allowable contact voltage drop when measured external to the connector, a measurement may be made directly at the pins of the relay. If the readings are then within the allowable limits, the relay will be considered to have passed. In the case of relays with potted connections, special provisions should be made to allow for voltage drop due to resistance of leadwires. For group A, one reading per contact will suffice and may be performed at a lower current level. At the option of the manufacturer, the relay contacts may be closed prior to the application of test current. The contact voltage drop shall be measured within 10 seconds after the contacts close and the flow of current begins. The contact voltage drop shall be within the average limits specified in table III adjusted for the lower current level used in test.

4.7.6.2.1 Contact resistance. This test is applicable to relays which have contact ratings of 2 amperes or less as specified in 3.10. 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 rated dc. Test current for low level contact ratings shall not exceed 10 mA.

c. Maximum open-circuit test voltage shall be 6 V dc except for contacts rated for low level the maximum open circuit test voltage shall be 30 mV (dc or peak ac).

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.

4.7.6.3 Class C relays (output voltage drop). With the relay connected to nominal system voltage and rated load connected, operate relay normally, and check voltage difference between input and output to connected operating load.

4.7.7 Leakage current (class C relays) (see 3.11). With the relay connected to maximum system voltage and rated load connected, operate relay normally. During the load off interval, measure the leakage current to the load.

4.7.8 Input current (3.12). The maximum operating voltage (see 3.1) shall be applied to the input and control terminals, and the input current and, if applicable, the control current shall be measured during the timing cycle and during steady-state.

4.7.9 Waveform distortion (class C, ac relays) (see 3.13).

a. Apply the rated voltages (see 3.1) to the input and bias (when applicable). Apply rated output voltage and adjust the load to obtain rated current with relay turn on.

b. Connect an oscilloscope across relay output and adjust oscilloscope to display one complete cycle of relay output voltage.

c. With relay turned on, observe output voltage on oscilloscope. Output voltage distortion shall not exceed the limits specified (see 3.1).

4.7.10 DC offset voltage (class C, ac relays) (see 3.14).

a. Apply rated voltages and currents to the output and bias (when applicable).

b. Apply minimum turn-on voltage to the input and measure the dc component of the output circuit voltage drop which shall not exceed the value specified (see 3.1).

4.7.11 Current range (class C, ac relays) (see 3.15). Tests shall be conducted as described in 4.7.9 and 4.7.10 except the output current shall be 1 percent of highest load current rating. The dc offset voltage and waveform distortion shall not exceed specified values (see 3.1).

4.7.12 Zero crossover (class C, ac relays) (when specified, see 3.1) (see 3.16 and 6.4.8). Apply rated output voltage and resistive load to the relay. Apply rated input voltage. Apply and remove the input control voltage at random and monitor the output for zero voltage turn on and zero current turn off.

4.7.13 Bias current (when applicable) (class C relays) (see 3.17).

a. Apply rated voltages and currents to the output and bias (see 3.1).

b. Read the bias current when the relay is energized with the rated input voltage (relay shall be in on-state).

4.7.14 Maximum deactuation voltage (class C relays) (see 3.18). Apply minimum specified input voltage to turn the relay on, then reduce this input to the maximum deactuation voltage specified until the relay turns off and observe that the relay has deactuated.

4.7.15 Transients (see 3.19).

* 4.7.15.1 Voltage (surge) (see 3.19.1). Unless otherwise specified (see 3.1), relays shall be subjected at the input or control terminals to the maximum transient voltage limits for the time specified by MIL-STD-704, limit 1, for category B equipment. No impedance other than that of the wire or cable shall be used between the power source and the input or control terminals for this test.

4.7.15.2 Susceptibility (spike) (see 3.19.2). Relays shall be subjected, at the input or control terminals, to a transient spike voltage of ±600 V, 100 kHz, duration per MIL-STD-704 for 10 applications spaced 10 seconds apart. Relays shall be tested before, during, and after exposure for timing cycle and after exposure for recycle tests as specified in 4.7.16.1.1 and 4.7.17, respectively.

4.7.15.2.1 Alternate transient susceptibility test. Charge a one microfarad capacitor to 600 V. With a 60 ohm resistor in series discharge capacitor across the input and output control terminals. Five applications spaced 10 seconds between applications. Reverse polarity and repeat five additional applications. Relays shall be tested before, during and after exposure for timing cycle and after exposure for recycle tests as specified in 4.7.16.1.1 and 4.7.17, respectively.

4.7.15.3 Susceptibility, extraneous voltage (applicable to type IIA) (see 3.19.3). With the relay operating voltage applied, apply 25 percent of the nominal control voltage and monitor the output to see that there is no change in condition. Conduct the test at minimum, normal room ambient, and maximum temperature specified.

4.7.15.4 Self-generated (spike) (see 3.19.4). The relay shall be operated normally at nominal voltage. At the input and/or control terminals, check for transients when relay is switched on or off and during time interval. The self-generated transient voltage shall not exceed the value specified (see 3.1). (This test to be made without loads on the output controls.)

4.7.16 Timing cycle (see 3.20).

* CAUTION: If a rise or fall time of the power source is greater than 10 microseconds, the timing cycle may be adversely affected.

4.7.16.1 At 23°C. Relays shall be tested in accordance with the following, as applicable:

a. Type I - When minimum rated operating voltage is applied to the input terminals, relay must operate within the time interval specified (see 3.1). When voltage is removed, the relay shall return to the deenergized condition within the specified time interval. Output circuits shall be monitored to insure that the switching action is as specified. Repeat test at maximum rated operating voltage.

b. Type IIB - When minimum rated operating voltage is applied to the input terminals, the relay must operate within the specified time interval (see 3.1). When voltage is removed, the relay contacts in classes A, B, D, and E relays, or the solid state output in class C relays, must return to the deenergized condition within the specified time interval. Output circuits shall be monitored to insure that the switching action is as specified. Repeat test at maximum rated operating voltage.

c. Type IIA - Test as above with minimum and maximum rated voltage at both power and control terminals. Repeat test with minimum voltage on power terminals and maximum voltage on control terminals. Repeat again with maximum voltage on power terminals and minimum voltage on control terminals. Time intervals and switching action to be monitored. They must be within values specified (see 3.1).

d. Type III - When minimum and/or maximum voltages are applied to the input terminals, switching circuits must operate and return to normal within the time intervals specified (see 3.1). Removal of input voltage shall reset the time delay relay for the next operation, within the reset time specified.

e. Types IV and V - When minimum and/or maximum voltages are applied to the input terminals, the switching circuits are to operate in accordance with timing cycles and tolerances specified (see 3.1).

4.7.16.1.1 At nominal input voltage. Relays shall be tested in accordance with 4.7.16.1 except at nominal input voltage.

4.7.16.2 High temperature. The relay shall be operated at maximum voltage at maximum rated ambient temperature for a period of 4 hours for qualification inspection and 45 minutes for quality conformance inspection. Except for indicating means, the output circuit or contacts need not be loaded during this test. Following this period within 1 minute after removal of power, the relay while still maintained at the test temperature shall be tested as specified in 4.7.16.1. The minimum voltage shall be that specified for the high temperature test. The timing period or sequence shall be within the tolerance specified (see 3.1).

4.7.16.3 Low temperature. The relay shall be subjected to the minimum rated ambient temperature for a period of 4 hours for qualification inspection and 45 minutes for quality conformance inspection. At the end of this period and with the relay at the specified temperature, the relay shall meet the test requirements of 4.7.16.1. The timing period or sequence shall be within the tolerance specified (see 3.1). Except for indicating means, the output circuit or contacts shall not be loaded during this test. The indicating means shall not be more than 100 mA or 10 percent of the rated load, whichever is less.

