

MILITARY SPECIFICATION
AMPLIFIER, A7 NOSE GEAR STEERING,

This specification is approved for use within the Naval Air Systems Command, Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the design, performance, and acceptance requirements for the A7 Nose Gear Steering Amplifier herein referred to as the amplifier. The amplifier is to be used in A7 aircraft to amplify signals from the A7 rudder controls which direct a hydraulic valve to position the aircraft nose gear.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (SESD) Code 53, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-A-85881(AS)

SPECIFICATIONS

FEDERAL

PPP-B-636 Boxes, Fiberboard

MILITARY

MIL-P-116 Preservation, Methods of

MIL-E-5400 Electronic Equipment, Aerospace, General Specification for

MIL-E-17555 Electronic and Electrical Equipment Accessories and Repair Parts; Packaging and Packing of

MIL-N-18307 Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment

STANDARDS

MILITARY

MIL-STD-129 Marking for Shipment and Storage

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-471 Maintainability Demonstration

MIL-STD-704 Electric Power, Aircraft Characteristics and Utilization of

MIL-STD-781 Reliability Tests: Exponential Distribution

MIL-STD-810 Environmental Test Methods and Engineering Guidelines

MIL-STD-965 Parts Control Program

HANDBOOKS

MIL-HDBK-235 Electromagnetic (Radiated) Environment Considerations For Design and Procurement of Electrical and Electronic Equipment.

2.1.2 Other Government drawings. The following other Government drawings form a part of this specification to extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWINGS

NAVAL AIR SYSTEMS COMMAND

DL1069AS200

A7 Nose Gear Amplifier

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

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.3).

3.2 Parts and materials.

3.2.1 Nonstandard parts and material approval. Approval for the use of nonstandard parts and materials shall be obtained by the contractor as specified in MIL-STD-965, Procedure I.

3.2.2 Supplemental requirements. In the event that the contractor proposes to alter the equipment delineated by this specification and applicable drawings, the following supplemental requirements for the selection of parts and materials shall be applicable.

3.2.2.1 Basic conformance. Parts and materials shall be selected from those in accordance with MIL-E-5400, unless the parts listed therein will not perform adequately in the intended applications and environments specified herein.

3.2.3 Toxic and corrosive fumes. The materials, as used in the manufacture of the amplifier and under the conditions therein, shall not liberate deleterious or corrosive fumes. This shall include fungicidal agents that are used.

3.2.4 Recycled, virgin, and reclaimed materials. Except when intended use of the amplifier will be jeopardized by the use of reclaimed or recycled materials, these materials shall be used to the maximum extent possible.

3.3 Design and construction. Design and construction of the amplifier shall conform with MIL-E-5400 and DL1069AS200 except as otherwise noted herein. It is a condition of final acceptance that the amplifier manufactured shall meet all the design, construction, and workmanship requirements of this specification and applicable acceptance test documents.

3.3.1 Reliability.

3.3.1.1 Operational stability. The amplifier shall operate with required performance for six cycles as specified in 4.5.3.2. During this time, it shall not be necessary to readjust any controls that are inaccessible to the operator during normal use.

3.3.1.2 Operating life. The amplifier shall have a minimum total operating life of 10 years with minimal servicing and replacement of parts.

3.3.1.3 Reliability in mean-time-between-failure (MTBF). The MTBF of the amplifier shall be no less than 1300 hours when tested in accordance with 4.5.3.1.

3.3.2 Interchangeability. Interchangeability shall exist between all amplifiers and all replaceable assemblies, subassemblies, and parts of the amplifiers in accordance with MIL-E-5400. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance.

3.3.3 Maintainability. The faulty amplifier shall be maintained in the aircraft at organizational level. Piece part repair of the faulty amplifiers shall be performed at intermediate level maintenance shop.

3.3.4 Transportability. The amplifier shall be transportable by air, rail, truck, or ship when packaged as specified in section 5.

3.3.5 Dimensions. The dimensions of the amplifier shall be not greater than the following:

- | | |
|-----------|-------------|
| a. Height | 2.50 inches |
| b. Width | 2.94 inches |
| c. Length | 3.64 inches |

3.3.6 Weight. The total weight of the amplifier shall be not greater than one pound.

3.3.7 Color and finish. The color and finish of the amplifiers shall be in accordance with DL1069AS200.

3.3.8 Storage life.

3.3.8.1 Packaged condition. The amplifier shall be capable of being stored in sheltered areas when packaged to the requirements of section 5. The normal storage temperature extremes shall be between the existing dew point and 71°C.

3.3.9 Nameplates and identification marking. Serial number assignment, nameplate approval, and identification marking shall be in accordance with MIL-N-18307.

- a. Unit name (Amplifier, A7 Nose Gear Steering)
- b. Unit nomenclature (Amplifier Assembly, Nosegear Electronic Control (A7))
- c. Contract number
- d. Manufacturer's code number
- e. Equipment drawing number 1069AS200
- f. Technical manual
- g. Procuring activity (Department of Navy - Naval Air Systems Command)
- h. Serial number specified in contract shall be stamped on the amplifier.

3.3.9.1 Serial numbers. Serial numbers will be assigned by the procuring activity for the amplifiers under contract or purchase order. The contractor shall serialize sequentially all sets which are delivered under the contract.

3.3.10 Safety. The contractor shall ensure that safety requirements are in accordance with MIL-STD-454, Requirement 1.

3.3.11 Standard conditions. The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

- | | |
|----------------|--|
| a. Temperature | Room ambient ($25 \pm 5^{\circ}\text{C}$) |
| b. Altitude | Normal ground |
| c. Vibration | None |
| d. Humidity | Room ambient up to 90 percent relative |
| e. Input power | 113 \pm 5 volts, 400 \pm 7 Hz,
100 volt-amperes maximum |

3.3.12 Service conditions. The amplifier shall meet the performance requirements of this specification within the operational environment conditions specified herein.

3.3.12.1 Temperature-altitude. The amplifier shall meet the temperature altitude combination requirements of MIL-E-5400 for Class 1 equipment.

3.3.12.2 Vibration. The amplifier shall meet the performance requirements of this specification after being subjected to the vibration environment detailed herein.

3.3.12.2.1 Vibration test setup. The amplifier shall be mounted in a base similar to base used for aircraft installation.

