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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE STANDARD

SAE AS22145

Issued 1999-07

Accelerometer Group, Counting (MS25447 and MS25448)

FSC 6610

NOTICE

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1. SCOPE:

1.1 Scope:

This specification covers the design and performance requirements for a single axis, four load-factor level counting accelerometer group referred to hereafter as “equipment.”

1.2 Classification:

The equipment covered by this specification shall consist of one transducer and one indicator (see 3.4.1) as specified below:

Item	Applicable Military Standard Type Designation
Transducer	MS25447
Indicator	MS25448

2. APPLICABLE DOCUMENTS:

2.1 Government documents:

2.1.1 Specifications and standards: The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.3).

SPECIFICATIONS

FEDERAL

TT-P-1757	Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity

MILITARY

MIL-W-5088	Wiring, Aerospace Vehicle
MIL-E-5400	Electronic Equipment, Airborne, General Specification for
MIL-E-15090	Enamel, Equipment, Light Gray (Formula No. 111)
DOD-P-15328	Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric)
MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts): Packaging of
MIL-T-18303	Test Procedures; Preproduction, Acceptance, and Life for Aircraft Electronic Equipment, Format for

2.1.1 (Continued):

MIL-N-18307	Nomenclature and Identification for Aeronautical Systems Including Joint Electronics Type Designated Systems and Associated Support Systems
MIL-M-38510	Microcircuits, General Specification for

STANDARDS

FEDERAL

FED-STD-595	Colors Used in Government Procurement

MILITARY

MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-781	Reliability Testing for Engineering Development, Qualification, and Production
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-2073-1	DoD Materiel Procedures for Development and Application of Packaging Requirements
MIL-STD-2076	Unit Under Test Compatibility With Automatic Test Equipment, General Requirements for
MIL-STD-2077	General Requirements Test Program Sets
MIL-STD-2084	General Requirements for Maintainability of Avionic and Electronic Systems and Equipment
MS3134	Connector Receptacle, Electric, Solder Type, Jam Nut Mounting, Push-Pull Coupling, Series 1 (Class E, P, J and H)
MS3137	Connector Plug, Electric, Solder Type, Push-Pull Coupling Series, (Class E, P and J)
MS25447	Transducer, Counting Accelerometer
MS25448	Indicator, Counting Accelerometer
MS33558	Numerals and Letters, Aircraft Instrument Dial, Standard Form of

(Unless otherwise indicated, copies of federal and military specifications, standards and handbook are available from the DODSSP Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence:

In the event of a conflict between the text of this document and the references cited herein (except for related associated military standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS:

3.1 First article:

When specified (see 6.4), a sample shall be subjected to first article inspection in accordance with 4.3.

3.2 Parts and materials:

In the selection of parts and materials, fulfillment of major design objectives shall be the prime consideration. The following design criteria shall govern:

a. Microelectronic items shall conform to requirements specified in MIL-M-38510.

b. Other parts and materials requirements shall conform to MIL-E-5400.

c. Nonrepairable subassemblies, as specified in MIL-E-5400, shall be used when practicable. The general size of the subassembly and the amount of circuitry to be included therein shall be approved by the acquisition activity. Nonrepairable subassemblies shall be reliable (see 6.6).

d. When previously produced models of this equipment did not use nonrepairable subassemblies, the design shall not be changed to employ nonrepairable assemblies without the approval of the acquisition activity.

3.2.1 Modules, maintenance: The electronic portions of the equipment shall be divided into maintenance modules (see MIL-STD-2084). Maintenance modules shall be considered nonrepairable.

3.2.2 Nonmagnetic materials: Nonmagnetic materials shall be used for all parts of the equipment except where magnetic materials are essential.

3.2.3 Filling medium: When required by the transducer design, a gas or oil may be used which conforms to the equipment characteristics and requirements of this specification.

3.3 Design and construction:

Except as otherwise specified in the counting accelerometer group, the equipment shall conform to all the applicable requirements of MIL-E-5400 for design, construction and workmanship.

3.3.1 Total weight: The total weight of the equipment, excluding cables, shall not exceed 5 pounds.

3.3.2 Reliability:

3.3.2.1 Operational stability: The equipment shall operate continuously or intermittently, for at least 500 operations without the necessity of readjustment of controls which are inaccessible to the operator during normal use.

