MIL-R-83725B
03 October 1977
SUPERSEDING
MIL-R-83725A
12 February 1970

MILITARY SPECIFICATION

RELAYS, VACUUM, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for relays with vacuum dielectric (see 6.3) for use in high or low voltage circuits of electronic and electrical equipment (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Issues of documents.. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

NN-P-71	-	Pallets, Material Handling, Wood, Stringer Construction, 2 Way and 4 Way (Partial).
QQ-S-781	-	Strapping, Steel, and Seals.
PPP-B-566	-	Boxes, Folding, Paperboard.
PPP-B-585	-	Boxes, Wood, Wirebound.
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.
PPP-T-60	-	Tape, Packaging, Waterproof.
PPP-T-76	-	Tape, Pressure-Sensitive Adhesive Paper (For Carton Sealing).

MILITARY

MIL-I-10	-	Insulating Compound, Electrical, Ceramic, Class L.
MIL-P-116	-	Preservation-Packaging, Methods of.
MIL-W-583	-	Wire, Magnet, Electrical.
MIL-F-14256	-	Flux, Soldering, Liquid (Rosin Base).
MIL-C-45662	-	Calibration System Requirements.
MIL-R-83725/1	-	Relay, Vacuum, SPDT, 15 Amperes RMS, 12 Kilovolts (Peak).
MIL-R-83725/2	-	Relay, Vacuum, SPDT, 25 Amperes RMS, 25 Kilovolts (Peak).
MIL-R-83725/3	-	Relay, Vacuum, SPDT, DC, 8 Amperes.

STANDARD

FEDERAL

FED-STD-356	-	Commercial Packaging of Supplies and Equipment.

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	-	Marking for Shipment and Storage.
MIL-STD-143	-	Specifications and Standards, Order of Precedence for the Selection of.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering and Technical Support Division (AFLC/LOIE), Wright-Patterson AFB, OH 45433 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-STD-147 - Palletized Unit Loads for 40" x 48" Pallets.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454 - Standard General Requirements for Electronic Equipment.
MIL-STD-831 - Test Reports, Preparation of.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

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

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

National Bureau of Standards.

Handbook H28 - Screw-Thread Standards for Federal Service.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.)

3. REQUIREMENTS

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

3.2 Qualification. The 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 6.4).

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

3.3.2 Metals. All metal parts shall be of a corrosion- resistant type, or shall be plated or treated to resist corrosion.

3.3.2.1 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. Any joining of dissimilar metals external to the vacuum which may result in active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy), is not acceptable. However, metal plating or metal spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals shall be as defined in 6.5 through 6.5.4.

3.3.3 Ceramic. Ceramic insulating material shall conform to grade L322W or better as specified in MIL-I-10 (see 3.1). All external ceramic surfaces shall be glazed in accordance with the grade designation as specified in MIL-I-10.

3.3.4 Magnet wire. Magnet wire shall conform to MIL-W-583, except that when wire not covered by MIL-W-583 is required because of size or temperature range, other wire may be used.

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

3.4.1 Enclosure. The enclosure shall be of the type and within the dimensional limits specified on the applicable specification sheet (see 3.1).

3.4.2 Soldering. When soldering is employed, the use of flux shall be avoided whenever possible. If the use of flux is warranted, flux shall be in accordance with MIL-F-14256. Soldering shall be in accordance with requirement 5 of MIL-STD-454.

3.4.3 Weight. The weight shall be as specified (see 3.1).

3.4.4 Threaded parts. All threaded parts shall be in accordance with Handbook H28. Whenever practical, all threads shall be in conformity with the coarse-thread series. The fine-thread series shall be used only for applications that might show a 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 Coil. The coil shall be insulated electrically from the housing and the contacts.

3.4.5.1 Coil mounting. The coil shall be mounted in such a manner that it will not loosen or become displaced during any of the tests specified herein.

3.4.6 Contact arrangement. Relays shall have the contact arrangement specified (see 3.1). Terminals shall be as specified (see 3.1). Solder terminals shall be hot tinned dipped or solder coated. Gold plated terminals shall not be used.