4.7.17 Recycle time (see 3.21). When tested for timing cycle per 4.7.16.1, or 4.7.16.1.1 as applicable, the power to the input or control terminals as applicable shall be removed and reapplied in the recycle time specified (see 3.1). The relay shall repeat normal operation and the timing cycle shall be within tolerance. The test shall be performed during a timing interval and following a timing interval in accordance with the definitions of recycle time in 6.4.7.

4.7.18 Reverse polarity (dc operated relays) (see 3.22). Relays shall not be damaged, operate, or start timing when maximum rated voltage of reverse polarity is applied to the input and/or control terminals. Reverse polarity of maximum rated voltage shall be applied for a period of not less than 1 minute. Following the test, the relay shall be tested for the timing cycle and recycle time as specified in 4.7.16.1.1 and 4.7.17, respectively.

4.7.19 Electromagnetic interference (see 3.23). Relays shall be subjected to the electromagnetic interference tests specified in MIL-STD-461, class 1D and MIL-STD-462 with contacts unloaded. Relays shall not be susceptible to electromagnetic interference within the limits specified and shall not create electrical interference in excess of limits specified during timing interval or steady-state operation at nominal rated input voltage (or current).

4.7.20 Crosstalk (when specified, see 3.1) (see 3.24). Crosstalk shall be measured using equipment which shall have an input impedance of 1 megohm, minimum, and shall be paralleled with a capacitance of 20 picofarads maximum. A 1.0 to 10.0 volts peak-to-peak input signal at frequencies up to 10 megahertz shall be applied to the switching circuit through coaxial cable, terminated in 50 ohms ±5 percent at the device terminal. The coaxial cable shall conform to MIL-C-17. The input signal

amplitude shall be measured at the terminals of the relay. The terminals where crosstalk is to be detected, shall be connected through a similar type coaxial cable, terminated in 50 ohms ±5 percent at the measuring device. The resultant attenuation, in decibels (dB) equals:

$$20 \left(\text{Log}_{10} \frac{V_{IN}}{V_{OUT}}\right)$$

4.7.21 Capacitance (when specified, see 3.1) (see 3.25). Relays shall be tested as specified in method 305 of MIL-STD-202. The following detail and exception shall apply:

a. Test frequency: 1 kHz, unless otherwise specified (see 3.1).

b. Points of measurement as specified, see 3.1.

4.7.22 Continuous current (see 3.26). Relays shall be energized continuously for 100 hours with maximum rated voltage applied to the input and/or control terminals and with maximum rated load connected to each output circuit. The test shall be performed at the maximum temperature and altitude specified (see 3.1). Following the test and with the relay at the maximum temperature and altitude, and contacts still loaded, the relay shall be deenergized and shall immediately be tested for timing cycle, and recycle time as specified in 4.7.16.2 and 4.7.17, respectively. The *minimum* voltage shall be as specified for the continuous current test (see 3.1). After the test the relay shall be tested for insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance) as specified in 4.7.4, 4.7.5, and 4.7.6, respectively.

4.7.23 Coil life (class D and E relays) (see 3.27). Relays shall be tested for 1,000 hours as follows:

a. Relays shall be mounted as specified in 4.4.7. Each contact terminal shall be connected as specified in 4.7.6.1a.

b. During the maximum temperature portion of the test, rated voltage or current (see 3.1) shall be applied continuously to the input and/or control terminals and at least half of the normally open contacts shall carry rated current. During room temperature and minimum temperature exposures the relay shall be deenergized and contacts shall not be loaded. Ambient temperatures shall be varied as shown on figure 2 with heating and cooling rates not to exceed 1°C per second average. The portion of the cycle run at minimum temperature shall be approximately 10 percent of the test cycle time.

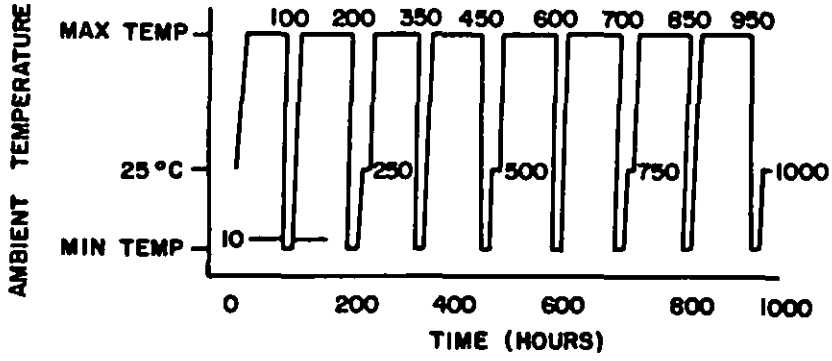


FIGURE 2. Ambient temperatures.

c. After the first 100 hours, and while still at the low temperature extreme, the relay shall be tested for contact voltage drop (or resistance), timing cycle, and recycle time as specified in 4.7.6, 4.7.16.3 and 4.7.17. Measurements of contact voltage drop (or resistance) as specified in 4.7.6 shall be taken at room temperature initially, then again after 250 ±25, 500 ±25, and 750 ±25 hours. Insulation resistance, dielectric withstanding voltage, timing cycle, and recycle time (only in the special mounting plane) (see 4.4.7) measurements shall be made as specified in 4.7.4, 4.7.5, 4.7.16.1.1, and 4.7.17 during the last temperature cycle after allowing the relay to stabilize, turned off, at each of the temperature extremes, and the values shall be recorded. Relays shall then be inspected for evidence of damage.

4.7.24 Mechanical life (endurance at reduced load) (class E relays) (see 3.28). With rated coil voltage and/or control voltage (current), the relay shall be cycled at 25 percent of rated resistive load for four times the specified minimum operating cycles for relays under 25 amperes contact rating (resistive), and two times the specified minimum operating cycles for relays 25 amperes and over. The cycling rate shall be that specified for resistive loads in 4.7.35.2.3. Each relay circuit (normally open and normally closed contacts of all poles), including interlock circuits if they exist, shall be loaded at 25 percent of rated resistive load current (steady-state) at 28 V dc or rated ac voltage. Associated with each load shall be a circuit that will detect failure to open and close the circuit. Failure to close shall be specified as a voltage drop across the contacts exceeding 10 percent of full load voltage. During the test, each set of contacts shall open and close its individual circuit in proper sequence. After the test, the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time shall be measured as specified in 4.7.4, 4.7.5.1, 4.7.6, 4.7.16.1.1, and 4.7.17, respectively.

4.7.25 Resistance to soldering heat (not applicable to plug-in relays) (see 3.29). Relays shall be tested in accordance with method 210 of MIL-STD-202. The following details shall apply:

a. Depth of immersion in molten solder: Within .060 ±.020 inch (1.52 ±.51 mm) of the relay base.

b. Test condition letter B.

c. Measurements after test: Insulation resistance, dielectric withstanding voltage, timing cycle, and recycle time shall be measured as specified in 4.7.4, 4.7.5.1, 4.7.16.1.1, and 4.7.17, respectively.

4.7.26 Salt spray (corrosion) (see 3.30). Relays shall be tested in accordance with method 101 of MIL-STD-202. The following detail and exceptions shall apply:

a. Applicable salt solution: 5 percent.

b. Test condition letter B.

c. Inspection after test: Relays shall be inspected for evidence of peeling, chipping, blistering of the finish, or exposure of base metal due to corrosion.

d. Measurement after test: Timing cycle and recycle time shall be measured as specified in 4.7.16.1.1 and 4.7.17.