3.3.12.2.2 Random vibration. The amplifier shall meet the operational requirements of this specification after being subjected to random vibration test in accordance with 4.9.3.1.

3.3.12.2.3 High rate gunfire vibration. The amplifier shall meet the operational requirements of this specification after being subjected to high rate gunfire vibration test in accordance with 4.9.3.2.

3.3.12.2.4 Low rate gunfire vibration. The amplifier shall meet the operational requirements of this specification after being subjected to low rate gunfire vibration test in accordance with 4.9.3.3.

3.3.12.3. Shock The amplifier shall meet the operational requirements of this specification during and following basic design shock tests in accordance with 4.9.4.

3.3.12.4 Humidity. The amplifier shall meet the operational requirements of this specification after being subjected to a humidity test in accordance with 4.9.2. The amplifier shall not be damaged as a result of the humidity test.

3.3.13 Warm-up time. The time required for the amplifier to warm-up prior to operation shall be not greater than 5 minutes under standard conditions and 2 minutes under service conditions.

3.3.14 Input power. The amplifier shall meet all applicable requirements of MIL-STD-704 and shall meet specified performance requirements when energized from the power source having characteristics and limits specified in MIL-STD-704 for 115 volts ac, 400 Hz and a 28 volts dc system.

3.3.15 Interference control. The generation of electromagnetic interference shall be controlled within the limits of MIL-STD-461 for the tests specified in 3.3.15.1 through 3.3.15.5. EMI testing shall be accomplished under standard conditions specified in 3.3.11 and in accordance with the procedures of MIL-STD-462 to demonstrate compliance with the requirements of MIL-STD-461.

3.3.15.1 Conducted emission, power, and interconnecting leads. Conducted emissions from the amplifier power and interconnecting leads shall be within the limits of MIL-STD-461, CE03.

3.3.15.2 Conducted susceptibility, power leads, 0.05 to 400 Hz. The amplifier shall not exhibit any malfunction degradation of performance or deviation from the specified indication of 3.4 beyond the tolerance specified therein when subjected to the susceptibility test of MIL-STD-462, CS01.

3.3.15.3 Conducted susceptibility, spikes, power leads. The amplifier shall not exhibit any malfunction, degradation of performance or deviation from the specified indications of 3.4 beyond the tolerance specified therein when subjected to test spikes having a waveform in accordance with MIL-STD-461, CS06.

3.3.15.4 Radiated emissions, electric field 14 kHz to 10 GHz. The amplifier shall not have radiated emissions that are greater than the limits of MIL-STD-461, RE02. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

3.3.15.5 Radiated susceptibility, electric field, 14 kHz to 40 GHz. The amplifier shall not exhibit any malfunction, degradation of performance or deviation from the specified indications of 3.4 beyond the tolerance specified therein when subjected to radiated susceptibility test in accordance with MIL-STD-462, RS03.

3.4 Performance. The performance of the amplifier shall be as specified in 3.4.1. Unless otherwise specified herein, these requirements shall apply under both standard and service conditions (see 3.3.11 and 3.3.12).

3.4.1 Function and description.

3.4.1.1 Functional characteristics. The amplifier shall have the functional characteristics listed in 3.4.1.1.1 through 3.4.1.1.3.3.

3.4.1.1.1 Connector pin resistance. Resistance between connector pins E-F and F-G shall be not less than 20,000 ohms.

3.4.1.1.2 Voltage inputs. Input voltage 113 ± 5 volts, 400 ± 7 Hz shall be applied to connector pins J and A (ground). The ac power input shall be not greater than 100 volt-amperes. Input voltage of 27 ± 2 volts dc shall be applied to pins C (+) and A (ground). The dc power input shall be not greater than 20 watts.

3.4.1.1.3 Test circuit. Test circuit figure 1 is a composite of circuit diagrams of Nose Landing Gear Steering Amplifier Bench Test Set, PN 215-00111-1, and Test Set Adapter, PN 1069AS300. Refer to figure 1 for test points and loads specified in 3.4.1.1.3.1 through 3.4.1.1.3.3.

3.4.1.1.3.1 Output voltage calibration. The output voltage calibration shall be accomplished by adjusting variable resistor R1 in the amplifier. The differential voltage across the dc voltmeter shall be variable from less than -6.0 volts dc to greater than +6.0 volts dc under the following conditions:

- a. 1k ohm loads ± 5 percent shall be placed in connector pin K to L and M to L.
- b. DC voltmeter shall be connected across connector pins K and M (Switch S1 shall be placed in position 3).
- c. Test set resistor R1 shall be adjusted for 0.00 ± 0.2 volts ac across test points J5 to J12.
- d. Voltage inputs shall be in accordance with 3.4.1.1.2.
- e. Amplifier variable resistor R1 shall be varied from clockwise limit to counter clockwise limit.

3.4.1.1.3.2 Voltage output. The amplifier variable resistor R1 shall be adjusted for 0.00 ± 0.03 volts dc under conditions of 3.4.1.1.3.1a through d. Voltage output shall be as shown in table I under the following conditions:

- a. Loads shall be in accordance with 3.4.1.1.3.1a.
- b. Voltage inputs shall be in accordance with 3.4.1.1.2.
- c. AC signal input voltages to connector pins G and H shall be set for the voltages indicated by adjusting test set resistor R1.

TABLE I. DC output voltage vs. ac input voltages.

AC Signal Voltage (TPJ4 to TPJ5)	DC Voltage Switch Position S1	DC Output Voltage
0.00 ± 0.01	1	-10.0 ± 2.0
0.00 ± 0.02	2	-10.0 ± 2.0
0.00 ± 0.02	3	$+0.0 \pm 0.2$
$0.5 \pm .02 \angle 0^\circ$	3	$+2.0 \pm 0.5$
$1.0 \pm .02 \angle 0^\circ$	3	$+3.5 \pm 1.0$
$3.0 \pm .02 \angle 0^\circ$	3	$+8.3 \pm 1.7, -12.8$
$4.0 \pm .02 \angle 0^\circ$	3	$+10.0 \pm 2.0$
$0.5 \pm .02 \angle 180^\circ$	3	-2.0 ± 0.5
$1.0 \pm .02 \angle 180^\circ$	3	-3.5 ± 1.0
$3.0 \pm .02 \angle 180^\circ$	3	$-8.3 \pm 1.7, -1.8$
$4.0 \pm .02 \angle 180^\circ$	3	-10.0 ± 2.0
$0.00 \pm .02$	1	0.0 ± 0.2

$\angle 0^\circ$ indicates ac signal voltage in phase with the ac voltages applied to connector pin J.