3.5 Dielectric withstanding voltage. When tested as specified in 4.7.2, the relays shall withstand the applications of the specified voltage without damage or breakdown. Any arcover (air discharge), flashover (surface discharge), or breakdown (puncture) causing excessive leakage current shall constitute failure. Unless otherwise specified (see 3.1), leakage current shall be considered excessive if greater than 30 microamperes root mean square (rms) continuous or more than (2) current surges of 100 microamperes or higher.

3.6 Insulation resistance. When relays are measured as specified in 4.7.3, the insulation resistance shall be 1,000 megohms minimum, unless otherwise specified (see 3.1).

3.7 Electrical characteristics.

3.7.1 DC resistance (coil). When relays are tested as specified in 4.7.4.1, DC resistance (coil) shall be as specified (see 3.1).

3.7.2 Contact bounce. When relays are tested as specified in 4.7.4.2, bounce time (see 6.3.5) shall be as specified (see 3.1).

3.7.3 Coil current. When relays are tested as specified in 4.7.4.3, the coil current shall be as specified (see 3.1).

3.7.4 Pickup and dropout voltage (or current). Relays shall pickup and all switching circuits shall close or open, as applicable, in the energized position when the energizing voltage (or current) is increased to a value equal to the maximum value specified, and must drop out before the energizing voltage (or current) is reduced to a value equal to the minimum value specified (see 3.1). For qualification inspection,

unless otherwise specified (see 3.1), the pickup and dropout voltages (or currents) shall fall within the applicable limits when the relay is mounted in each of three mutually perpendicular planes (see 4.7.4.3 and 4.7.4.4).

3.7.5 Operate and release time. When specified (see 3.1), the relays shall be tested in accordance with 4.7.4.5. The operate and release time shall not include any contact bounce and shall be as specified (see 3.1).

3.7.6 Contact resistance. When relays are tested as specified in 4.7.4.6, the resistance of any pair of mated contacts shall not exceed the value specified (see 3.1).

3.7.7 Capacitance. When relays are tested as specified in 4.7.4.7, the capacitance shall not exceed the value specified (see 3.1).

3.8 High and low temperature operation. When relays are tested as specified in 4.8, the relays shall be free of mechanical defects and shall meet the requirements of dielectric withstanding voltage, insulation resistance, contact bounce, operate and release time and pickup and dropout voltage as specified in 3.5, 3.6, 3.7.2, 3.7.5, and 3.7.4 respectively.

3.9 Salt spray (corrosion). When relays are tested as specified in 4.9, there shall be no evidence of corrosion, no breaking, chipping, or flaking of the finish nor exposure of base metal due to corrosion which would adversely affect the application of performance characteristics of the relay.

3.10 Terminal strength. When relays are tested as specified in 4.10, the terminals shall not loosen nor shall there be any other damage.

3.11 Vibration, high frequency. When tested as specified in 4.11, vibration shall not impair operation and contact chatter shall not exceed 10 microseconds. Following the vibration test, the relays shall be free of any observable damage and meet the requirements of pickup and dropout voltage (or current) as specified in 3.7.4.

3.12 Moisture resistance. When tested as specified in 4.12, relays shall meet the requirements of dielectric withstanding voltage and insulation resistance as specified in 3.5 and 3.6, respectively.

3.13 Shock (specified pulse). When relays are tested as specified in 4.13, contact chatter shall not exceed the value specified (see 3.1) and there shall be no evidence of loosening of parts.

3.14 Seal. When relays are tested as specified in 4.14, they shall meet the requirements of 3.5.

3.15 Life (mechanical cycling). When tested as specified in 4.15, relays shall not exhibit any failure to operate 1/ or any failure to release 2/. The contact resistance shall not exceed twice the value specified (see 3.1) during any contact resistance check and the contact bounce shall not exceed twice the initial limits specified (see 3.1) when measured following the test. Other electrical characteristics shall be as specified (see 3.1) when measured following the test.