4.7.27 Thermal shock (see 3.31). Relays shall be tested in accordance with method 107 of MIL-STD-202. The following details shall apply:

a. Test condition letter: As specified (see 3.1).

b. Measurements after cycling: Relays shall be visually examined for cracking, peeling and flaking of the finish, and the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time shall be measured as specified in 4.7.4, 4.7.5.1, 4.7.6, 4.7.16.1.1, and 4.7.17, respectively.

4.7.28 Low temperature operation (see 3.32). 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 timing cycle, recycle time, and contact voltage drop (or resistance) shall be measured as specified in 4.7.16, 4.7.17, and 4.7.6, respectively. (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 timing cycle and recycle time 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. All units subjected to this demagnetizing effect shall be tested in accordance with high temperature timing cycle (see 4.7.16.2), at the conclusion of this test.

4.7.29 Shock (specified pulse) (see 3.33). Unless otherwise specified (see 3.1), relays shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

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

b. Test-condition letter: As specified (see 3.1).

c. Electrical-load conditions: In each direction of shock, the relay shall be deenergized during two shocks and energized with rated control voltage or current during one shock.

d. Measurements during shock: Contacts shall be monitored as specified in method 310 of MIL-STD-202, test circuit B, test-condition letter A (open contacts shall be wired in parallel and closed contacts shall be wired in parallel and closed contacts shall be connected in series).

e. Inspection after shock: Relays shall then be inspected for evidence of loosening of parts.

f. Measurements after test: Timing cycle and recycle time shall be as specified in 4.7.16.1.1 and 4.7.17, respectively.

4.7.30 Vibration, high frequency (see 3.34).

4.7.30.1 Vibration, high frequency (classes A, B and D). 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: Rigidly mounted by normal mounting means. Connections to the relay shall be made by soldering flexible standard wires to the relay terminals.

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

c. Test-condition letter F.

d. Tests during vibration: Contacts shall be monitored as specified in method 310 of MIL-STD-202, test circuit B, test-condition letter A, (open contacts shall be wired in parallel and closed contacts shall be connected in series).

e. Measurements and inspections after vibration: Insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time as specified in 4.7.4, 4.7.5.1, 4.7.6, 4.7.16.1.1, and 4.7.17, respectively. Relays shall then be inspected for loosening of parts.

4.7.30.2 Vibration, high frequency (class C). 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: Rigidly mounted by normal mounting means. Connections to the relay shall be made by soldering flexible standard wires to the relay terminals.

b. Electrical-load conditions: Relays shall be tested, energized for 2 hours at rated voltage and deenergized for 2 hours, in each of the three mutually perpendicular directions.

c. Test-condition letter F.

d. Measurements and inspection after vibration: Insulation resistance, dielectric withstanding voltage, output voltage drop, timing cycle, and recycle time as specified in 4.7.4, 4.7.5.1, 4.7.6.3, 4.7.16.1.1, and 4.7.17, respectively. Relays shall then be inspected for loosening of terminals.

4.7.30.3 Vibration, high frequency (class E). Vibration tests shall be performed in accordance with the requirements specified (see 3.1 and figure 3). The high temperature shall be maximum high temperature specified for the relay being tested. Low temperature shall be as specified (see 3.1).

4.7.30.3.1 Test installation. The relay shall be rigidly attached to the vibrator table, either directly or with an adapter of sufficient rigidity to be nonresonant in the test frequency range. If necessary, an independent frequency scan shall be conducted on the adapter with a suitable dummy load in lieu of the relay to determine whether the adapter has resonances in the test frequency range. The test configuration shall be such that rotational motion of the vibrator table or adapter bracket is not induced owing to any unsymmetrical weight or stiffness distribution of the component.

4.7.30.3.2 Amplitude measurement. Measurements of vibratory accelerations or amplitudes shall be made at the mounting base of the components. If vibration of the component is induced by its own operation, or if the response to vibratory accelerations is increased by its own resonances, then this response or acceleration shall not be considered as part of the applied vibration. The means of measuring vibratory amplitudes of acceleration shall not be considered as part of the applied vibration. The means of measuring vibratory amplitudes or acceleration must provide a clear distinction between the applied vibration and the response to the vibration of the relay assembly.

4.7.30.3.3 Frequency measurements. All frequency measurements shall be accurate within ±5 percent. All amplitude or acceleration measurements shall be accurate within ±10 percent. The motion of the vibrator table shall be simple harmonic motion with not more than 10 percent distortion. Distortion of the table motion caused by the operation or response of the component itself shall not be considered part of the distortion of the driving motion.

4.7.30.3.4 Tests during vibration. As specified in 4.7.30.1d.

4.7.30.3.5 Voltage. The test voltage shall be between 12 and 25 volts with a series noninductive resistor of suitable resistance to limit the closed circuit current to some value between 5 and 10 milliamperes. The indicator shall be an oscilloscope with high input impedance and a bandwidth of 1 megacycle, or greater.

4.7.30.3.6 Frequency scan. The relay shall be vibrated first in the energized and then in the deenergized position along each of three mutually perpendicular axes for resonance under the conditions defined (see 3.1). Frequency scan shall be conducted slowly and carefully. The frequency range shall be broken into small convenient intervals, and each interval scanned at a constant applied acceleration or amplitude which produces approximately the table amplitude or acceleration defined by the applicable test curve. The table amplitude or acceleration shall be observed closely during the frequency scans to detect frequencies of minimum table motion which define