3.3.2.2 Operating life: The equipment shall have a total operating life of 100,000 operations with reasonable servicing and replacement of parts.

3.3.2.3 Reliability in mean time between failures (MTBF): For the test program under 4.5.3, the mean time between failures shall be 50,000 operations.

3.3.3 Cabling and connections:

3.3.3.1 Cables and connectors: The equipment shall provide for the use of cables and connectors in accordance with MIL-STD-454, Requirement 10, and figure 1 of this specification.

3.3.3.2 Interconnection cabling: The equipment shall be capable of satisfactory operation using external wiring in accordance with the applicable requirements of MIL-W-5088, the external wiring shall be unshielded, except that a minimum number of the individual wires may be shielded when demonstrated as necessary to meet interference control requirements and provided the assembly of the cable to its plugs may be easily accomplished. External cables and that portion of the connectors attached to the cables shall not be supplied as part of the equipment.

3.3.4 Interchangeability: The equipment shall meet the interchangeability requirements of MIL-STD-454, Requirement 7.

3.3.4.1 Interchangeability of reordered equipment: For reordered equipment, interchangeability shall exist between all units of any previously manufactured equipment as supplied or designated by the acquisition activity. Such interchangeability shall be measured against the supplied or designated model, drawings, and other technical information provided for this purpose. In the event the contract or order does not stipulate whether the model, drawings, or other information shall govern, the designated model shall be used.

3.3.5 Interference control: The generation of radio interference by the equipment and vulnerability of the equipment to radio interference shall be controlled within the limits specified in MIL-STD-461 when tested in accordance with 4.7.

3.3.6 Interface requirements: The equipment shall be capable of operation while using the external wiring conforming with the detailed requirements of 3.3.3.2, 3.4.1.1 and figure 1. The equipment shall be interchangeable with all units previously acquired by this specification. Internal and external wiring, dimensions, design, assemblies, circuits, etc., shall conform to the required interface of all equipment of previous acquisitions.

3.3.7 Provisions for maintainability: Provisions for maintainability shall be as specified in MIL-STD-454, Requirement 54. Built-in test equipment, construction and packaging, and provisions for test points to the greatest extent practicable for ease of field testing and maintenance shall be as specified in MIL-STD-2084. Equipments that are required to be compatible with the Versatile Automatic Shop Test (VAST) System shall be in accordance with MIL-STD-2076. When required, VAST System Test Programs shall be furnished in accordance with MIL-STD-2077.

3.3.8 Nameplates: Nomenclature assignment and nameplate approval for equipment identification shall be in accordance with MIL-N-18307.

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

Temperature	Room ambient (25°C ±5°C)
Altitude	Normal ground
Vibration	None
Humidity	Room ambient up to 90 percent relative humidity
Input power voltage	27.5 ±0.5 VDC

3.3.10 Service conditions: The equipment shall operate satisfactorily under any of the environmental service conditions or reasonable combination of these conditions specified in MIL-E-5400 for Class 2 equipment, except as modified herein.

3.3.11 Vibration: The equipment shall operate in accordance with the specified performance requirements when subjected to the vibration requirements of figure 2.

3.3.12 Primary input power requirements: The equipment shall meet all applicable requirements of MIL-STD-704 and shall give specified performance from the following power sources with characteristics as defined in MIL-STD-704 having limits as specified therein. The power required shall not exceed the specified amounts.

a. DC power, +28V Category A, 1.5 Amps.

3.3.13 Test conditions and equipments:

3.3.13.1 Standard conditions: Unless otherwise specified, all tests required by this specification shall be made under the conditions of 3.3.9 herein.

3.3.13.2 Attitude: Unless otherwise specified, the equipment shall be tested with the sensing axis normal to the direction of the earth's gravitational field.

3.3.13.3 Vibration stand: The vibration stand shall be capable of subjecting the accelerometer groups to accelerations from 0.1 to 10.5g within the frequency range of 5 to 2000 Hz.

3.3.13.4 Static calibration and dynamic test equipment: The equipment used for static calibration and dynamic tests shall be capable of determining load-factor levels within the limits required by 4.5.1.4 and 4.5.2.4 of this specification.