3.16 Shelf life (accelerated). When relays are tested as specified in 4.16, they shall meet the requirements of dielectric withstanding voltage as specified in 3.5.

1/ This includes the failure of any or all normally open contacts to close, and the failure of any or all normally closed contacts to open, within the normal cycling condition.

2/ This includes the failure of any or all normally open contacts to open, and the failure of any or all normally closed contacts to close, within the normal cycling condition.

3.17 Load life (carry only). When relays are tested as specified in 4.17, the temperature shall not exceed +125°C at any time with any load current (see 3.1) or contact combination.

3.18 Resistance to solvents. When relays are tested as specified in 4.18, the marking shall remain legible.

3.19 Marking. Relays shall be marked in accordance with MIL-STD-1285 with the following information.

a. Military part number.
b. Terminal identification (see 3.1).
c. Manufacturer's name, trademark, or code symbol.
d. Date code.

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, 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.

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-C-45662.

4.2 Classification of inspection. The examination and testing of relays shall be classified as follows:

a. Material 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 by verifying data that the materials listed below, used in fabricating the relays, are in accordance with the applicable referenced specifications prior to such fabrication:

Material	Requirement	Specification
Ceramic	3.3.3	MIL-I-10
Magnet wire	3.3.4	MIL-W-583
Flux	3.4.2	MIL-F-14256

4.4 Inspection conditions. Unless specified herein, all inspections shall be made in accordance with the test conditions specified in the general requirements of MIL-STD-202.

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the government (see 6.4) on sample units produced with equipment and procedures normally used in production.

4.5.1 Sample size. Ten (10) relays shall be subjected to qualification inspection.

4.5.2 Inspection routine. The samples shall be subjected to the tests specified in table I, in the order shown. Ten (10) sample units shall be subjected to the examination and tests of group I. The ten (10) sample units shall be divided equally into 5 groups of 2 units each.

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

4.5.4 Test reports and data.

4.5.4.1 Test reports. One reproducible test report, prepared in accordance with MIL-STD-831, shall be submitted.

4.5.4.2 Data. Test data from any source may be used to fulfill all or any part of qualification. Data shall not be older than 3 years. Results of test data may include but are not restricted to: the original equipment manufacturer, those testing for a prime contractor or subcontractor, the manufacturer's normal quality control tests, production control tests, production tests, environmental tests and so forth. However, all qualification inspection shall be completed as specified in 4.5.

4.5.5 Retention of qualication. To retain qualification, the manufacturer shall submit a summary of group A inspection and a certification of compliance at yearly intervals via the Government quality assurance representative. The summary of group A inspection shall indicate the number of inspection lots that passed and the number that failed (including the number and type of failures) together with corrective action taken to correct failures. The certification of compliance shall include verification that materials, processes, and quality control have not changed. Failure to submit the group A summary and certification of compliance shall result in loss of qualification.

4.6 Quality conformance inspection.

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

4.6.1.1 Inspection lot. An inspection lot, as far as practicable, shall consist of all relays of the same design and materials, produced under essentially the same conditions, and offered for inspection at one time or at a maximum of one week's production.

4.6.1.2 Group A inspection. Group A inspection shall consist of the examination and tests specified in table II in the order shown.

4.6.1.2.1 Sampling plan. Each relay offered for inspection shall be subjected to the tests in subgroup 1. Statistical sampling and inspection for subgroup 2 shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table II. Major and minor defects shall be defined in MIL-STD-105.

4.6.1.2.2 Rejected lots. Inspection lots rejected in subgroup 1 shall not be offered for reinspection. If an inspection lot is rejected in subgroup 2, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.6.1.2.3 Disposition of sample units. Sample units which have passed group A inspection shall be delivered on the contract.

4.6.2 Packaging inspection. Except when commercial packaging is specified, the sampling and inspection of the preservation-packaging 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

TABLE I. Qualification inspection.