$\angle 180^\circ$ indicates signal voltage is 180° from voltage applied at connector pin J1.

3.4.1.1.3.3 Reset characteristics. With voltage inputs as specified in 3.4.1.1.2, reset characteristics shall be as follows:

- a. Relay K1 shall become energized and remain energized with the momentary application of $27 \pm 2, -7$ volts dc to connector pin R with all of the following conditions present:
 - (1) A 2,000 ohm ± 10 percent external load to connector pins G and H.
 - (2) A 1,000 ohm ± 5 percent external load to connector pins K and L.
 - (3) A 1,000 ohm ± 5 percent external load to connector pins M and L.
 - (4) An 11 ma 400Hz current from an external source through connector pin B to A (ground).

b. Relay K1 shall become de-energized and remain de-energized when any one of the following conditions are present:

- (1) The external load between connector pins G and H is an open circuit.
- (2) No ac voltage applied to connector pins G and H.
- (3) Open circuit between connector pin M and external load.
- (4) Open circuit between connector pin K and external load.
- (5) Open circuit between connector pin L and load connector common.
- (6) A short to ground on the external circuit to connector pin G or H.

3.4.1.2 Physical characteristics. The amplifier shall consist of the following major subassemblies:

- a. Amplifier Housing
- b. Electronic Chassis
- c. Circuit Card Assembly (A1)
- d. Circuit Card Assembly (A2)
- e. Transformer and Bracket Assembly (A3)
- f. Connector (P1) with attaching dust cap.

3.4.1.2.1 Amplifier housing. The amplifier housing shall be manufactured in accordance with Drawing 1069AS136.

3.4.1.2.2 Electronic chassis. The electronic chassis shall be manufactured in accordance with Drawing 1069AS153.

3.4.1.2.2 Circuit Card (A1). The circuit card (A1) shall have a diode bridge D12, D13, D14 and D15 which shall be capable of monitoring the output ripple voltage of transistors A1Q1 and A1Q2. The circuit card shall be manufactured in accordance with Drawing 1069AS205.

3.4.1.2.3 Circuit card (A2). The circuit card (A2) shall operate in the go condition when all inputs to the positive (+) pins of integrated circuit A2U2 are positive (+) relative to negative (-) pins. The circuit card shall be manufactured in accordance with Drawing 1069AS208.

3.4.1.2.4 Transformer and bracket assembly (A3). The transformer and bracket assembly shall be manufactured in accordance with Drawing 1069AS159.

3.4.1.2.5 Connector(P1) with attaching dust cap. The connector (P1) and attaching dust cap shall be in accordance with Drawings MS27508E-14A18P and MS90376-16Y, respectively.

3.5 Wiring. The amplifier wiring shall be in accordance with MIL-E-5400.

3.6 Workmanship. Workmanship shall conform to MIL-STD-454, Requirement 9 and the following:

- a. Printed wiring board coatings shall be free of dirt and metal particles.
- b. Chemically coated and painted surfaces shall have uniformly coated surfaces.
- c. Metal parts shall be free of burrs or sharp edges.
- d. The final assembly shall be free of dirt, solder fragments, hardware, or other foreign objects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, 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 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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

- a. First article inspections (see 4.4)
- b. Quality conformance inspections (see 4.5)

4.3 Inspection conditions. Unless otherwise specified in the contract, all inspections shall be performed in accordance with the test conditions specified as follows:

- a. Temperature Room ambient ($25 \pm 10^{\circ}\text{C}$)
- b. Altitude Normal ground

c. Vibration	None
d. Humidity	Room ambient up to 90% relative humidity
e. Input power	113 \pm 5 volts, 400 \pm 7 Hz (aircraft power)

4.3.1 Performance characteristics.

4.3.1.1 Before testing. The amplifier shall satisfy the requirements for interference control (see 3.3.15) and warm-up time (see 3.3.13).

4.3.1.2 During inspection acceptance testing. The amplifier shall satisfy the requirements of Section 3.

4.4 First article inspection. First article inspection shall be conducted by the contractor on two amplifiers representative of the production amplifiers to be supplied under the contract. First article test performance shall be the responsibility of the contractor and shall be performed in accordance with approved test procedures (see 4.12). The Government inspector and the procuring activity shall be advised when tests are to be conducted so that a representative may be designated to witness or supervise the tests when so desired. Contractors not having adequate facilities to conduct all the required tests shall obtain the services of a commercial laboratory acceptable to the Government. No first article inspections shall be conducted prior to approval of the first article test procedure by the contracting officer (see 6.2.2).

4.4.1 Scope of first article tests. First article tests shall include all tests deemed necessary by the procuring activity to determine that the amplifiers meet all the requirements of this specification and the contract. First article tests shall include environmental tests in accordance with MIL-E-5400 and MIL-STD-810 and electromagnetic interference (EMI) tests in accordance with MIL-STD-461 (see table II).

4.4.2 First article approval. Approval of the first article shall be by the procuring activity upon completion of all tests (see 6.2.2).

4.4.3 Production equipment. Amplifiers supplied under the contract shall, in all respects including design, construction, workmanship, performance and quality, be equal to the approved first article sample and specifications referenced herein. Each amplifier shall be capable of successfully completing the same tests as imposed on the first article sample. Evidence of non-compliance with the above shall constitute cause for rejection of an amplifier and of an amplifier already accepted by the Government. It shall be the obligation of the contractor to make necessary corrections as authorized by the procuring activity.

4.5 Quality conformance inspection. The contractor shall furnish all samples and shall be responsible for accomplishing the quality conformance inspection. All inspection and testing shall be to the procuring activity approved acceptance test procedures under the supervision of the Government inspector. Contractors not having testing facilities acceptable to the procuring activity shall engage the services of a commercial testing

TABLE II. Inspection requirements.

