

A COMPARISON OF
GOVERNMENT RELAY SPECIFICATION REQUIREMENTS

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Revised

INTRODUCTION

Experience has shown that a great many relay failures result from lack of knowledge as to just what a particular relay has or has not been tested to and what is and what is not covered by a particular specification. Absorbing all that is covered by each of several widely used government specifications is almost impossible, especially for the casual relay user. Maximum relay reliability will result from selecting a relay to meet the application requirements rather than from selecting a relay specification. Even though a specification contains test provisions such as minimum current (intermediate switching area), it does not mean that all QPL relays have been tested to or can even meet these requirements.

Therefore, data in outline form of most widely used specification requirements are presented to provide maximum information with minimum effort. Specific paragraph numbers are listed for direct referral. MIL-R-5757 and MIL-R-6106 tend to be general purpose relay specifications, whereas the others are more specialized, as indicated by their scopes and intended uses (see Requirement 2 of chart). Additional relay data are included to assist all relay users.

- *1 MIL-R-5757D AMEND 3 (1 APRIL 1964), Relays (Electrical, excluding Thermal, for Electronic and Communication-Type Equipment).
- 2 MIL-R-6106E (ASG) (30 MAR 1964), Relays, Electric, Aerospace.
- 3 MIL-R-22527 (WEP) (15 OCT 1963), Relay, Armature. (See details, Page 21)
- 4 MIL-R-39016 (30 MARCH 1964), Relays, Electromagnetic, Established Reliability.
- **5 NASA-MSFC-SPEC-339 (22 JULY 1963), Relays, dc, Hermetically Sealed for Space Vehicles and Ground Support Equipment. (Supplement 1A Feb 20, 1964)

NASA	ABMA-PD-R-187 (1958)	
	10MO1569 (1962)	Reference, Only
	50MO2403 (1963)	

*Most relays on Qualified Parts List (QPL) for MIL-R-5757 are for 28 volt dc RESISTIVE contact ratings ONLY!

**Relays approved to MSFC-SPEC-339 are for 28 volt dc RESISTIVE contact ratings ONLY!

NOTE: Latest amendment repeats provisions of previous amendments unless altered. Thus grounding requirement of Amend 1 (1963) to MIL-R-5757 is included in Amends 2 and 3. Early amendment is sometimes included in this list to establish date of requirement. (See additional Notes, Pages 22-28)

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RELAY DEFINITIONS AND COMMENTS

There are certain areas in the relay field that are not covered by ASA C83.16 (1959) "Definitions and Terminology" and which urgently require at least generalized definitions so as to avoid the present widespread misunderstanding that exists. It is suggested that definitions somewhat along the following lines be adopted by the military for use in Section 6 of such relay specifications as:

MIL-R-5757
MIL-R-6106
MIL-R-22527
MIL-R-39016
etc.

1. LOAD TYPES

- 1.1 Dry Circuit - In telephone practice, many contacts in series are closed before the final contact establishes current flow. Those closing without initial flow are "dry circuit". Since the original were voice currents, industry has more or less agreed that dry circuits are in the microampere-millivolt area, although the exact values have not been established. Hence, dry circuit is contact by mechanical forces alone.

- 1.2 Low Level - "Low level" is used somewhat loosely to include "minimum current" by those who do not know, or do not acknowledge, the all important distinction and resulting failures. Low level is similar to dry circuit except in current flows. Some "miss" tests permit 500 to 800 ohms per individual contact closure which can be tolerated in high impedance circuits, but not where one relay contact energizes another relay. MIL-R-39016 requires, unless otherwise specified, a low level test at 50 millivolts dc or peak ac across open contacts with a closed contact current of 10 milliamperes or less. The contact resistance shall not exceed 50 ohms.
- 1.3 Minimum Current - Both MIL-R-5757 and MIL-R-6106 state "performance may be impaired when contact current or voltage is substantially less than the rated value." This refers to minimum current area between full load and dry circuit. "Minimum current," therefore, is the minimum value of current for contacts to perform reliably on successive operations in low impedance circuits. 100 ma resistive and 300 ma inductive are critical values. A typical failure is for one relay to close its contacts and have such a high contact resistance that a second relay will not pick up. Passage of a low level "miss" test and full load is no indication as to minimum current performance. Both MIL-R-5757 and MIL-R-6106 have test provisions for minimum current, but so far MIL-R-6106 detail sheets are the only ones that specify the requirement and for which there are qualified relays. Because meeting this necessary contact performance is difficult, it is not given the publicity it deserves.
- 1.4 Full Load - "Full load" is rated contact load for a particular type of load. Lamp and motor ratings will be less than resistive load ratings and must be specified so that relays are not erroneously applied at resistive values. Inductive ratings are often given for fewer operations than resistive ratings and user should be aware of this fact and its implication. For ac ratings frequency must be given, and for dc the largest L/R ratio.
- 1.5 Rupture - "Rupture" is the ability of contacts to break apart or "rupture" the electrical flow without welding under excessive currents. As such, it can well become a safety-of-flight requirement for certain aircraft or other manned vehicles.
2. RELAY TYPES - The following statements are pertinent to relay types and show the need for adequate definitions. Full terminology should be used, e. g., "magnetic latching" not just "latch."
 - a. Not all latching relays are magnetic. (They may be mechanical, or electrical latching.)
 - b. Not all magnetic latch relays are polarized. (Some may be built with rectifier circuits for ac actuation.)
 - c. Not all polarized (polar) relays are magnetic latch. (They may be single biased (side stable), or no bias (center stable).)
 - d. Not all polarized magnetic latch relays have two coils. (Some may have but a single coil and some may have multi-coils).
- 2.1 Latch - (See Lock-Up relay definition and comment).
- 2.1.1 Latch - Latch or latching relays may be electric, mechanical, or magnetic latching. The modifying adjective should be included when discussing relays to avoid confusion. (See Lock-Up).