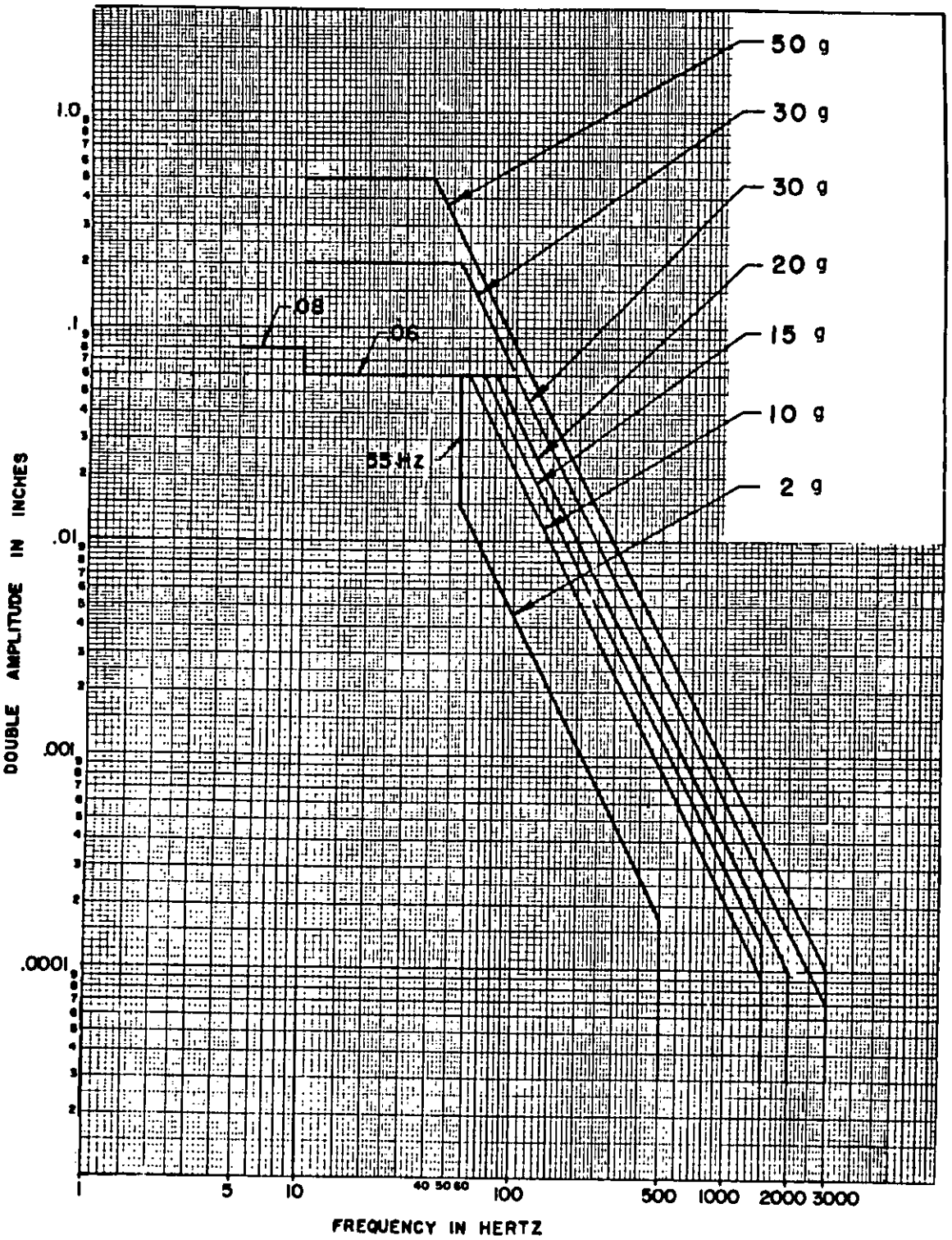


FIGURE 3. Range curve for vibration test.

some of the frequencies at which some components may be in resonance. These frequencies are quite sharply tuned and do not necessarily coincide with the frequencies at which maximum component amplitude or noises occur when scanning at constant applied force amplitude. When the resonant components are small, the reduction of table motion at resonance may not be discernible, in which case the resonant frequencies may be determined for observation of maximum amplitudes, noises or changes in performance such as contact disturbance. In all cases, the resonant frequencies shall be verified, if possible, by checking for minimum table motion.

4.7.30.3.7 Resonance endurance. After completion of the frequency scanning, resonance endurance tests shall be conducted as specified (see 3.1), modified as follows: The duration of a test shall be one million cycles or 8 hours, whichever occurs first. A separate test shall be performed for each resonance found in frequency scan specified in 4.7.30.3.6; the test time shall not be divided between resonances. Separate resonance endurance tests may be performed on separate relays, if the resonance is common to more than one sample. The specimen shall be vibrated for 15 minutes at the specified maximum temperature and 15 minutes at the specified minimum temperature. The relay shall be stabilized at the maximum and minimum temperature before conducting resonance endurance tests at these temperatures. If total time at resonance is less than 30 minutes, the time shall be divided equally between high and low temperatures. Vibrations shall be continued at room temperature for the duration of the test. The resonance endurance time shall be divided equally between vibration with the relay coil in the energized and the deenergized conditions. For type III relays, the coil shall be energized for 3 minutes at the end of each temperature level of the cycle. Endurance tests shall not be conducted at any frequency at which the table amplitude abruptly increases when scanning at constant applied force amplitude. If a change in resonant frequency occurs during testing or owing to change in test temperature, the frequency of vibration shall be adjusted to follow the resonance. However, if large or abrupt resonant frequency shifts occur, the item shall be inspected for structural failure or excessive wear.

4.7.30.3.8 Cycling endurance. The relay shall be cycled for 30 minutes at maximum and 30 minutes at minimum rated ambient temperature. The relay shall be in the energized position for the first half of each test period. During the other half, the relay shall be deenergized. The frequency shall be cycled for 15 minute periods between the frequency limits and at the vibration levels specified on figure 3 for the class of relay being tested. The rate of change of frequency shall be logarithmic. Where there is no provision for logarithmic cycling, a linear rate of frequency change may be used. The cycling test may be broken into convenient frequency ranges, providing cycling rates and test times for each range are not changed.

4.7.30.3.9 Test after vibration. As specified in 4.7.30.1e.

4.7.30.4 Vibration random. When specified (see 3.1), relays shall be tested in accordance with method 214 of MIL-STD-202. The following details shall apply:

a. Mounting method: Rigidly mounted by normal mounting means. Connections to the relay shall be made by soldering flexible standard wires to the relay terminals.

b. Electrical-load conditions: Relays shall be tested with the coil energized for 7.5 minutes at rated voltage and with the coil deenergized for 7.5 minutes, in each of the three mutually perpendicular directions (relays with intermittent duty coils shall not be energized above their duty cycle). Except as specified in d, contacts shall not be loaded.

c. Test condition I, letter G, duration 15 minutes.

d. Tests during vibration: Contacts shall be monitored as specified in method 310 of MIL-STD-202, test circuit B, test condition letter A (open contacts shall be wired in parallel and closed contacts shall be connected in series).

e. Measurements and inspection after vibration: Insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time as specified in 4.7.4, 4.7.5.1, 4.7.6, 4.7.16.1.1, and 4.7.17, respectively. Relays shall then be inspected for loosening of parts.

4.7.31 Acceleration (class A, B, D, and E relays) (see 3.35). Relays shall be tested in accordance with method 212 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting: The relays shall be rigidly fastened, using normal mounting means, in each of three mutually perpendicular positions.

b. Test-condition letter A, except that acceleration shall be applied in each direction along three mutually perpendicular axes of the specimen and one of the axes shall be in the direction most likely to cause malfunction. Unless otherwise specified (see 3.1), the acceleration force shall be 15G.

c. Electrical operating conditions during acceleration: Relays shall be tested with the relay in deenergized condition and repeated with the relay coil energized at specified 23°C pickup voltage. An indicating instrument shall be connected across the contacts while the relay is undergoing this test to determine the ability of the contacts to remain in the proper position. Open contacts shall be wired in parallel and closed contacts shall be wired in series during this test.

d. Measurements during acceleration: Timing cycle and recycle time as specified in 4.7.16.1.1 and 4.7.17, respectively.

4.7.32 Resistance to solvents (see 3.36). Relays shall be tested in accordance with method 215 of MIL-STD-202. The following details and exception shall apply:

a. Portion of the specimen to be brushed: All marking.

b. Number of specimens to be tested: Two using first solvent solution; and one specimen each using second and third solvent solutions. A total of four specimens shall be tested.

c. Specimen shall be inspected for legibility of marking.

4.7.33 Strength of terminals and mounting studs (see 3.37).

4.7.33.1 Strength of threaded terminals and mounting studs. Relays having mounting studs or threaded terminals, shall be tested to determine compliance with the strength requirements specified in 3.37.1, and tables I and II. The specified pull force shall be applied both coaxially with the threaded terminal in a direction away from the main body of the relay, and again normal to the threaded axis of the terminal in approximately the same plane as the seat for the terminal lug. The specified torque shall be applied to the terminal mounting nut, or screw with all terminal mounting hardware, including one terminal lug of proper size, assembled in proper order. The relays shall withstand the specified force for 1 minute without damage. Relays, with threaded terminal assemblies soldered in place, shall be tested as follows (not applicable to relays with maximum temperature rating above 125°C). The relays shall be stabilized in a 180°C ambient temperature. After stabilizing at this temperature for a minimum of 2 hours, the terminals shall be subjected to the pull and torque test as specified above.