Requirements	I. First Article Inspection	II. Quality Conformance Inspections			
		Individual (A)	Sampling (B)	Special (C)	Life (D)
Visual Examination (3.2, 3.3)	4.5.1.1	4.5.1.1	4.5.1.1	4.5.1.1	4.5.1.1
Performances Characteristics (3.4)	4.5.1.2	4.5.1.2	4.5.1.2	4.5.1.2	4.5.1.2
Workmanship (3.6)	4.5.1.3	4.5.1.3	4.5.1.3	4.5.1.3	4.5.1.3
Vibration (3.3.12.2)	4.9.3	↑ ↓	↑ ↓	↑ ↓	(see 4.7)
Temperature-Altitude (3.3.12.1)	4.9.1				
Shock (3.3.12.3)	4.9.4				
Humidity (3.3.12.4)	4.9.2				
Warm-up Time (3.3.13)					
Interference Control (3.3.15)	4.10				
Reliability (3.3.1)	4.5.3.1	↓	4.5.3.2	↓	

1/ Additional individual tests may be requested by the procuring activity (see 4.5.1).

2/ Sampling tests to be performed shall be determined by the procuring activity base on first article and individual test results (see 4.5.2.1).

3/ Special tests to be performed shall be determined by the procuring activity (see 4.5.5)

Laboratory acceptable to the procuring activity. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of the acceptance of the finished product. Quality conformance tests shall consist of the following (see table II):

- a. Individual tests (see 4.5.1 and table II)
- b. Sampling tests (see 4.5.2 and table II) or Reliability Assurance tests (see 4.5.3)
- c. Special tests (see 4.5.5 and table II)
- d. Life tests (see 4.7 and table II)

4.5.1 Individual tests. Each amplifier submitted for acceptance shall be subjected to the individual tests. These tests shall be adequate to determine compliance with the requirements of material, workmanship, operational adequacy and reliability. As a minimum, each amplifier accepted shall have passed the following tests:

- a. Examination of product (see 4.5.1.1)
- b. Operational test (see 4.5.1.2)
- c. Manufacturing run-in test (see 4.5.1.3)

4.5.1.1 Examination of product. Each amplifier shall be examined carefully to determine that the material and workmanship requirements have been met.

4.5.1.2 Operational test. Each amplifier shall be operated a minimum of 2 minutes to permit the temperature to stabilize and to check sufficient characteristics and record adequate data to assure specified amplifier operation.

4.5.1.3 Manufacturing run-in test. Each amplifier shall be operated under the conditions specified herein without failure. Specifically each amplifier will be subjected to 10 minutes of random vibration followed by 10 temperature cycles. The random vibration will contain frequencies between 20 and 2000 Hz with the acceleration power spectral density 0.01g /Hz at 20 Hz with the acceleration power spectral density 0.01g /Hz at 20 Hz increasing at +3 dB/Octave to 0.04g Hz at 80 Hz and remaining constant to 350 Hz than decreasing at -3 dB/Octave to .007g Hz at 2000 Hz. The 10 temperature cycles will be between -54°C and +55°C. The amplifiers will remain at the high and low temperature levels until the internal parts stabilize within 3°C of the temperature level. The amplifiers will be energized during the heating portion of the temperature cycling and de-energized during the cooling portions of the temperature cycles. Once each day and during the final hot cycles, the amplifier in test will be subjected to an operational performance test. The last temperature cycle must be failure free to complete testing.

4.5.2 Sampling tests. Amplifiers selected for sampling tests shall first have passed the individual tests. (Sampling tests shall not be conducted unless reliability assurance tests of 4.5.3 are deleted by contractual action.) Amplifiers shall be selected for sampling tests by the Government inspector in accordance with table III.

4.5.2.1 Scope of tests. As a minimum, each amplifier selected for sampling tests shall be subjected to the following:

- a. Complete operational test at ambient room conditions, making all necessary measurements to assure that all applicable specification requirements have been met.
- b. Operational test at certain environmental conditions. The conditions may vary for each amplifier tested and should be based on results of the first article, initial production, individual, and special tests.
- c. Manufacturing run-in test specified in 4.5.1.3 except that the test duration shall be 120 hours with no restriction on the number of failures.

TABLE III. Sampling tests sample selection.

Quantity of equipments offered for acceptance	Quantity to be selected for sampling tests
First 10	1
Next 50	1
Next 75	1
Next 100	1
	1 for each additional 200 or fraction thereof.

4.5.3 Reliability assurance tests.

4.5.3.1 Qualification phase. Six or more amplifiers shall be operated and cycled as specified in MIL-STD-781, Test Level E, consisting of 12-hour environmental test cycles. Operation shall continue until the MTBF of 1300 hours can be confirmed. Failures shall be analyzed to identify failure modes. Corrective action to replace defective components shall be initiated when failure patterns are identified. A minimum of one test cycle shall be made with input power at each voltage level listed in table IV.

TABLE IV. Voltage levels for reliability test cycles.

Level	115V, 400 Hz	27 Vdc
1	108	22
2	118	29

4.5.3.2 Production reliability acceptance tests. Each amplifier shall be subjected to a test cycle as specified herein. The test cycle shall be no less than 6 cycles of 8 hours each (48 hours). In the event of a failure, the amplifier shall be removed from the test, repaired, and the test started over. Amplifiers shall be accepted after no less than six cycles of failure-free operation.

4.5.3.2.1 Test. The amplifier shall be operated during this test as follows:

- a. With 0.00 ± 0.02 ac inputs to pins G and H, outputs at connector pins K and M shall be -10.0 ± 3.0 volts dc.
- b. All resets shall be operated eight times each hour.
- c. Lines to amplifier pins H, M, B and K shall be interrupted to cause the amplifier relay K2 to open (amplifier pin P ungrounded).
- d. Reset (+27 volts dc to pin R) shall follow Relay K2 actuation.
- e. No less than 50 set-reset operations shall be accumulated on each amplifier.

4.5.4 Maintainability demonstration. The amplifier maintainability shall be demonstrated in accordance with MIL-STD-471.

4.5.5 Special tests. Special tests shall be conducted on a quantity of amplifiers as specified by the procuring activity for the purpose of checking the effect of any design or material change on the performance of the amplifier and to assure quality control. The amplifiers selected for special tests may be selected from amplifiers previously subjected to the sampling or reliability assurance tests.

4.5.5.1 Special test schedule. Selection of amplifiers for special tests shall be made as follows:

- a. On early amplifiers after an engineering or material change.
- b. Whenever failure reports or other evidence indicate that tests are required. (This will be determined by the procuring activity.)