- *2.1.2 "Latching Relay - A relay having contacts that lock in either the energized and de-energized positions, or both, until reset either manually or electrically."
- 2.1.3 Latch, Electric - An electric latching relay is one that sticks, seals, or holds itself up by means of more than one of its normally open contacts. Reset occurs upon interruption of this circuit.
- 2.1.4 Latch, Mechanical - A mechanical latching relay can have different forms. It could be a one or two coil, two position latch relay. It could also be a ratchet or stepping relay (see 2.1.2). If manually latched, single coil repositions; if two coil type each coil may position oppositely.
- 2.1.5 Latch, Magnetic - A commonly applied term to a relay that holds in one of two positions after receiving an input pulse of correct polarity and of sufficient duration. It may have one, two or more coils. Repositioning is accomplished by reversing flux; thus current is reversed in single coil type, but separate coils may be used for each position in multicoil type.
- *2.1.6 "Interlock Relay - A relay with two or more armatures having a mechanical linkage, or an electrical interconnection, or both, whereby the position of one armature permits, prevents, or causes motion of another armature." (A form of latch or lock-up relay).
- *2.1.7 "Lock-Up Relay - 1) A relay that locks in the energized position by means of permanent magnetic bias (requiring a reverse pulse for releasing) or by means of a set of auxiliary contacts that keep its coil energized until the circuit is interrupted." Differs from a latching relay in that locking is accomplished magnetically or electrically rather than mechanically. 2) Sometimes used for "latching relay".
 - (1) According to above, "magnetic latch" although widely used is erroneous.
 - (2) Reverse pulse above can be from either the same or a second coil.
- *2.1.8 "Memory Relay - 1) A relay having two or more coils, each of which may operate independent sets of contacts, and another set of contacts that remain in a position determined by the coil last energized." 2) Sometimes erroneously used for "polarized relay." (See "Polarized Relay" and comment).
- *2.1.9 "Polarized Relay - A relay the operation of which is dependent upon the polarity of the energizing current." (There are many types of "polar" or polarized relays that are variously described as, side stable, center stable magnetically biased, bi-stable, double biased, no bias, etc. There is no implied "memory" as such in the term "polarized relay" by itself).
- *2.2.0 "Ratchet Relay - A stepping relay actuated by an armature-driven ratchet."

*From 1961 NARM "Definitions of Relay Terms" - based on ASA C83.16 - Relay Definitions and Terminology." (1959).

STANDARDS, RELAY REFERENCE LIST

Rev 5/7/64

Military Standards

- MIL-STD-12 - Abbreviations for use on Drawings. (e. g. GRD = ground)
- MIL-STD-15-1 - Electrical and Electronic Symbols. (e. g. $\text{+}\text{C}$ capacitor)
- MIL-STD-16 - Electrical and Electronic Reference Designations (e. g. k = relay; CR = diodes; etc.)
- MIL-STD-27 - Designations for Electric Switch gear and Control Devices
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 - Marking for shipment and storage
- MIL-STD-130 - Identification Marking of U. S. Military Property
- MIL-STD-143 - Specifications and Standards, Order of Precedence for the Selection of
- MIL-STD-195 - Marking of Connections for Electric Assemblies
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts
- MIL-STD-242 - (Navy) Part II Electronic Equipment Parts - Selected Standards for Electromechanical Parts
- MIL-STD-255 - Electric Voltages, Alternating and Direct Current
- MIL-STD-456 - Electronic Parts, Date and Source Coding for
- MIL-STD-643 - Evaluation of Contract Quality N/A Control System
- MIL-STD-704 - Electric Power, Aircraft Characteristics and Utilization of
- MIL-STD-706A - Power Supply Voltages for Electronic Equipment

American Standards Association - ASA

- C83.16 (1959) Definitions and Terminology for Relays
- Z32.13 (1950) Abbreviations for Use on Drawings (e. g. GRD = ground)
- Y32.2 (1962) Graphical Symbols for Electrical Diagrams (e. g. Polarized, Double Biased, No Bias, etc.)