4.7.33.2 Strength of solder-lug, plug-in, and wire-lead terminals (see 3.37.2). Relays shall be tested in accordance with method 211 of MIL-STD-202 in accordance with the following, as applicable. 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.

4.7.33.2.1 Pull test (all terminal types). Terminals shall be tested as specified in test-condition letter A; the force shall be as specified (see 3.1).

4.7.33.2.2 Bend test (not applicable to plug-in terminals). Terminals shall be tested as specified in test-condition letter B (two bends) or C, as applicable. Loads for test-condition letter C shall be as specified (see 3.1).

4.7.33.2.3 Twist test (wire lead terminals only). All terminals shall be tested as specified in test-condition letter D, except during application of torsion, each terminal shall be rotated 45 degrees in one direction, then returned to start; rotated in opposite direction 45 degrees, then returned to start. Each terminal shall be subjected to two such rotations and returns. Each terminal shall be held at a point 3/4 inch from the point of emergence from the relay and in one plane shall be bent 20 ±5 degrees in one direction, then returned to start; rotated in opposite direction 20 ±5 degrees, then returned to start; this procedure shall then be repeated in the perpendicular plane.

Following these tests, relays shall be inspected for evidence of loosening or breaking of the terminals and other damage that could adversely affect the normal operation of the relay.

* 4.7.33.2.4 Solderability (see 3.6). Solder terminations shall be tested in accordance with method 208 of MIL-STD-202. All terminations shall be tested.

4.7.34 Moisture resistance (nonhermetically-sealed relays) (see 3.38). Relays shall be tested in accordance with method 106 of MIL-STD-202. The following details shall apply:

a. Mounting: On a corrosion-resistant panel by normal mounting means.

b. Initial measurement: Not applicable.

c. Polarization: During steps 1 through 6, 100 volts dc shall be applied between the coil and the case.

d. Final measurements: Upon completion of step 6 of the final cycle, insulation resistance shall be measured as specified in 4.7.4. After a 24-hour drying period at a relative humidity of 50 ±5 percent, dielectric withstanding voltage shall be measured as specified in 4.7.5.1, except the test voltage shall be 90 percent of initial potential; and insulation resistance, timing cycle, and recycle time shall be measured as specified in 4.7.4, 4.7.16.1.1, and 4.7.17, respectively.

e. Inspection after test: Relays shall be inspected for evidence of breaking, cracking, chipping, and loosening of terminals.

4.7.35 Loads and endurance (life) (see 3.39, 3.40, 3.42, 3.43, 3.44, and 3.45). Test loads and circuits shall be so arranged that the specified current will flow through each pole. During all load or endurance (life) tests, the relay enclosure shall be maintained at the electrical system ground to neutral through a F02 or F03 fuse in accordance with MIL-F-15160/2 or /3, rated at 5 percent of the rated resistive load but in no event greater than 3 amperes or less than 100 milliamperes. Blowing of this fuse shall constitute failure. Line-to-line and line-to-ground voltages shall be as specified (see 3.1). The load test cycles shall be performed in any number of continuous periods, each not less than 3 hours. The relays shall be mounted in accordance with 4.4.7. Double-throw relays shall have the normally open (NO) and normally closed (NC) contacts tested. If the NO and NC contacts are tested separately, an additional sample unit shall be provided for this test which shall be required to meet all other tests in the test sequence. If both NO and NC contacts of double-throw relays are being tested at the same time, a separate load shall be provided for each NO and NC contact. The movable contacts shall be connected to the power source, except for double break contacts. All loads shall be connected between the contacts and power supply ground or neutral. When testing multipole relays with three-phase ratings, three-phase loads shall be connected to adjacent contacts. During endurance tests, every operation of each contact shall be monitored for failure to make, carry and break specified load, any of which constitutes a relay failure. The minimum sensing period shall be 10 percent of the dwell time in the

open or closed position. Test equipment must either lock in the state of failure or record the sequence number of the miss. Failure to close shall be specified as a voltage drop across the contacts exceeding 10 percent of full load voltage, except for minimum current tests when the minimum current voltage drop shall be as specified.

After the tests, the insulation resistance, dielectric withstanding voltage, contact voltage drop (or resistance), timing cycle, and recycle time shall be measured as specified in 4.7.4, 4.7.5.1, 4.7.6, 4.7.16.1.1, and 4.7.17, respectively.

4.7.35.1 Overload (see 3.39).

4.7.35.1.1 Overload (class C, when specified (see 3.1)). Relays shall be tested in accordance with 4.7.35.1.1.1 through 4.7.35.1.1.4 as specified (see 3.1). The number of operations for each test shall be 50; the cycling rate shall be a minimum of 3 cycles per minute with the output "on" time being a minimum of 0.2 second per cycle. The output shall be tested at three times the rated current; the input shall be energized with rated voltage.

4.7.35.1.1.1 Resistive. Suitable resistors shall be used.

4.7.35.1.1.2 Inductive, dc. Unless otherwise specified (see 3.1), inductive dc loads shall be computed in accordance with the formula $CE^2 = (0.28)I^{1.18}$. A shunting capacitor shall be placed across the test contacts to absorb the arc energy. The voltage across the capacitors shall be measured upon circuit interruption by means of an oscilloscope and shall be taken as the peak value of the first oscillation.

Where: W = Energy (in joules).
C = Capacitance of shunt capacitor (in farads).
E = Voltage across capacitor (in volts).
I = Maximum dc inductive current rating of the output.

The energy thus calculated is the energy which would be dissipated by the relay if the capacitor were removed. This energy shall be within 10 percent of the energy calculated by the formula $W = (0.14)I^{1.18}$. This method of energy measurement requires the use of a pulse-type noninductive capacitor having a working voltage of 1,000 volts. The size of the capacitor shall be such that the peak voltage measured shall be not less than 200, nor greater than 900 volts. During the overload test, the capacitor shall be disconnected. Unless otherwise specified (see 3.1), the inductive shall have an L/R ratio of 0.008.

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

4.7.35.1.1.4 Lamp. The load shall consist of tungsten lamps which shall be operated at approximately their rated voltage. Optional lamp load, see 4.7.35.2.3.4.

4.7.35.1.2 Overload (class D relays). Relay contacts (both normally open and normally closed) shall be subjected to the tests specified in 4.7.35.1.2.1 through 4.7.35.1.2.4, as applicable. Relay coil energization shall be nonsynchronous with the power supply for ac loads. The number of operations shall be 100 for dc contact loads, and 200 for ac contact loads ("on" and "off" times shall be approximately equal). The coil shall be energized at rated voltage. Overload current shall be twice rated load current. Test may be performed on electromechanical relays only.

4.7.35.1.2.1 Resistive. Suitable resistors shall be used. Cycling rate shall be 20 ±2 cycles per minute (cpm).

4.7.35.1.2.2 Inductive. Cycling rate shall be 10 ±1 cpm.

4.7.35.1.2.3 Inductive, dc. The L/R ratio shall be the same as for rated load (see 3.1).

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

4.7.35.1.3 Overload (class E relays). The contacts of the relay shall be caused to make and break the overload values and durations as shown in table X for 50 operations at each of the maximum system voltage (open circuit) ratings. For double-throw relays, separate tests shall be performed for the normally open and for the normally closed contacts. Test may be performed on electromechanical relays only.