4.5.5.2 Scope of tests. Special tests shall consist of such tests as approved by the procuring activity. Test procedures previously approved for the first article tests may be used where applicable (see 6.2.2).

4.6 Equipment failure. Should a failure occur during either the sampling, reliability assurance or special tests, the following action shall be taken:

- a. Determine the cause of failure.
- b. Determine if the failure is an isolated case or due to design defect.
- c. Where practical, include a test (in the individual test) to check all amplifiers for this requirement until assurance is forthcoming that the defect has been corrected.

4.7 Life test. The contractor shall furnish all samples and shall be responsible for accomplishing the life test. The test shall be for 72 hours duration and shall be conducted on amplifiers that have passed the

individual tests. The life test shall be performed under the conditions specified in 4.7.1. The life test sample shall be selected by the Government inspector in accordance with table V. (Amplifiers which have successfully completed the sampling tests, reliability tests, or special tests may be selected for life tests.)

TABLE V. Life test sample selection.

Quantity of equipments offered for acceptance	Quantity to be selected for life test
First 25	1
Next 175	1
Next 300	1
	1 for each additional 500 or fraction thereof.

When reliability tests are conducted, the life test may be omitted if, during the reliability tests, a quantity of amplifiers equal to or more than that listed above receive at least 300 hours each of test time.

4.7.1 Life test conditions. The life test shall be conducted under the following simulated service conditions:

- | | |
|------------------|--|
| a. Temperature | Room ambient ($30 \pm 10^{\circ}\text{C}$) |
| Altitude | Normal ground (0 - 5000 ft.) |
| b. Humidity | Room ambient up to 90% relative humidity |
| c. Input voltage | Nominal |
| d. Vibration | None |

4.7.2 Life test period. The life test may be run continuously or intermittently. Any period of operation shall be of sufficient duration to permit the amplifier temperature to stabilize. Periodically, the amplifiers shall be turned on and off several times, and put through its various phases of operation.

4.7.3 Performance check. At approximately 8-hour intervals during the test, a limited performance check shall be made (see 6.2.2).

4.7.4 Test data. In the event of part failures, the defective part shall be replaced and the operation resumed for the remainder of the test period.

4.7.4.1 Failure report. In the event of a failure, the Government inspector shall be notified immediately (see 6.2.2).

4.8 Presubmission testing. No item, part, or complete amplifier shall be submitted by the contractor until it has been previously tested and inspected by the contractor and found to comply with all applicable requirements of this specification and the contract.

4.9 Environmental tests. The amplifier shall meet specified operational requirements when subjected to the following tests:

4.9.1 Temperature-altitude. The amplifier shall be tested in accordance with MIL-E-5400, Class 1, temperature-altitude combination test. Adjustment of external controls shall be allowed.

4.9.2 Humidity. The amplifier shall be humidity tested in accordance with MIL-STD-810, Method 507.2, Procedure I.

4.9.3 Vibration.

4.9.3.1 Random vibration. The individual amplifier test item shall be subjected to broadband random vibration excitation. The power spectral density tolerances of applied vibration shall be in accordance with figure 2. The amplifier shall be attached to the vibration excitor by means of a rigid fixture capable of transmitting the vibration conditions specified. The amplifiers shall be hard mounted to the test fixture. Vibration shall be applied sequentially along each of the three orthogonal axes of the test item. Two test levels are required, a functional level and an endurance level. For each axis, one half of the functional test shall be conducted first, then the endurance test, followed by the second half of the functional test. The amplifier shall meet the performance requirements of 3.4 during functional testing. The acceleration power spectral density (G^2/Hz) of applied vibration, as measured on the test fixture at mounting points of the test item, shall be according to table VI and figure 2. The functional and endurance test time durations and other test conditions shall be determined from the test level equations and other parameter values from table VI.

4.9.3.2 High rate gunfire vibration. The amplifier shall be subjected to the gunfire vibration spectrum shown on figure 3 with an amplitude tolerance of ± 10 percent. The harmonic frequencies shall be applied simultaneously and within the range shown in table VII. The test duration shall be 48 minutes in each of the three orthogonal axes. The amplifier shall be non-operating during the test but shall be subjected to the required performance test following high rate gunfire vibration test in each axis.

4.9.3.3 Low-rate gunfire vibration test. The amplifier shall be subjected to the gunfire vibration spectrum shown on figure 4 with an amplitude tolerance of ± 3 dB. The harmonic frequencies shall be applied simultaneously and within the range shown in table VII. The test duration shall be 12 minutes in each of the three orthogonal axes. The amplifier shall be non-operating during the test but shall be subjected to the required performance test following low rate gunfire vibration test in each axis.

4.9.4 Shock. A shock test shall be performed in accordance with MIL-STD-810, Method 516.3, Procedure I. The test shall be performed at room ambient with the amplifier non-operating. The amplifier shall be subjected to an operational check and visual examination prior to and after the shock test. Failure to operate as required during testing or evidence of damaged parts observed shall be cause for rejection.

TABLE VI. Random vibration test criteria.

Criteria	Notes
Aerodynamic induced vibration (curve A, figure 2) Functional test level <u>1/</u> , <u>6/</u> $W_0 = K(q)^2$ Endurance test level <u>2/</u> , <u>3/</u> , <u>6/</u> $W_0 = K(q)^2 (K/3T)^{1/4}$	1. Functional test time shall be 1 hour per axis. 2. Use $W_0 = 0.04 \text{ g}^2/\text{hz}$ if calculated endurance test level values are less than $0.04 \text{ g}^2/\text{hz}$, $T = 1$. 3. If 1 hour ($T = 1$) endurance test level is \leq functional test level, no endurance test is required except according to Note 2.
Jet engine noise induced vibration (curve A, figure 2) Functional test level <u>1/</u> , <u>4/</u> , <u>6/</u> , <u>7/</u> , <u>8/</u> $W_0 = (0.48 \cos^2\theta/R)[D_C(V_C/1850)^3 + D_f(V_f/1850)^3]$ Endurance test level <u>2/</u> , <u>3/</u> , <u>4/</u> , <u>6/</u> , <u>7/</u> , <u>8/</u> $W_0 = (0.48 \cos^2\theta/R)[D_C(V_C/1850)^3 + D_f(V_f/1850)^3]$ $(N/10T)^{1/4}$	4. If aircraft has more than one engine, W_0 shall be the sum of the individually computed values for each engine. 5. For equipment weighing more than 80 pounds, the vibration W_0 level may be reduced according to Curve B, figure 2.
<p style="text-align: center;">Definitions</p> $K = 2.7 \times 10^{-8}$ for cockpit equipment and equipment attached to structure in compartments adjacent to external surfaces that are smooth and free from discontinuities. $K = 14 \times 10^{-8}$ for equipment attached to structure in compartments adjacent to or immediately aft of external surfaces having discontinuities (cavities, chins, blade antennas and speed brakes) and equipments in wings, pylons, stabilizers and fuselage aft of trailing edge wing root. $q = 1200 \text{ psf}$ or maximum aircraft q , whichever is less. $N =$ maximum number of anticipated service missions for equipment or carrying aircraft ($N \geq 3$). $T =$ test time per axis, hours ($T \geq 1$).	6. For $70^\circ < \theta \leq 180^\circ$, use $\theta = 70^\circ$ to compute W_0 . 7. For engines with afterburners, use W_0 which is 4 times larger than W_0 computed using maximum V_C and V_f without after burner.