Examination or test	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of defectives permitted
Group I				
Visual and mechanical examination	3.1, 3.3, 3.4	4.7.1	All sample units	0
Dielectric withstanding voltage	3.5	4.7.2		
Seal	3.14	4.14		
Insulation resistance	3.6	4.7.3		
Electrical characteristics	3.7	4.7.4		
Group II				
High and low temperature operation	3.8	4.8	2	
Salt spray (corrosion)	3.9	4.9		
Terminal strength	3.10	4.10		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.19, 3.20	4.7.1		
Group III				
Vibration, high frequency	3.11	4.11	2	
Moisture resistance	3.12	4.12		
Electrical characteristics	3.7	4.7.4		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.19, 3.20	4.7.1		
Group IV				1
Shock (specified pulse)	3.13	4.13	2	
Terminal strength	3.10	4.10		
Shelf life (accelerated)	3.16	4.16		
Electrical characteristics	3.7	4.7.4		
Resistance to solvents 1/	3.18	4.18		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.19, 3.20	4.7.1		
Group V				
Life (mechanical cycling)	3.15	4.15	2	
Group VI				
Load life (carry)	3.17	4.17	2	

1/ Any four of the ten sample units may be used for the resistance to solvents test.

applicable container specification and the marking requirements of MIL-STD-129. The inspection of commercial packaging shall be as specified in the contract (see 6.2).

TABLE II. Group A inspection.

Examination or test	Requirement paragraph	Test method paragraph	AQL percent defective	
			Major	Minor
Subgroup 1				
Dielectric withstanding voltage	3.5	4.7.2	100% inspection	---
Electrical characteristics	3.7	4.7.4		
Subgroup 2				
Visual and mechanical examination 1/	3.1.3.3 3.4, 3.19, 3.20	4.7.1	1.0%	4.0%
Insulation resistance	3.6	4.7.3		

1/ 2 sample units only for physical dimensions.

4.7 Methods of inspection.

4.7.1 Visual and mechanical inspection.

4.7.1.1 External. Relays shall be examined to verify that the materials, external design and construction, physical dimensions, marking, and workmanship are in accordance with applicable requirements.

4.7.2 Dielectric withstanding voltage (see 3.5). Relays shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

a. Test potential - As specified (see 3.1).
b. Points of application:
   (1) Between all mated contacts in the open position.
   (2) Between high voltage terminals and housing.
   (3) Between coil and housing.

4.7.3 Insulation resistance (see 3.6). Relays shall be tested in accordance with method 302 of MIL-STD-202. The following details and exception shall apply:

a. Test condition letter - B.
b. Points of application, see 4.7.2(b).

4.7.4 Electrical characteristics (see 3.7).

4.7.4.1 DC resistance (coil) (see 3.7.1). The DC resistance (coil) shall be measured in accordance with method 303 of MIL-STD-202.

4.7.4.2 Contact bounce (see 3.7.2). Contact bounce shall be observed using an oscilloscope. Since contact welding influences contact bounce, contact current shall not exceed 0.5 amperes from a source not to exceed 10 Vdc. Bounce measurements shall be made on all contacts.

4.7.4.3 Pickup voltage (or current) (see 3.7.4). Prior to measuring the pickup voltage (or current), the relay shall be energized with rated voltage (or current)

for approximately 30 minutes for qualification inspection. The energizing potential shall be reduced to zero and gradually increased until the contacts operate. A suitable indicating device shall be used to determine if the contacts operate properly.

4.7.4.4 Dropout voltage (or current) (see 3.7.4). Rated operating voltage (or current) shall be applied to the coil terminals. This voltage (or current) shall be gradually reduced until the contacts return to the unenergized position. A suitable indicating device shall be used to determine if the contacts operate properly.

4.7.4.5 Operate and release time (see 3.7.5). The operate and release time shall be measured using an oscilloscope or other suitable means. The source shall be the rated coil voltage. For purposes of test, the operate and release time shall be exclusive of contact bounce. All contact pairs shall be tested.