TABLE X. Overload values and durations.

Relay rating	Percent rated resistive load			Duty cycle (seconds)	
Amperes	28 V dc	115 V ac	115/200 V ac 3 phase	ON ±0.05	OFF ±1
0-24	400	400	600	0.2	20
25 and up	800	800	800	0.2	20

4.7.35.2 Life (see 3.40).

4.7.35.2.1 Life (class A, B, and C relays). Unless otherwise specified (see 3.1), relays shall be tested for 100,00 cycles or 500 hours, whichever occurs first, in accordance with 4.7.35.2.1.1 through 4.7.35.2.1.5 as specifed (see 3.1). The input voltage (current) and output load shall be as specified (see 3.1). Unless otherwise specified (see 3.1), the ambient temperature of the test chamber shall be the maximum rated temperature (see 3.1). For each test, the output voltage drop shall be monitored during 40 percent minimum of each "ON" and "OFF" period. The duration of ON-time shall be 50 ±10 percent of each relay cycle.

4.7.35.2.1.1 Resistive. Suitable resistors shall be used.

4.7.35.2.1.2 Inductive. Current shall be rated current. Appropriate inductive load components (see 4.7.35.1.1.2 and 4.7.35.1.1.3, as applicable) shall be used. A suitable resistor may be placed in the circuit to obtain rated steady-state current flow.

4.7.35.2.1.3 Lamp. The load shall consist of tungsten lamps which shall be operated at their rated voltage. The specified current (see 3.1) shall flow when the lamps have stabilized.

4.7.35.2.1.4 Motor load, dc (when specified). The relay shall be subjected to the minimum operating cycles for making six times the rated motor load at rated system voltage and breaking the normal rated motor load.

4.7.35.2.1.5 Motor load, ac (when specified). The ac motor load test shall be as specified in 4.7.35.2.1.4 except that the value of the ac inrush current shall be five times rated motor load current, or as specified (see 3.1).

4.7.35.2.2 Life (class D relays). Unless otherwise specified (see 3.1), relay shall be cycled in accordance with 4.7.35.2.2.1. Relay coil energization shall be nonsynchronous with the power supply for ac loads. Ambient temperature of relays shall be 125°C minimum. All contacts in each sample unit shall switch identical loads.

4.7.35.2.2.1 High level loads. The cycling rate for resistive loads shall be 20 ±2 operations per minute. The cycling rate for inductive loads shall be 10 ±1 operations per minute. The coil shall be energized at rated voltage during 50 ±10 percent of each operation. Load voltage shall be rated voltage. The relays shall be cycled for 100,000 operations with the contacts loaded at rated current. Inductive load test may be performed on electromechanical relays only.

4.7.35.2.3 Life (class E relays). Life (endurance) load cycling tests shall be performed as specified (see 3.1), and succeeding paragraphs, and with a duty cycle in accordance with table XI. Loads, connections, and test conditions shall be in accordance with 4.7.35. The endurance test shall be conducted with 50 percent of the required operating cycles performed at the maximum temperature altitude specified for the class of relay being tested. The altitude requirement for hermetically sealed relays may be waived, provided that the ambient temperature is increased by 10 percent of that specified for the class of relay being tested. Unless otherwise specified, during all endurance tests, the control and contact voltages shall be the applicable dc or ac (open circuit) system voltage specified (see 3.1). The minimum number of operating (life) cycles shall be 100,000 cycles at each contact load rating. Inductive motor and lamp tests may be performed on the electromechanical relays only.

4.7.35.2.3.1 Inductive load, dc. The relay shall be subjected to the minimum operating cycles with the inductive loads specified, using the duty cycle of table XI. Inductive dc loads shall use MIL-I-81023 inductors.

TABLE XI. Duty cycle (seconds).

Inductive (ac or dc)		Motor (ac or dc)		Resistive (ac or dc)		Lamp (28 V dc)	
ON	OFF 1/	ON	OFF 1/	ON	OFF 1/	ON	OFF 1/
.5 ±.05	3.0 ±0.1	.35 ±.09 2/	2 ±0.1	1.5 ±1.0	1.5 ±1.0	2 ±.05	7 ±2

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

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

4.7.35.2.3.3 Resistive load, dc. 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}.

4.7.35.2.3.4 Lamp load. Unless otherwise specified, the lamp load shall be performed with the 28 V dc power supply voltage. Relays shall be subjected to the minimum operating cycles specified (see 3.1), making 12 times the rated lamp load and breaking the rated lamp load. The duration of the 12 times inrush shall be 0.015-0.020 second, the total "ON" time shall be 2 ±0.05 seconds and the "OFF" time shall be 7 ±2 seconds. Except for single-throw relays, one normally open and one normally closed contact shall be tested. Multipole relays shall be tested with the loads on two separate poles which shall be selected at random by the testing activity.

4.7.35.2.3.5 Inductive load, ac. 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 XI. Inductive load circuits shall consist of inductive and resistive load elements connected in series. The circuit parameter shall be rated inductive current, voltage, and frequency, and a 0.7 ±0.05 lagging power factor.

4.7.35.2.3.6 Motor load, ac. The ac motor load test shall be as specified in 4.7.35.2.3.2 except that the value of the ac inrush current shall be five times rated motor load current, or as specified (see 3.1).

4.7.35.2.3.7 Resistive load, ac. The test shall be the same as 4.7.35.2.3.3, except that the ac load shall be the resistive current specified.

4.7.35.3 Minimum current (classes D and E) (see 3.42). The relay shall be subjected to 50,000 cycles as follows. (For group B tests, the number of cycles shall be 1/10 of the specified minimum cycles.) Normally open and normally closed contacts shall be tested. Tests on normally open and normally closed contacts of double-throw relays shall be performed concurrently. The test voltage shall be 28 V ±1 V dc. During each cycle, the relay coil shall be energized for 29 ±3 seconds and deenergized for 1.5 ±0.5 seconds. During each cycle, the contacts to be tested shall make, carry, and interrupt the test current specified in the applicable paragraph below. While the contacts are carrying the test current, contact voltage drop measurements shall be made at the start of the test and shall not exceed the values shown in table XII. Monitoring shall be performed to provide either a continuous record of contact voltage drop or cause cessation of the test if the values of table XII are exceeded. Tests on main and auxiliary contacts shall be performed concurrently. The test shall be performed at the maximum ambient temperature specified (see 3.1). The test shall be performed at sea level. Where a relay is required to be cycled for more than 50,000 cycles, the cycling in excess of 50,000 may be accomplished at the rate specified in table XI. The indicator shall be calibrated prior to load-endurance test. Photographic record of oscilligrams showing compliance with curves 1 and 2 of MIL-I-81023 shall be submitted for qualification approval. Test may be performed on the electromechanical relays only.

TABLE XII. Contact voltage drop.

Contact ratings amperes rated resistive load	Initial millivolt drop (max.) (see 4.7.6)	Initial allowable resistance calculated (ohm)	Allowable millivolt drop after test begins (max.) 1/			
			Amperes 0.5	Amperes 0.3	Amperes 0.1	Rated resistive load
2	150	0.075	63	38	13	175
5	150	0.030	40	24	8	175
10	150	0.015	32	20	7	175
15	150	0.010	30	18	6	175
20	150	0.010	30	18	6	175

1/ Maximum allowable contact voltage drop for ratings not listed shall be determined by adding 0.05 ohm to calculated initial allowable resistance based on initial allowable contact voltage drop with a maximum of 200 millivolts. The millivolts drop at rated current shall not exceed the limits of contact voltage drop specified in 4.7.6.

$$E_{max}\ (mV) = I_{load} \times \left[\frac{0.150 + 0.05}{I_{rated}}\right] \times 1{,}000$$

For relays rated above 20 amperes and minimum current 10 percent of rated resistive load, E_{max} (mV) shall be as calculated by the above formula, or 200 mV, whichever is less.