TABLE VI. Random vibration test criteria - Continued.

Definitions	Notes
D_c = engine core exhaust diameter, feet (for engines without fans, use maximum exhaust diameter). D_f = engine fan exhaust diameter, feet. R = minimum distance between center of engine aft exhaust plane and the center of gravity of installed equipment, feet. V_c = engine core exhaust velocity, feet per second (for engines without fans, use maximum exhaust velocity without afterburner). V_f = engine fan exhaust velocity, feet per second. θ = angle between R line and engine exhaust axis, degrees, aft vectored.	

4.10 Electromagnetic interference and compatibility (EMIC). The amplifier shall be subjected to the EMIC tests specified in 4.10.1 through 4.10.5 in accordance with the test methods of MIL-STD-462 to verify that amplifier meets the requirements of MIL-STD-461, Class A1, Category A1b, for the EMIC tests herein.

4.10.1 Conducted emissions, power and interconnecting leads, 0.15 to 50 MHz. Conducted emissions measurements shall be made over the frequency range of 0.15 to 50 MHz on power and interconnecting leads in accordance with MIL-STD-462, Test Method CE03.

4.10.2 Conducted susceptibility, power leads, 50Kz to 400 MHz. The amplifier shall be subjected to conducted susceptibility tests by having signals over the range of 50 KHz to 400 MHz injected on the power leads in accordance with MIL-STD-462, Test Method CS01.

4.10.3 Conducted susceptibility, spikes, power leads. The amplifier shall be subjected to conducted susceptibility tests consisting of superimposing a 32 volt maximum spike on the power line voltage waveform in accordance with MIL-STD-462, Test Method CS06.

4.10.4 Radiated emissions, electric field, 14 kHz to 10 GHz. Radiated emissions emanating from the amplifier shall be measured over the frequency range of 14 kHz to 10 GHz in accordance with MIL-STD-462, Test Method RE02.

4.10.5 Radiated susceptibility, electric field, 14 kHz to 40 GHz. The amplifier shall be subjected to radiated susceptibility tests over the frequency range of 14 kHz to 40 GHz, electric field, in accordance with Mil-STD-462, Test Method RS03. Radiated susceptibility requirements of MIL-HDBK-235, table 5A shall be used in lieu of the RS03 field strengths of RS03.

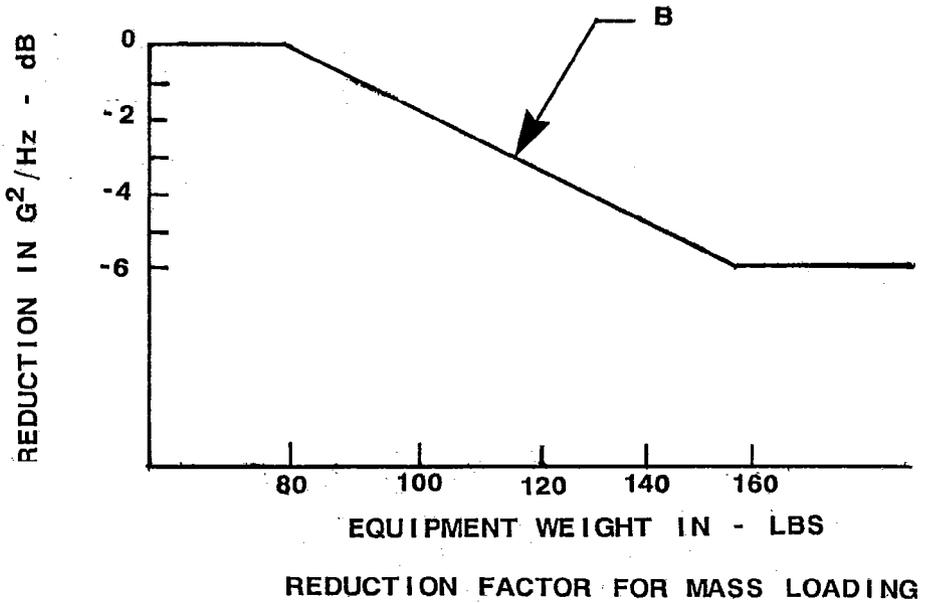
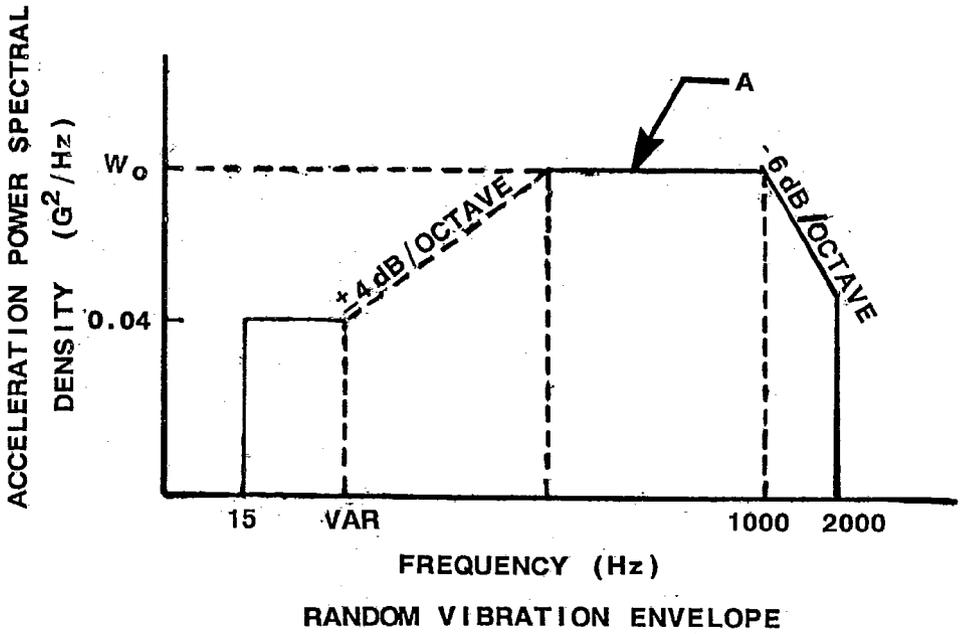