3.4 Detail requirements:

3.4.1 Counting accelerometer group: The equipment shall consist of two components:

a. A hermetically sealed force-balance accelerometer (referred to as the transducer) which shall furnish voltage signal outputs, proportional to applied accelerations, and provide filter circuitry for required dynamic response, and test circuits; and

b. A counting accelerometer display (referred to as the indicator) which shall have: 1. electromechanical counters with associated circuits to indicate the number of times the aircraft is subjected to load factors of preset levels; 2. a group power supply section with voltage regulation providing 18.5 ±0.5 Vdc for the proper signal voltage functions of both the indicator and the transducer; 3. a delay circuit permitting satisfactory load level counting without interference; 4. an inhibitive circuit precluding registration of improper counts during initial application of power; and 5. a digital lockout circuit which precludes registration of counts when the load factor maneuver has a duration of less than 150 milliseconds.

The accelerometer group, when electrically interconnected, shall provide signals and control circuits as shown on figure 1.

(1) The transducer shall provide signals on wire numbers 3 and 4 with system reference to wire number 1 as follows:

	VDC	
Load	Wire 3	Wire 4
+1g	1.1 ±0.9	0.9 ±0.4
Reset level	7.8 ±2.0	0.9 ±0.4
Counter #1 level	12.5 ±1.0	0.9 ±0.4
Counter #2 level	12.5 ±1.0	6.8 ±1.3
Counter #3 level	12.5 ±1.0	11.45 ±0.85
Counter #4 level	12.5 ±1.0	18.0 ±0.5

(2) The indicator shall be capable of proper respondence to the above signal level of the transducer as specified.

3.4.1 (Continued):

(3) The following equipment impedances shall apply to figure 1:

J101 Pin Numbers	Equipment Impedance Transducer Ohms	Indicator Ohms
1	reference +	reference +
2	225 ±12	1 Max
3	4600 ±250	100K ±10K (a) 40 Max (b)
4	55 ±10	1-5M
5	1650 ±50	(c)
6	0 to 20	(c)

All impedance shall be measured with respect to pin 1 J101 + system ground (common for wires 2, 3 and 4)
(a) when signal voltage is less than 12 Vdc
(b) when signal voltage is 12 Vdc or greater
(c) not to be used

3.4.1.1 Wiring: The wiring of the accelerometer group shall be in accordance with MIL-E-5400 and shall operate in the environment stated herein. The wiring of each component shall comply with the requirements specified in 3.3.6, 3.4.1 and figure 1.

3.4.1.2 Electrical protection: The equipment shall provide electrical protection for overvoltage in accordance with MIL-E-5400 and shall automatically resume normal operation when the voltages return within limits. In addition, electrical protection for undervoltage conditions shall be provided to ensure that normal operation shall automatically resume when the voltage returns within limits.

3.4.1.3 Painting: External surfaces shall be painted in accordance with MIL-E-15090, formula II with color 26329 as specified in FED-STD-595.

3.4.1.4 Protective coating: The protective coating and finishing procedure shall conform to the requirements of DOD-P-15328 and TT-P-1757.

3.4.1.5 Case: The components shall be constructed of lightweight, nonmagnetic metal, uniform in texture and having a smooth surface in accordance with MIL-E-5400.

3.4.1.6 Dynamic response: The dynamic response of the counting accelerometer group to sinusoidal inputs shall be flat to within ±2 percent from zero to 2.5 Hz. Above 2.5 Hz, the output per "g" shall decrease smoothly at an average rate not less than 18dB per octave. The equipment shall indicate counts at single-amplitude load-factor levels specified in table I, within the following limits:

a. ±0.15g for load-factor levels of 2.0g to 5.0g.
b. ±0.20g for load-factor levels of 5.5g to 7.0g.
c. ±0.30g for load-factor levels of 7.5g to 10.0g.

The indicator shall not indicate a count on operation with sinusoidal or square wave inputs of 4.0 Hz and above.

3.4.2 Transducer: The transducer shall have four load-factor levels and a reset level. The levels shall be the values specified in table I.

3.4.2.1 Size: The maximum outline dimensions of the transducer shall be as shown in MS25447.

3.4.2.2 Weight: The weight of the transducer shall not exceed 1.5 pounds.

3.4.2.3 Markings: Each transducer shall have indicated on the case, the location of the center of gravity of the seismic mass and the direction of mounting to obtain positive vertical accelerations.