4.7.4.6 Contact resistance (see 3.7.6). Relays shall be tested in accordance with method 307 of MIL-STD-202. The following details and exception shall apply:

a. Method of connection - Connection jigs or other suitable means.
b. Test current - 1 ampere DC.
c. Maximum open-circuit test voltage - 25 percent of the rated contact voltage or 6 volts, whichever is lower.
d. Points of application.
   (1) Between all normally closed mated contacts (coil deenergized).
   (2) Between all normally open mated contacts, with the coil energized with rated voltage (or current). No load shall be switched by the contacts.
e. Number of activations prior to measurement - None.
f. Number of test activations - Three.
g. Number of measurements per activation - One for each contact position.

4.7.4.7 Capacitance (when specified, see 3.7.7). Relays shall be tested in accordance with method 305 of MIL-STD-202. The following detail and exception shall apply:

a. Test frequency - 1 kilohertz, unless otherwise specified (see 3.1).
b. Points of application - As specified (see 3.1).

4.8 High and low temperature operation (see 3.8). High and low temperature tests shall be performed at 125°C and -65°C, respectively, after two hours exposure at each temperature. The pickup voltage and dropout voltage (or current) shall be measured as specified in 4.7.4.3 and 4.7.4.4 and shall meet the values specified (see 3.1). Following the high and low temperature test, the relay shall be tested at 25°C ±5°C for dielectric withstanding voltage, insulation resistance, pickup and dropout voltage (or current), and operate and release time as specified in 4.7.2, 4.7.3, 4.7.4.3, 4.7.4.4 and 4.7.4.5, respectively.

4.9 Salt spray (corrosion) (see 3.9). Relays shall be tested in accordance with method 101 of MIL-STD-202. The following detail and exception shall apply:

a. Test condition - B.
b. Examination after test - Relays shall be examined for evidence of corrosion, peeling, chipping, blistering of the finish, and exposure of base metal due to corrosion.

4.10 Terminal strength (see 3.10). Terminals shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition - A.
b. Applied force - 5 pounds.
c. Direction of force - Also at right angles to the direction of the longitudinal axis of the terminals.

d. Point of application - Within 1/8-inch of the tip end of the terminal.

The relays shall be examined for evidence of breakage of the terminals or damage to the insulating base.

4.11 Vibration (see 3.11). Relays shall be tested in accordance with method 204 of MIL-STD-202. Calibration of the test table shall be accomplished by using a substitute mass having weight and dimensions equivalent to the relay to be tested. The following details and exception shall apply:

a. Mounting: Relays shall be rigidly mounted by normal mounting means in a suitable test jig. The vibration shall be monitored on top of the test jig in the proximity of the relay support points.
b. Frequency and amplitude - Test condition A, unless otherwise specified (see 3.1).
c. Electrical load conditions - The relay shall be deenergized and energized (one hour each) with rated coil voltage (or current) in each of the three mutually perpendicular directions.
d. Measurements during vibration - Chatter of the relay contacts shall be monitored in accordance with method 310 of MIL-STD-202.
e. Measurements after vibration - Not applicable.

4.12 Moisture resistance (see 3.12). Relays shall be tested in accordance with method 106 of MIL-STD-202. The following details and exception shall apply:

a. Mounting - On a corrosion resistant panel by normal mounting means.
b. Initial measurement - Insulation resistance (see 4.7.3).
c. Final measurements - Upon completion of step 6 of the final cycle, insulation resistance shall be measured as specified in 4.7.3. After a 24-hour drying period, relays shall be tested as specified in 4.7.2 and 4.7.3.

4.13 Shock (specified pulse) (see 3.13). Relays shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - The relay shall be mounted by normal mounting means such as flanges or threaded base. Auxiliary mounting means such as braces, pads, or potting shall not be used.
b. Test condition letter - J, unless otherwise specified (see 3.1).
c. Basic test - Two shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen for both the energized and deenergized condition (24 shocks).
d. Measurements during shock - Not applicable.
e. Measurements after shock - Upon completion of the final shock, measurements shall be made of dielectric withstanding voltage as specified in 4.7.2, pick up voltage as specified 4.7.4.3 and contact resistance as specified in 4.7.4.6.

4.14 Seal (see 3.14). Relays shall be held seven days after completion of the final vacuum seal and shall then be subjected to the test specified in 4.7.2.