FIGURE 2. Random vibration test curve and mass loading reduction factor for jet aircraft equipment.

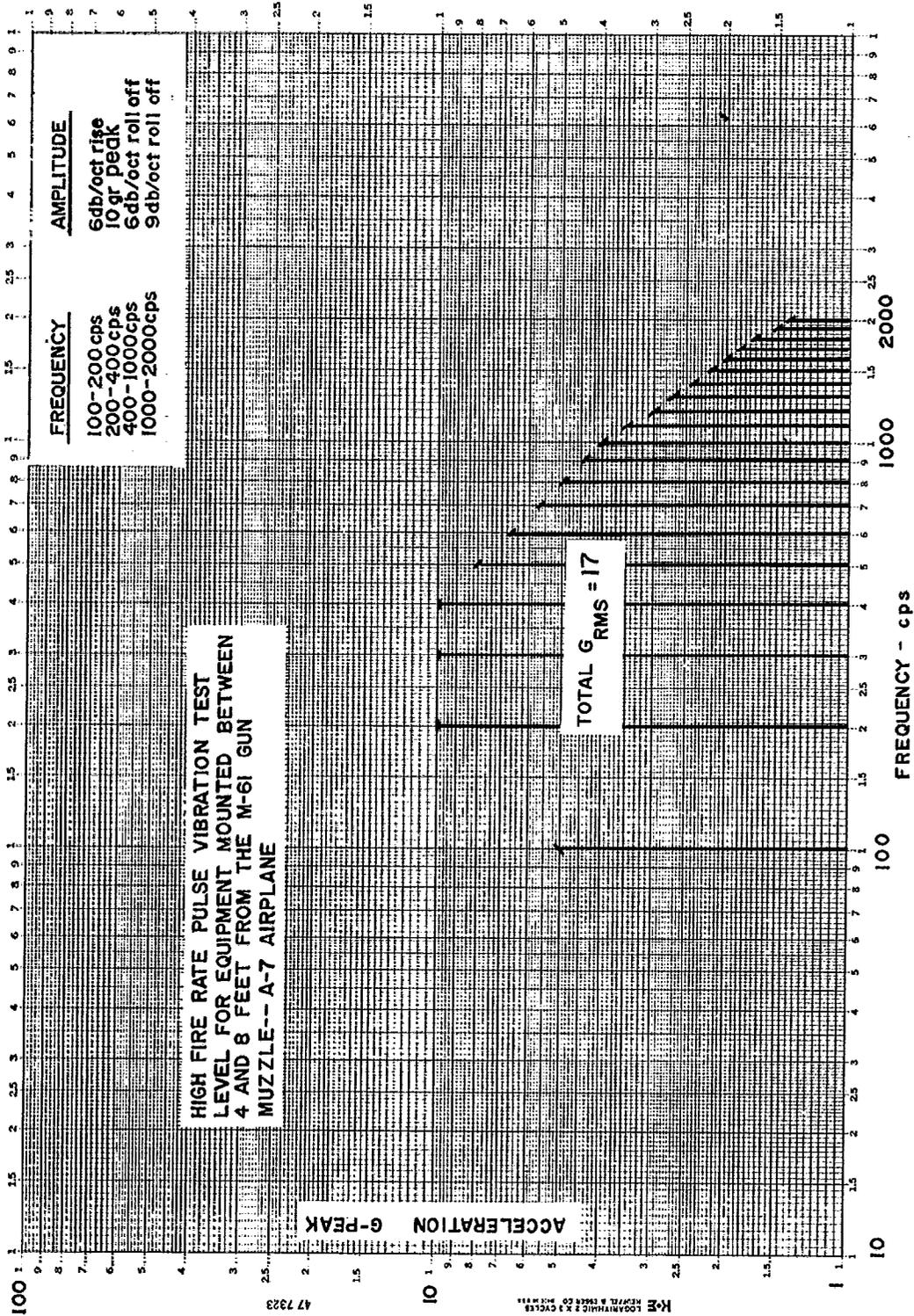


FIGURE 3. High fire rate gunfire vibration test.

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TABLE VII. Pulse test frequency spectrum for both M-61 gun firing rates.

HIGH FIRE RATE - 6000 spm Fundamental Frequency and Harmonics	LOW FIRE RATE - 4000 spm, Fundamental Frequency and Harmonics
Hz	Hz
100 ± 5	67 ± 3
200 ± 10	133 ± 7
300 ± 15	200 ± 10
400 ± 20	267 ± 13
500 ± 25	333 ± 17
600 ± 30	400 ± 20
700 ± 35	467 ± 23
800 ± 40	534 ± 27
900 ± 45	600 ± 30
1000 ± 50	667 ± 33
1100 ± 55	734 ± 38
1200 ± 60	800 ± 40
1300 ± 65	867 ± 43
1400 ± 70	934 ± 47
1500 ± 75	1000 ± 50
1600 ± 80	1067 ± 53
1700 ± 85	1134 ± 57
1800 ± 90	1200 ± 60
1900 ± 95	1267 ± 63
2000 ± 100	1334 ± 67
	1400 ± 70
	1467 ± 73
	1534 ± 77
	1600 ± 80
	1667 ± 83
	1734 ± 87
	1800 ± 90
	1868 ± 93
	1934 ± 97
	2000 ± 100