3.4.3 Indicator: The indicator shall contain four counters, each counter displaying four digits. The design shall be in accordance with MS25448. The four counters shall not respond to sinusoidal or square wave input voltages at frequencies of 4.0 Hz and above. The circuit of the indicator shall prevent the counters from counting until the load-factor level has returned to the reset level or below, as specified in table I.

3.4.3.1 Size: The size of the indicator unit shall be in accordance with MS25448.

3.4.3.2 Weight: The weight of the indicator unit shall not exceed 3.5 pounds.

3.4.3.3 Window material: The window material shall be clear and free from flaws which would interfere with normal readings of the counters and shall otherwise conform to this specification.

TABLE I. Load-factor and reset levels.

MS Part No.	Counter 1	Counter 2	Counter 3	Counter 4	Reset Levels
MS25447-1	2.00	2.50	3.00	3.50	1.50 + 0 - 0.25
MS25447-2	2.50	3.50	4.00	4.50	1.75 ±0.20
MS25447-3	2.50	3.50	4.50	5.50	1.75 ±0.20
MS25447-4	3.00	4.00	5.00	6.00	2.00 ±0.20
MS25447-5	4.00	4.50	5.00	5.50	2.50 ±0.20
MS25447-6	4.00	5.00	6.00	7.00	2.50 ±0.20
MS25447-7	5.00	6.00	7.00	8.00	3.00 ±0.20
MS25447-8	5.50	6.00	6.50	7.00	3.25 ±0.20
MS25447-9	6.00	7.00	8.00	9.00	3.50 ±0.20
MS25447-10	6.00	7.00	8.50	10.00	3.50 ±0.20
MS25447-11	2.50	3.00	3.50	4.00	1.75 ±0.20
MS25447-12	2.50	3.50	4.50	5.00	1.75 ±0.20
MS25447-13	3.00	3.50	4.00	4.50	1.75 ±0.20
MS25447-14	3.50	4.00	4.50	5.00	2.50 ±0.20
MS25447-15	3.50	4.50	5.50	6.00	2.50 ±0.20
MS25447-16	6.50	7.50	8.50	9.50	3.50 ±0.20
MS25447-17	7.00	8.00	9.00	10.00	3.50 ±0.20

3.4.3.3.1 Distance from window to counter: The distance from any window to its counter shall be as small as practicable and shall not exceed 0.156-inch.

3.4.3.4 Counters: Four counter units shall be provided. The counters shall be viewed through windows in the indicator case and shall indicate the occurrence of load factors.

3.4.3.5 Counter markings: All the counter dials shall have the following numerals: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The digit height shall be 0.150- to 0.201-inch, and the line thickness shall be 0.018- to .0270-inch. The style and proportions of the numerals placed on the dial shall conform to MS33558. The colors shall be lusterless white color no. 37875 and lusterless black color no. 37038 in accordance with FED-STD-595.

3.4.3.5.1 Visibility of counter numerals: The numerals on the counter shall be visible from any point within the frustrum of a cone whose sides make an angle of 30 degrees with a perpendicular to the counter and whose small diameter is the aperture of the indicator case. When the indicator is viewed from all angles forward of the plane of the indicator face, only the numerals representing the present count shall be visible; the next advancing and next receding numerals shall not be visible.

3.4.3.6 Markings: Each counter of the indicator shall be identified by number. The lowest number shall correspond to the lowest load level counter until all counters are identified.

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance: All items shall 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections:

The inspection requirements specified herein are classified as follows:

a. First Article Inspection (see 4.3).
b. Initial Production Tests (see 4.4).
c. Quality Conformance Inspections (see 4.5).
d. Life Tests (see 4.8).

4.3 First article inspection:

First article inspection shall be made on an equipment representative of the production equipments to be supplied under the contract (see 6.4). First article inspection shall consist of the tests specified in table II and in the order listed. The Government Inspector and the acquisition 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 required tests shall obtain the services of a commercial testing laboratory acceptable to the Government (see 6.12).

TABLE II. First article inspection.

