

INCH-POUND

MIL-PRF-28776C  
AMENDMENT 2  
30 June 1998  
SUPERSEDING  
AMENDMENT 1  
13 June 1995

PERFORMANCE SPECIFICATION

RELAYS, HYBRID, ESTABLISHED RELIABILITY,  
GENERAL SPECIFICATION FOR

This amendment forms a part of MIL-PRF-28776C, dated 18 July 1994, and is approved for use by all Departments and Agencies of the Department of Defense.

PAGE 2

2.1.1, SPECIFICATIONS, delete and substitute:

"SPECIFICATIONS

FEDERAL

QQ-N-290 - Nickel Plating (Electrodeposited).

DEPARTMENT OF DEFENSE

MIL-G-45204 - Gold Plating, Electrodeposited."

PAGES 3 AND 4

Delete 3.4 through 3.5 inclusive and substitute:

"3.4 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the relays to meet the performance requirements of this specification. Materials used externally shall be fungus inert, self-extinguishing, and shall not support combustion, nor give off noxious gases in harmful quantities. Materials used internally shall not give off gases in quantities sufficient to cause explosion of sealed enclosures, cause contamination of the contacts or other parts of the relay that will adversely affect life or reliability, or form current-carrying tracks when subjected to any of the tests specified herein. Cotton-filled or wood-flour-filled materials shall not be used. Ceramic used for external surfaces shall be glazed. The use of silicone (see 6.8) or silicone compounds for any purpose is prohibited. The selection of materials shall be such as to provide maximum shelf life. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

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

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"3.4.1.1 Plated finishes.

- a. Use of tin plating is prohibited internally and externally (see 6.6.4.1). Use of tin-lead finishes are acceptable provided that the minimum lead content is 3 percent.
- b. Use of zinc plating is prohibited internally and externally.
- c. Use of cadmium plating is prohibited internally and externally.

"3.4.1.2 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tends toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy), is not acceptable. However, metal spraying or metal plating of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. Dissimilar metals should be as defined in 6.6 through 6.6.4, inclusive. In hermetic seals, the 0.25 volt difference between the header material and the housing material is not applicable.

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

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

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3.5.7.4.2, delete and substitute:

"3.5.7.4.2 Solder dip/retinning options. The manufacturer may solder dip/retin as follows:

- a. After the 100 percent A1 screening test but before the A2 electrical tests.
- b. As a corrective action, if the lot fails the A3 solderability test. Following the solder dip/retinning process of paragraph 4.7.2.2.2.2, as a minimum, insulation resistance (all terminals to case) shall be tested, and the A4 tests shall be performed, as applicable.
- c. For relays that have been subjected to and passed group A inspections. Following the solder dip/retinning process, as a minimum, the insulation resistance (all terminals to case) shall be tested, and the solder coating coverage and workmanship shall be visually examined. Minor scratching of the terminals due to insertion into test sockets shall not be cause for rejection."

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3.12.2, delete and substitute:

"3.12.2 Specified pickup, hold, and dropout values (voltages), control signal on (see 4.8.7.2). The specified pickup, hold, and dropout values (voltages) shall be as specified (see 3.1)."

3.12.8, delete and substitute:

"3.12.8 Coil transient suppression (applicable to dc operated relays with coil transient suppression diodes) (see 4.8.7.8). Coils of dc operated relays shall not generate a back EMF greater than that specified (see 3.1)."

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3.18, first line, delete "pickup" and substitute "specified pickup".

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3.25, delete and substitute:

"3.25 Mechanical life (see 4.8.20). After cycling, the insulation resistance and dielectric withstanding voltage shall not exceed the limits as specified (see 3.1) and the turn-on and turn-off time shall not exceed 120 percent of the limits specified (see 3.1). There shall be no mechanical or electrical failure during or following cycling. Failure of the fuse connected between case and load system ground or neutral shall constitute a failure. For relays with semiconductor devices, failure of a diode, transistor, or FET coil driver shall constitute a failure. The manufacturer's test system shall have the means to ensure that the required number of test cycles have been performed."