4.7.35.3.1 Rating, not specified. When the value of the minimum current rating is not specified (see 3.1), each normally open and normally closed contact shall be connected to loads in accordance with the following:

Circuit no. pole no.	Loads
1	0.5 ampere resistive load
2	0.3 ampere inductive load
3	0.1 ampere resistive load
4	Rated resistive load

If the relay has more than four poles, the above loads shall be repeated in the sequence listed. Rated load shall be omitted for single pole, single throw relays. For single pole, double throw relays, each sample unit shall be tested with rated load on the normally open and specified minimum current on the closed contact. One pole of all other relays shall be tested with rated load on one normally open and one normally closed contact. The test shall be performed at 125°C or the maximum ambient temperature specified for the class of relay, whichever is higher. Both normally open and normally closed contacts shall make and break the above specified loads with no failure throughout the test. For relays rated above 20 amperes resistive load (dc), one pole of the relay power contacts shall be loaded at rated resistive load (dc), and all other poles shall be loaded at 10 percent of rated resistive load.

4.7.35.3.2 Rating, specified (see 3.1). When the value of minimum current rating is specified, one pole of the relay shall be loaded at the rated resistive current specified (see 3.1), with minimum current on the other pole(s).

4.7.35.4 Rupture (class E relays) (see 3.43). The relay shall be made to make and break its rated rupture current at each of the maximum system voltage (open circuit) ratings, for a minimum of 50 operations using the values of current and cycling time in table XIII. For double-throw relays, separate tests shall be performed for the normally closed and normally open contacts. For those relays with both ac and dc ratings, ac and dc rupture tests shall be performed on separate samples at highest system voltage (open circuit), as specified (see 3.1). Test may be performed on electromechanical relays only.

TABLE XIII. Rupture values and durations.

Relay resistive rating	Percent rated resistive load			Duty cycle (second)	
Amperes	28 V dc	115 V ac	115/200 V ac 3 phase	ON ±0.05	OFF ±1
10 and under	500	500	800	0.2	30
Greater than 10	1,000	1,000	1,000	0.2	30

* 4.7.35.5 Time current relay characteristics at 25°C (class E relays when specified see 3.1) (see 3.44). Each relay tested shall sustain five applications (make and carry only) of power concurrently on adjacent poles at each of the current levels and for the associated time duration as specified (see 3.1). Relays shall be tested at 28 V dc and 115/200 V ac, 400 Hz, 3-phase. The load shall be resistive. The cooling time between successive application of current shall be 30 minutes. Tests shall be performed at room ambient conditions and both the normally open and normally closed contacts shall be tested. After the tests, the contact voltage drop shall be measured as specified in 4.7.6.

4.7.35.6 Low level (when specified, see 3.1) (see 3.45). Relays shall be tested in accordance with method 311 of MIL-STD-202. The following details shall apply:

a. Number of misses considered a failure: One.

b. Maximum dynamic contact resistance allowed: 100 ohms.

c. Number of cycles of operation and cycling rate: 100,000 cycles unless otherwise specified at a rate of 60 to 300 cycles per minute.

4.7.36 Vibration scan (see 3.41). Relays shall be subjected to the vibration test method 204, test condition A of MIL-STD-202; however, only one cycle shall be performed. Sweeptime shall be reduced to the time required to sweep the entire range of frequencies specified (see 3.1). The relay shall be vibrated in each of the three mutually perpendicular axes. Relays having both normally open and normally closed contacts shall be subjected to one vibration scan in the deenergized condition and one scan in the energized condition. Contact monitoring shall be in accordance with 4.7.30.1d.

5. PACKAGING

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

5.1.1 Level A.

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

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

5.1.1.3 Preservative application. Preservatives shall not be used.

5.1.1.4 Unit packs. Each relay shall be unit packed one each in accordance with the methods of MIL-P-116 specified herein insuring compliance with the applicable requirements of that specification.

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

5.1.1.4.2 Encapsulated relays. Encapsulated (nonhermetically sealed) relays shall be unit packed in accordance with submethod IC-2. The container shall conform to variety 2 of either PPP-B-566 or PPP-B-676.

5.1.1.5 Intermediate packs. Intermediate packs are not required.

* 5.1.2 Level B. The requirements for level B preservation shall be as specified for level A except that all relays shall be unit packed in accordance with method III and that any variety of the containers specified may be used.

* 5.1.3 Level C. The level C preservation of relays shall conform to the MIL-STD-794 requirements for this level.

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

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

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

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

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

* 5.2.4.1 Level A. Relays, packed as specified in 5.2.1, shall be unitized on pallets in conformance with the MIL-STD-147, load type 1, with a wood cap (storage aid 5) positioned over each load.

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

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

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

5.4 General.

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

5.4.2 Packaging inspection. The inspection of these packaging requirements shall be in accordance with 4.6.4.

5.4.3 Army acquisitions.

* 5.4.3.1 Level A and B packing. When the gross weight exceeds 200 pounds or the container length and width is 48 x 24 inches or more and the weight exceeds 100 pounds, 3 x 4 inch skids (laid flat) shall be applied in accordance with the requirements of the container specification. Unitization shall be required when the containers specified in 5.2.1 and 5.2.2 do not require skids; quantities per destination exceed either a total of 250 pounds (excluding the pallet) or a volume of 20 cubic feet; and the container size permits use of one of the pallet patterns of MIL-STD-147. A quantity of containers, packed as specified, except that container strapping may be omitted, shall be placed on a pallet, load type I conforming to MIL-STD-147. For level B, unit containers which meet these requirements may be palletized without further packing. The pallet shall conform to NN-P-71, type IV, group I or II woods. The load shall be "bonded" to the pallet by strapping conforming to QQ-S-781, type I, finish A, or shrink film conforming to L-P-378, type IV. Stretch wrap in accordance with MIL-STD-147 is authorized for shipments within the continental United States and for containerized shipments.

6. NOTES

6.1 Intended use. Relays conforming to this specification are intended for use in dc or ac (single or polyphase) electrical systems as a means of timing and controlling the making and breaking of circuits for electrically operated equipment and devices. Their principal areas of application (i.e., aircraft, missiles, spacecraft, and ground support equipment) does not preclude the use of these relays in other military applications. Thermal time delay relays are excluded from this specification.

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

* 6.2 Ordering data. Acquisition documents should specify the following:

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

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

Levels of preservation and packing required (see 5.1 and 5.2). If special or additional identification marking is required see 5.3.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the applicable 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. The activity responsible for the Qualified Products List is the Electronic Support Division, AFLD/PTS, Gentile Air Force Station, Dayton, OH 45444, and information pertaining to qualification of products may be obtained from that activity.

6.4 Definitions.

6.4.1 Time delay relay. A relay in which an additional time function is added beyond that normally inherent in the switching mechanism.