Tests	Paragraph
Examination of product	4.5.1.1
Acceleration test	4.3.1
Impact test	4.3.2
Operational test	4.5.1.2
Dielectric test	4.5.1.3
Static calibration test	4.5.1.4
Leak test	4.5.1.5
Indicator circuit test	4.5.1.6
Counting rate test	4.5.1.7
Electromagnetic compatibility	4.7
Vibration	4.5.2.2
Temperature shock	4.5.2.3
Dynamic test	4.5.2.4
Low temperature	4.5.2.5
High temperature	4.5.2.6
Reliability assurance	4.5.3
Humidity	4.6.1
Fungus	4.6.2
Salt fog	4.6.3
Explosive atmosphere	4.6.4
Life test	4.8

4.3.1 Acceleration test: With electrical power off, the accelerometer group shall not record any counts when subjected to 10g for one minute along each of three mutually perpendicular axes. (One of these mutually perpendicular axis shall be the sensitive axis of the transducer.) With electrical power on, the accelerometer group shall record only one count when subjected to 10g along the sensitive axis of the transducer with the indicator in its normal position. This test shall be repeated with the transducer remaining in the sensitive axis position and the indicator rotated to each of the remaining mutual perpendicular axis. Upon completion of this test, the equipment shall be subjected to the static calibration test.

4.3.2 Impact test: With electrical power off, the counting accelerometer group shall not record any counts when subjected to three impacts of 25g in each direction along each of its three mutually perpendicular axes for a total of 18 impacts. Each impact shall be a half sine-wave with a rise time of approximately 5.5 milliseconds and a time duration of 11 ±1 milliseconds.

4.3.3 Production equipments: Equipments supplied under the contract shall be in all respects, including design, construction, workmanship, performance and quality, equivalent to the approved first article sample. Each equipment shall be capable of successfully passing the same tests as imposed on the first article sample. Evidence of non-compliance with the above shall constitute cause for rejection. For equipment already accepted by the Government, it shall be the obligation of the contractor to make necessary corrections as approved by the acquisition activity (see 6.12).

4.4 Initial production tests:

The equipment shall be selected by the acquisition activity after it has successfully passed all individual tests. The first article sample shall not be selected for this test.

4.4.1 Scope of tests: This equipment shall be subjected to any and all tests to ensure that the production equipment is equivalent to the previously approved first article sample in design, construction, workmanship, performance, and quality and that it meets all applicable requirements.

4.4.2 Initial production sample approval: The acquisition activity will approve the initial production sample upon satisfactory completion of all tests. Corrective action shall also be accomplished on equipment previously accepted when requested by the acquisition activity.

4.5 Quality conformance inspection:

The contractor shall furnish all samples and shall be responsible for accomplishing the quality conformance inspections. All inspection and testing shall be under the supervision of the Government Inspector. Contractors not having testing facilities satisfactory to the acquisition activity shall engage the service of a commercial testing laboratory acceptable to the acquisition 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. Acceptance shall be by lots, and tests shall consist of the following:

a. Individual Tests (see 4.5.1).
b. Sampling Tests (see 4.5.2).
c. Reliability Assurance Tests (see 4.5.3).
d. Special Tests (see 4.5.4).

4.5.1 Individual tests: Each equipment 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 equipment accepted shall have passed the tests specified in table III and conducted in the order listed.

TABLE III. Individual tests.

Tests	Paragraph
Examination of Product	4.5.1.1
Operational Test	4.5.1.2
Dielectric Test	4.5.1.3
Static Calibration Test	4.5.1.4
Leak Test	4.5.1.5
Indicator Circuit Test	4.5.1.6
Indicator Counting Rate Test	4.5.1.7

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

4.5.1.2 Operational test: Each equipment shall be operated long enough to permit the equipment temperature to stabilize and to enable the operator to check sufficient characteristics and record adequate data to ensure satisfactory equipment operation.

4.5.1.3 Dielectric test:

4.5.1.3.1 Transducer: A potential of 200 Vdc shall be applied between isolated pins and between pins and case for 5 seconds. During application of this voltage, the insulation resistance measured shall not be less than 3.5 megohms.

4.5.1.3.2 Indicator: A potential of 500 Vdc shall be applied between isolated pins and between pins and case for 5 seconds. During application of this voltage, the insulation resistance measured shall not be less than 3.5 megohms.