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4.1.2.1, second sentence, delete and substitute: "The following list is the minimum required raw material/component parts and subassemblies for which traceability is applicable."

4.1.4, delete and substitute:

"4.1.4 ESDS protection program. This requirement is applicable to all manufacturers who handle ESDS component parts and/or materials in the relay manufacturing and/or testing process. The manufacturer shall establish and maintain an ESD control program in accordance with MIL-STD-1686 and MIL-HDBK-263. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification. As a minimum, this system must address the identification of ESDS sub-components and end items, facilities, training, design protection, handling procedures, marking, cleaning, preservation, packaging, and quality assurance. A model ESD control program is available from the qualifying activity and may be used as a guideline document. Further guidance for ESD control is available from the EOS/ESD Association and the Electronics Industry Association (EIA)."

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TABLE II, Q5, columns 3 and 4: Delete and substitute "See TABLE III".

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TABLE III, delete and substitute:

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

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

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

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\* 4.7.2.2.1, first sentence, add "(see footnotes to table V)" after "specification".

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\* TABLE V, delete and substitute:

"TABLE V. Group A inspection. 1/

Inspection	Requirement paragraph	Test method paragraph	Inspection requirements
<u>A1</u>			
Vibration (sinusoidal) <u>2/</u>	3.15	4.8.10.1	100 percent
Screening, internal moisture <u>3/</u>	3.7	4.8.2.1	see <u>3/</u>
Screening, run-on	3.7	4.8.2.2	100 percent
<u>A2</u>			
Dielectric withstanding voltage <u>4/</u>	3.11	4.8.6	100 percent
Insulation resistance <u>4/</u>	3.10	4.8.5	
Electrical characteristics <u>4/</u>	3.12	4.8.7	
<u>A3</u>			
Solderability	3.8	4.8.3	2 samples
<u>A4</u>			
Visual and mechanical inspection (external) <u>5/ 6/</u>	3.1, 3.28, 3.29, 3.30	4.8.1	100 percent
Seal	3.9	4.8.4	

1/ Tests shall be performed in the order shown.2/ For FR level L relays, the vibration (sinusoidal) test shall be performed on 13 relays per lot with no failures allowed. In the event of a failure, the lot shall be 100 percent inspected. For lots with fewer than 13 relays, the lot shall be 100 percent inspected.3/ The internal moisture test shall be performed on 13 relays per lot with no failures allowed. In the event of a failure, the lot shall be 100 percent inspected. For lots with fewer than 13 relays, the lot shall be 100 percent inspected."4/ Coil current may be done prior to dielectric withstanding voltage and insulation resistance. Testing sequence is optional for insulation resistance and dielectric withstanding voltage prior to the electrical characteristics. Turn-on voltage (or current), see 3.1, and turn-off voltage may be done after coil transient suppression voltage.5/ Minor defects, such as marking, may be reworked.6/ It is intended that a two piece sample of each relay style be inspected in accordance with 6.3.2, except as limited by the housing style, external attachments, etc.."

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4.8.5, second sentence, delete and substitute: "The hybrid device should be protected during testing in the deenergized position."

4.8.6, second sentence, delete and substitute: "Testing in accordance with 4.8.6.2 is not applicable to groups A, B, C1, or C5."

4.8.6, third sentence, delete and substitute the following: "The hybrid device should be protected during testing in the deenergized position."

4.8.6.1b, delete and substitute:

"b. Maximum leakage current: 100  $\mu$ A. For group A, leakage current measuring device shall be capable of measuring the leakage current to an accuracy of at least 10 percent."