4.15 Life (mechanical cycling (see 3.15). Relays shall be cycled for 100,000 cycles at the specified rate (see 3.1). "ON" and "OFF" periods shall be approximately equal. The equipment shall test for missed operations during at least 10 percent of the expected closed and open times of the contacts for each cycle respectively. The equipment shall automatically cut off when failure occurs or shall record any failures. Insulation resistance, dielectric withstanding voltage, and electrical characteristics (except DC coil resistance) shall then be measured as specified in 4.7.3, 4.7.2 and 4.7.4 respectively.

4.16 Shelf life (accelerated) (see 3.16). The relay shall be subjected to maximum rated ambient temperature (see 3.1) for a minimum of one hour. The relay shall then

be cooled to room temperature and shall then be subjected to dielectric withstanding voltage (see 4.7.2).

4.17 Load life (carry only) (see 3.17). The relay shall be mounted by normal mounting means with leads connected to the coil and contact terminals. The mounting shall be maintained at a temperature no lower than 20°C. The leads to the contact terminals shall not act as a substantial heat sink or source during the load life. The temperature shall be measured at the juncture of the contact leads and the insulating material using temperature sensitive lacquer or equivalent. Each mated contact pair shall be tested with the specified load currents (see 3.1) for 30 minutes minimum.

4.18 Resistance to solvents (see 3.18). Relays shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:

a. Portion to be brushed - All marking.
b. 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 used.
c. Examination - Specimens shall be examined for legibility of marking.

5. PACKAGING

5.1 Preservation-packaging. Preservation-packaging shall be level A or C, or 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 packaging. Each relay shall be individually unit packaged and cushioned in accordance with method III of MIL-P-116 insuring compliance with the applicable requirements of that specification. The unit container shall conform to PPP-B-566 or PPP-B-676.

5.1.1.5 Intermediate packaging. Relays, not exceeding ten amperes and packaged as specified in 5.1.1.4, shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676. Intermediate containers shall be uniform in size, shape, and quantities, shall be of minimum tare and cube and shall contain multiples of five unit packages, not to exceed 100 unit packages. No intermediate packaging is required for relays over ten amperes or when the total quantity shipped to a single destination is less than 100 unit packages.

5.1.2 Level C. Relays shall be clean, dry, and packaged in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment from supply source to the first receiving activity. This level may conform to the contractor's commercial practice when such meets the requirements of this level.

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

5.2.1 Level A. The packaged relays shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirements. In lieu of the closure and waterproofing requirement in the appendix of PPP-B-636, closure and waterproofing shall be accomplished by sealing all seams, corners, and manufacturer's joint with tape, two inches minimum width, conforming to PPP-T-60, class 1 or PPP-T-76. Banding (reinforcement requirements) shall be applied in accordance with the appendix to PPP-B-636 using nonmetallic or tape banding only.

5.2.2 Level B. The packaged relays 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.

5.2.3 Level C. The packaged relays shall be packed in shipping containers in a manner that will afford adequate protection against damage during direct shipment from the supply source to the first receiving activity. These packs shall conform to the applicable carrier rules and regulations and may be the contractor's commercial practice when such meets the requirements of this level.

5.2.4 Unitized loads. Unitized loads, commensurate with the level of packing specified in the contract, 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 MIL-STD-147, load type I, with a fiberboard cap (storage aid 4) positioned over the 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 the fiberboard caps shall be class domestic.

5.2.4.3 Level C. Relays, packed as specified in 5.2.3, shall be unitized with pallets and caps of the type, size, and kind commonly used for this purpose. These unitized loads shall conform to the applicable carrier rules and regulations and may be the contractor's commercial practice when such meets the requirements of this level.

5.3 Marking. In addition to any special marking required by the contract (see 6.2), each unit package, intermediate and exterior container and unitized load shall be marked in accordance with 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 4.6.2.

5.4.3 Army requirements.

5.4.3.1 Level A (maximum military protection) unit and intermediate packaging. Unit and intermediate containers shall either be overwrapped with waterproof barrier materials or conform to PPP-B-566 or PPP-B-676, variety 2 (see 5.1.1.4 and 5.1.1.5).