American Standards Association - ASA (Cont'd)

Y32.16 (1963)	Reference Designations (e. g. Q = transistor)
C42.40	Definitions of Electrical Terms, General
C42.41	Definitions of Electrical Terms, Air
C42.42	Definitions of Electrical Terms, Land
C42.43	Definitions of Electrical Terms, Marine

National Association of Relay Manufacturers - NARM

Definitions of Relay Terms - NARM (1961)

Relay Testing Procedures - NARM Issue A (1962)

Recommended Specifications for High Reliability Relays Issue A (1963)

Reliability Guidelines for Relays Issue A (1963)

Aerospace Industries Association - AIA

National Standards Association - NAS

Guidelines to Controlled Reliability Relay Specifications (EETC Report No. 27)

REQUIREMENT	CURRENTLY IN EFFECT					REMARKS
	MIL-R-6106E (ASG)	Amend 3 MIL-R-5757D	MIL-R-39016	MIL-R-22527 (WEP)	MSFC-SPEC-339	
1. TITLE	Relays, Electric, Aerospace, General Specification For	Relays, (Electrical, excluding Thermal, for Electronic and Communication-Type Equipment), General Specification For	Relays, Electromagnetic, Established Reliability, General Specification For	Relay, Armature	Relays, dc, Hermetically Sealed For Space Vehicles and Ground Support Equipment, General Specification For	NASA-Marshall Space Flight Center, Huntsville, Alabama
2. SCOPE (intended use)	Relays for Electrical and Electronic system. Directly mountable on structure, missiles, aircraft, spacecraft and associated ground support equipment without special environmental provisions. 6.1 Intended Use, Air-craft, missiles, spacecraft and ground equipment. Remote control of electrically operated accessories	Electrical (excluding thermal) relays with contact ratings up to and including 10 amperes, for use in electronic and communication-type equipment. 6.6 Airborne Applications Sealing Test III. Shock 30g min Hermetically Sealed	Established reliability, electromagnetic, hermetically sealed (excluding thermal) relays for use in electronic and communication-type equipment. Low and medium power up to 10 amperes ac and dc. Failure rate 0.01 to 1.0% in 10,000 relay operations. Confidence level 90% for qualification 60% for maintenance of qualification under rated load 85C, 125C, 200C 6.1 "..." shall not be used in plug-in sockets.	1.1 Ten types general purpose, hermetically sealed, plug-in, for shipboard fire control. 6.1 Intended Use Angle Solvers Mark 18 Mods 2 & 3 Fire Control System Mark 112 Mod 1 Sonar Receiver Sets AN/BQG-1, -2, -3, -4	Hermetically Sealed, dc, relays with contact ratings up to and including 10 amperes General switching in space vehicles and ground support equipment	MSFC spec 339 apparently supersedes ABMA-PD-R-187 (1958) 10MO1569 (1962) and 50MO2403 (1963). Although there are no cross referencing or supersession notes on specs ML-R-6106 most comprehensive, contacts from zero up, variety of loads and includes 3# with grounded relay cases
3. DATE	30 Mar 1964	(Supplement 1) and spec 20 Sept 1960 Amend 3, 1 Apr 64	30 March 1964 Supplement 1	15 Oct 1963	July 22, 1963 Supplement 1A Feb 20, 1964 QPL May 7, 1964	Data as of Oct 1964
3a. DATE CODE	3.3 ML-STD-456 Yr and wk (e.g. 6301)	ML-STD-456 Yr and wk (e.g. 6301)	ML-STD-456 Yr and wk (e.g. 6301)	None	3.11.1 Yr and wk (e.g. 0163)	ML-STD-456.01 starts first Thursday of year (same as EIA). MSRC week starts first Monday and reverses order.
4. TYPES OR CLASS	1.2 Type I Continuous hermetic Type II Continuous non-hermetic Type III Intermittent Table I - A5, A8, B8, B30, C8, D10	1.2 Classification. - Shock Temp Vib RY - - - - - (e.g. RY4LC3L01)	1.2 Table I Vibration 10, 20, 30g and .3g ² /c/s random. 10 to 2000/3000 Table II Temp (A, B & C) Table III Shock (1 and 2) Table IV Terminal Type (L, W & P) Table V Failure rate level (M, P, and R) (See detail sheets for number & example)	1.2 1 thru X in accordance with detail Bu Ord (SIC) dwgs 2, 4, and 6 pdt types including low level, and sensitive, slow operate, and ac	1.2 Classification. - Spec No. poles Coil Service Terminals Coil Resistance Detail Spec Sheet No.	
	Example Part Number MS25271-D1 Relay, 1.0 amp, 4 PDT, class B8 with solder hooks	Example Part Number M5757/9-001 Type Designation RY4XX4B8L11 Relays, hermetically sealed, subminiature, with DPDT contacts (configuration XX and YY)	Example Part Number MS89016/92-0001 Relays, electromagnetic, established reliability, miniature, 2PDT, combination high level and low level, 0 to 2 amperes	Example Type I - Bu Weps Drawing Number 1884556 Armature relay, miniature, four-pole, double-throw, dc		