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4.8.7.2, delete and substitute:

"4.8.7.2 Specified pickup, hold, and dropout voltages (turn-on voltage or current applied) (see 3.12.2). Specified pickup, hold, and dropout voltages shall be measured as specified in 4.8.7.2.1, 4.8.7.2.2, or 4.8.7.2.3. For qualification inspection, the relay shall be mounted in each of three mutually perpendicular planes, unless otherwise specified (see 3.1). For quality conformance inspection, the relay mounting position is optional. A suitable indicating device shall be used to monitor contact position. During the test, all contacts shall not change state (break or remake) when the coil is energized above the pull-in voltage, when the coil voltage is lowered to any value above the specified hold (maximum) dropout voltage, or when the coil voltage is reduced from the (minimum) dropout voltage to zero. It is permissible to perform specified pickup, hold, and dropout voltages using step function voltage changes as specified in 4.8.7.2.1 or 4.8.7.2.2, 4.8.7.2.3, and 4.8.7.2.4. Due to the fact that slow ramping will overheat relay coils and vary specified pickup, hold, and dropout voltages, the step function method shall be the governing method in cases of dispute."

4.8.7.2.1, delete and substitute:

"4.8.7.2.1 Specified pickup voltage (turn-on voltage or current applied). The voltage shall be increased from zero until the relay operates, and the specified pickup voltage shall be measured. It is permissible to perform specified pickup, hold, and dropout voltage using a step function voltage changes as follows and as illustrated on figure 3.

- a. Step up to the specified pickup value (voltage), contacts should have transferred and all normally-open contacts should be making.
- b. Increase to rated coil voltage.
- c. Step down to specified hold voltage. Normally-open contacts must still be making.
- d. Step down to specified dropout voltage, all contacts should have transferred and all normally-closed contacts should be making.
- e. Step down to zero voltage."

4.8.7.2.2, delete and substitute:

"4.8.7.2.2 Specified hold voltage (turn-on voltage applied). Rated voltage shall be applied to the coil. The voltage shall then be reduced to the specified hold voltage (see 3.1). All contacts shall not change state. It is permissible to perform this test using the step function voltage program described in 4.8.7.2.1 and figure 3."

4.8.7.2.3, delete and substitute:

"4.8.7.2.3 Specified dropout voltage (turn-on voltage applied). Rated voltage shall be applied to the coil. The voltage shall then be gradually reduced until all contacts return to the deenergized position and the specified dropout voltage shall be measured. It is permissible to perform this test using the step function voltage program described in 4.8.7.2.1 and figure 3."

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4.8.8c, first sentence: Delete "insulation resistance," and "4.8.5".

4.8.8d, delete and substitute:

"d. Examination after test: Relays shall be visually examined for cracking, peeling, and flaking of the finish, and the insulation resistance and dielectric withstanding voltage shall then be measured as specified in 4.8.5 and 4.8.6.1."

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4.8.10.1d, delete and substitute:

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

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4.8.14.1f, delete and substitute:

"e. Following the test, the coil current or resistance, as applicable, shall be measured in accordance with 3.12.3 and shall be as specified (see 3.1)."

4.8.17, second to last sentence: Delete "test current of 100 mA" and substitute "test current or 100 mA".

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4.8.22, third sentence, delete and substitute: "For a period of 60 seconds minimum at 10 ms +1 ms intervals, repetitively apply on the input, a voltage transient pulse with an amplitude as specified in 4.8.22a and 4.8.22b and a pulse duration of 100  $\mu$ s +10  $\mu$ s."

4.8.22a, first sentence: Delete "Minimum" and substitute "Specified".

4.8.22b, first sentence: Delete "Maximum" and substitute "Specified" in two places.

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FIGURE 11, configuration A: Delete "MINMUM" and substitute "SPECIFIED".

FIGURE 11, configuration B: Delete "MAXIMUM" and substitute "SPECIFIED".

FIGURE 11, configuration B: Delete "2.0 VOLTS" and substitute "-2.0 VOLTS".

NOTE: The margins of this amendment are marked with asterisks to indicate where changes from the previous amendment 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 amendment.

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Preparing activity:  
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Review activities:  
Army - AR, CR4, MI  
Navy - AS, MC, OS  
Air Force - 17, 19