5.4.3.2 Level A (maximum military protection) and level B (minimum military protection) packing. For level A packing the fiberboard containers shall not be banded but shall be placed in a close fitting box conforming to PPP-B-601, overseas type; PPP-B-621, class 2 style 4 or PPP-B-585, class 3, style 2 or 3. Closure and strapping shall be in accordance with applicable container specification except that metal strapping shall conform to QQ-S-781, type I, finish A. 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. If not described in the container specification, the skids shall be applied in a manner which will adequately support the item and facilitate the use of material handling equipment. For level B packing, fiberboard boxes shall be weather resistant as specified in level A and the containers shall be banded (see 5.2.1 and 5.2.2).

5.4.3.3 Level A and B unitization. For level A and B unitization, softwood pallets conforming to NN-P-71, type IV, size 2 shall be used. Weather resistant fiberboard caps shall also be used for level B unitization. The loads for both levels shall be bonded to the pallets by strapping conforming to QQ-S-781, type I, finish A or shrink film (see 5.2.4.1 and 5.2.4.2).

5.4.3.4 Commercial packaging. Commercial packaging (including unit packaging, packing and marking) shall be in accordance with Fed Std 356.

6. NOTES

6.1 Intended use. These relays are intended for use to provide antenna switching, switching between couplers, tap changing on RF coils, switching between transmitter and receiver, pulse forming networks, and heavy duty switching in power supplies.

6.2 Ordering data.

a. Title, number, and date of this specification.
b. Specification sheet part number.
c. Inspection of commercial packaging (see 4.6.2).
d. Levels of preservation-packaging and packing required (see 5.1 and 5.2).
e. Special marking, if required (see 5.3).

6.3 Definitions.

6.3.1 Relay, vacuum. A relay especially designed to encase the contactor mechanism in a low atmospheric pressure environment.

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

6.3.3 Release time. The interval between the trailing edge of a step function input signal and closing of all normally closed contacts. Bounce time is not included.

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

6.3.5 Contact bounce time. The time interval from initial actuation of a contact to the end of bounce.

6.3.6 Chatter. Uncontrolled making and breaking of the contacts under conditions in which the contact should remain stable.

6.4 Qualification.

6.4.1 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 contractor is called to this requirement, 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 for the products covered by this specification. The activity responsible for the Qualified Products List is the Department of the Air Force, Air Force Logistics Command (AFLC/LOIE), Wright-Patterson Air Force Base, Ohio 45433.

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 III. Table III shows metals and alloys (or plates) by groups which have common electromotive forces (EMF) within 0.05 volt when

TABLE III. Compatible couples (see 6.5) 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.

coupled with a saturated calomel electrode in sea-water at room ambient temperatures. All members of a group are considered as completely compatible, one with the other. Compatible couples between groups have been specified in table III based on a potential difference of 0.25 volt maximum. To simplify any arithmetic involved, table III shows, in addition to EMF against a calomel electrode, a derived "anodic index" with Group I (gold, etc.) as 0 and Group 18 (magnesium, etc.) as 175. Subtraction of a lower group anodic index gives the EMF difference in hundredths of a volt.

6.5.1 Groups. Table III 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 unsusceptible 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 unsusceptible when coupled together.

6.5.2 Compatibility graphs. Permissible couple series are shown in table III by the graphs at the right. Members of groups connected by lines will form permissible couples. A "●" indicates the most cathode member of each series, a "O" 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 III. 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 unsusceptible to corrosion in the presence of an electrolytic medium. If the surface area of the cathodic part is significantly greater than that of the anodic part, the corrosive attack on the contact area of the anodic part may be greatly intensified. Material selection for intermetallic contact parts, therefore, should establish the smaller part as the cathodic member of the couple, whenever practicable.

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

6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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

Review activities:
Air Force - 99
Navy - OS
DLA - ES

User activity:
Navy - AS

Preparing activity:
Air Force - 85

(Project 5945-0439)