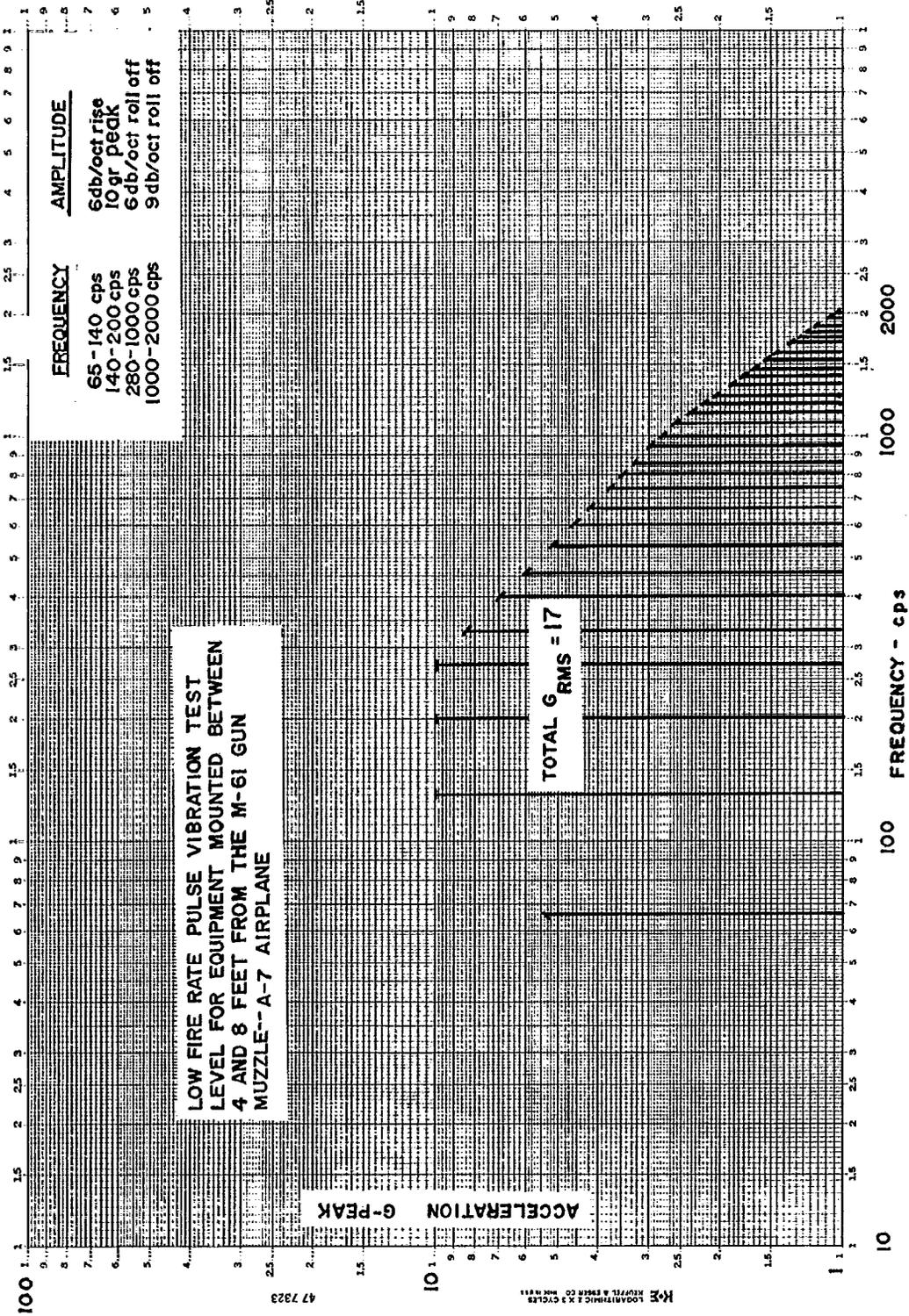


FIGURE 4. Low-fire rate gunfire vibration test.

4.11 Inspection of packaging. The sampling and inspection of the preservation and interior package marking shall be in accordance with groups 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 shown in section 5 and the marking requirements of MIL-STD-129.

4.12 Methods of examination and test. The right is reserved by the procuring activity or the Government inspector to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of this specification and the contract (see 6.2.2).

5. PACKAGING

5.1 General. Packaging shall be in accordance with the general requirements of MIL-E-17555, supplemented as follows:

5.2 Preservation-packaging. Unless otherwise specified in the contract or purchase order (see 6.2.1), preservation-packaging shall be in accordance with MIL-P-116, Method III.

5.3 Packing. Unless otherwise specified in the contract or purchase order (see 6.2.1), packing shall be level C. The packaged amplifiers shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, normal requirements. Sealing (taping) and reinforcing (banding) shall be in accordance with the appendix to PPP-B-636.

5.3.1 Unitized loads. Unitized loads, commensurate with the level of packing specified herein or in the contract (see 6.2.1), shall be used whenever the 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 possible.

5.4 Marking. In addition to any special marking required by the contract (see 6.2.1); each unit package, intermediate and exterior container and unitized load shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The A7 Nose Gear Steering Amplifier is designed for use in the A7 aircraft as part of the control and monitor system for the nose wheel. The amplifier monitors aircraft transducer signals and provides dc control signals to drive the aircraft selector valve. The amplifier has circuits to monitor external wiring and provides a disable (fail safe) signal to the selector valve when a wiring failure is detected.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Selection of applicable levels of packaging and packing (see section 5)
- c. When a first article is required (see 4.4)

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DOD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
4.4, 4.12	Procedure, First Article Inspection	DI-T-4901	---
4.4.2	Report, First Article Inspection	DI-T-4902	---
4.5.5.2, 4.7.3, 4.12	Procedures, Production/ Acceptance Inspection	DI-T-4903	---
4.7.4.1,	Report, Failure	UDI-R-21141A	---

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12.L, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 First article. When a first article inspection is required, the amplifier should be a first article sample. The first article should consist of two amplifiers. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Subject term (key word) listing.

Aircraft, A7
Amplifier, steering
Diode bridge
Nose gear, aircraft
Nose wheel, aircraft
Rudder controls, aircraft
Selector valve, aircraft

Preparing Activity:
Navy - AS
(Project 1620-N131)