6.4.1.1 Types. Relay types are defined as follows (see figure 4):

a. Type I (time delay on operate). A time delay relay in which the switching or load circuits are operated for a specified period of time after the input control circuits are energized.

b. Types IIA and IIB (time delay on release). A time delay relay in which the switching or load circuits are operated when the input control circuits are energized and remain operated for a specified period of time after the control circuit is deenergized.

c. Type III (interval timer). A time delay relay in which the switching or load circuits are immediately energized and remain energized for a specified period of time after the input circuit is energized.

d. Type IV (repeat cycle timer). A relay that repeats ON-OFF cycle as specified as long as the input circuit is energized; i.e., flashers.

e. Type V (time sequence as specified, see 3.1). Variations and combinations not included above have time characteristics specified in the specification sheet.

6.4.1.2 Classes. Relay classes are defined as follows:

a. Classes A, B, D, and E (hybrid). A combination of solid state circuit input elements function with an electromagnetic relay that performs the switching function and/or time delay.

b. Class C (solid state). A combination of electronic devices such as semiconductors, resistors, capacitors, etc., assembled to perform a time delay and/or switching function with no moving parts.

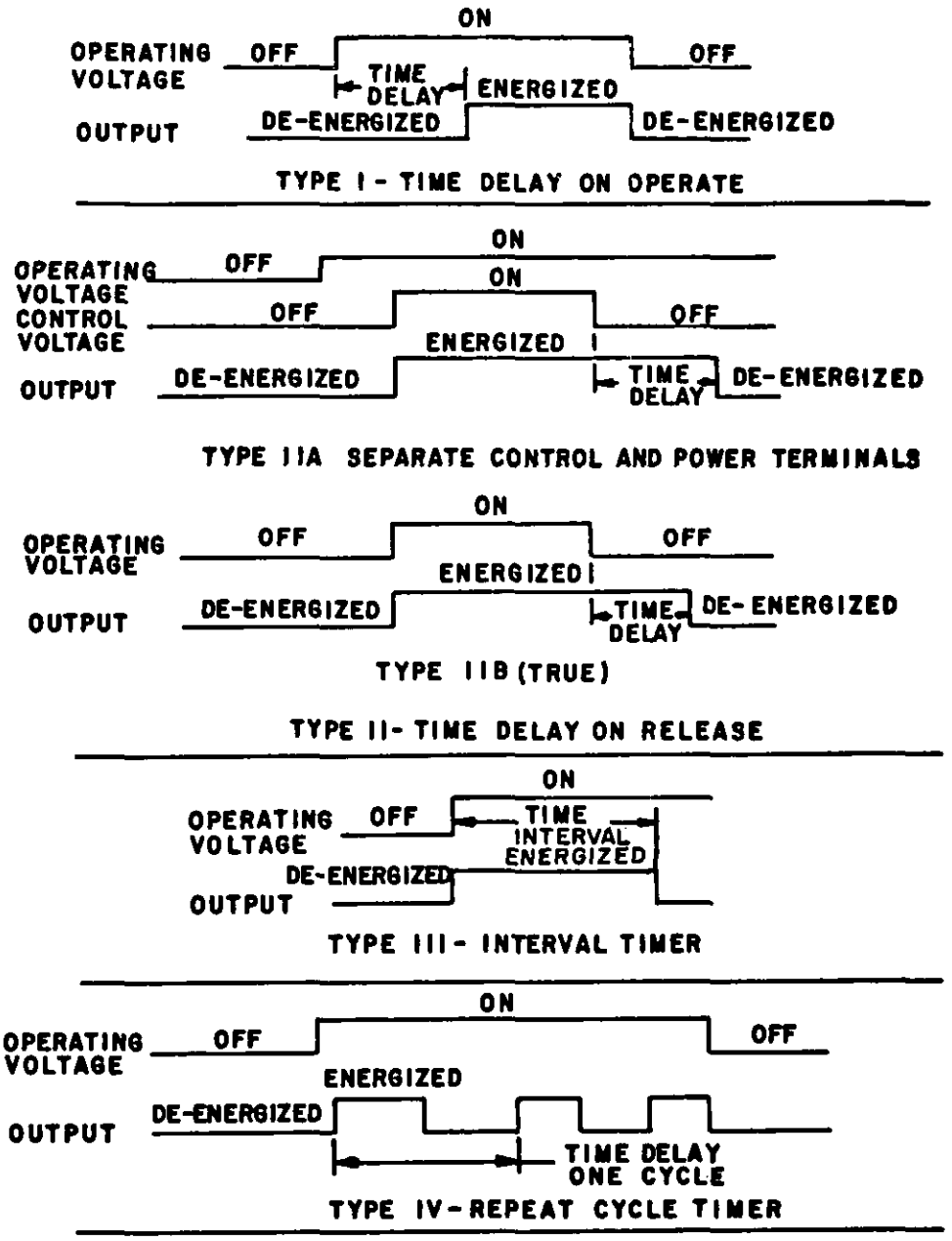


FIGURE 4. Relay timing diagrams.

6.4.2 System voltage. The normal voltage of the electric system in which the relay will be required to operate.

6.4.3 Nominal voltage. The standard designation which approximates the normal voltage of the system at which the relay is designed to operate.

6.4.4 Control voltage. The voltage applied to the input terminals to control the relay.

6.4.5 Operate time. The time between application of input or control voltage and the energization of the output contacts.

6.4.6 Release time. The time between removal of input or control voltage and the deenergization of the output contacts.

6.4.7 Recycle time.

a. Time delay on operate and interval timer relays: The minimum time that power must be removed from the input terminals in order to insure that a new timing cycle can be initiated within the specified timing tolerance.

b. Time delay on release relays: The minimum time that power must be applied to the input or control terminals in order to insure that the timing cycle can be completed as specified.

6.4.8 Zero voltage turn on and zero current turn off. A characteristic that requires the relay to turn ON and turn OFF only at the half-cycle, zero crossing point when connected to a load, regardless of when the control voltage is applied or removed.

6.5 Intermetallic contact. The finishing of metallic areas to be placed in intimate contact by assembly presents a special problem, since intermetallic contact of dissimilar metals results in electrolytic couples which promote corrosion through galvanic action. To provide the required corrosion protection, intermetallic couples are restricted to those permitted by table XIV. Table XIV shows metals and alloys (or plates) by groups which have common electromotive forces (EMF) within 0.05 volt when coupled with a saturated calomel electrode in sea-water at room ambient temperature. All members of a group are considered completely compatible, one with the other. Compatible couples between groups have been specified in table XIV based on a potential difference of 0.25 volt maximum. To simplify any arithmetic involved, table XIV shows, in addition to EMF against a calomel electrode, a derived "anodic index" with group 1 (gold, etc.) as 0 and group 18 (magnesium, etc.) as 175. Subtraction of a lower group anodic gives the EMF difference in hundredths of a volt.

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

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

6.5.3 Selection of compatible couples. Proper selection of metals in the design of equipment will result in fewer intermetallic contact problems. For example, for sheltered exposure, neither silver nor tin require protective finishes. However, since silver has an anodic index of 15 and tin 65, the EMF generated as a couple is 0.50 volt, which is not allowable by table XIV. In this case, other metals or plates will be required. It should be noted that, in intermetallic couples, the member with the higher anodic index is anodic to the member with the lower anodic index and will be susceptible to corrosion in the presence of an electrolytic medium. If the surface

TABLE XIV. Compatible couples (see 6.14) 1/

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

1/ Compatible couples - potential difference of 0.25 volt maximum between groups.

area of the cathodic part is significantly greater than that of the anodic part, the corrosive attack on the contact area of the anodic part may be greatly intensified. Material selection for intermetallic contact parts, therefore, should establish the smaller part as the cathodic member of the couple, whenever practicable.

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

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

6.7 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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