4.5.1.4 Static calibration test: A static calibration shall be conducted on each transducer connected to an indicator to determine that the load-factor and reset levels are within the limits of table I. All calibrations shall remain within ±0.10g of the levels specified in table I for load-factors of 2.00 to 7.00g and ±0.15g for load-factor levels of 7.50 to 10.00g. These limits shall apply before and after the transducer is subjected to environmental tests. An electrical vibrator set at 60 Hz with a maximum amplitude of 0.002-inch when attached to the transducer shall be used to impart vibrations to the transducer. All calibrations shall remain within the limits specified by this paragraph when the calibrations are obtained with and without the vibrator. The reset channel shall be calibrated for increasing and decreasing load-factor. The difference between the calibration levels of the reset channel under increasing and decreasing load-factors shall remain within the limits specified by this paragraph. For first article, initial production, quality conformance, reliability assurance, and special tests, the static calibration test shall be performed on an equal number of transducers and indicators connected together as a counting accelerometer group. The transducers and indicators shall be randomly interchanged on subsequent tests performed following each environmental test.

4.5.1.5 Leak test: Each transducer shall be tested for case leakage with either a mass spectrometer or by an equally sensitive leak test. The gas, or mixture of gases, in the case, adjusted to a pressure differential of one atmosphere, shall not have a leakage rate from the case exceeding 1 micron cubic foot per hour (10^{-5} cubic centimeters per second). Oil-filled transducers shall be leak tested, prior to filling with oil, by means of the mass spectrometer. The measured leak rate shall not exceed an equivalent of 1 cubic centimeter of air/year/inch of seal.

4.5.1.6 Indicator circuit test: The counter shall not count when subjected to the following test: Three continuous load cycles that vary from above the highest load-factor level to above the reset level, but lower than the first load level. (NOTE: The counters shall have counted once when returned to a value less than the rest level after completion of the test.) The first counter shall not count when subjected to the following test: Twelve continuous load cycles, at a minimum rate of 1 Hz, varying from just below the first load-factor level to just below the reset level.

4.5.1.7 Counting rate test: The counting accelerometer group shall be subjected to a sinusoidal or square wave input of 1, 2 and 2.5 Hz. The counters shall operate for a minimum of 150 counts and each counter shall be advanced by the same number of incremental counts. There shall be no counts at 4 Hz and above.

4.5.2 Sampling tests: Equipments selected for sampling tests shall first have passed the individual tests before sampling tests are conducted. Counting accelerometer groups shall be selected at random for sampling tests by the Government Inspector in accordance with the following:

Quantity of Counting Accelerometer Groups Offered for Acceptance	Quantity to be Selected for Testing
100 or less	5
Each additional 100 or fraction thereof	5

4.5.2.1 Scope of tests: Each sample selected shall be subjected to the tests specified in table IV and conducted in the order listed.

TABLE IV. Sampling tests.

Test	Paragraph
Vibration Test	4.5.2.2
Temperature Shock Test	4.5.2.3
Leak Test	4.5.1.5
Dynamic Tests	4.5.2.4
High Temperature Test	4.5.2.5
Low Temperature Test	4.5.2.6

4.5.2.2 Vibration: Tests shall be conducted under ambient room conditions and also at -54°C and 125°C. The time specified in table V shall be divided as follows: 50 percent at room ambient, 25 percent at -54°C, and 25 percent at 125°C. Total time of the tests shall be 9 hours for the three mutually perpendicular axes of the counting accelerometer group.

TABLE V. Vibration test schedule.

Test	Hours (Time shown refers to one axis of vibration)			
Number of Resonances	0	1	2	3
Total Vibration Time at Resonance*	-	1/2	1 hr	1-1/2 hrs
Cycling Time	3 hrs	2-1/2 hrs	2 hrs	1-1/2 hrs

*30 minutes at each resonance.

4.5.2.2 (Continued):

The counting accelerometer group shall be normally mounted on the vibration equipment. The mounting shall simulate service installation orientation. The test fixture shall be free of resonances through 1000 Hz. Power shall be applied to the counting accelerometer group during the following steps:

Step 1, resonance survey - Resonance modes and/or minimum performance points of the equipment shall be determined by varying the frequency of applied vibration slowly through the range of 5 to 500 Hz at a double amplitude not exceeding those indicated in figure 2. Individual resonance survey shall be conducted with vibration applied along each of the three mutually perpendicular axes of the counting accelerometer group.

Step 2, resonance vibration - With the counting accelerometer group mounted on the test fixture, vibration shall be applied at each of the individual resonance points obtained in step 1 at the double amplitude indicated in figure 2. Vibration shall be 30 minutes at each resonance and/or minimum performance points. If more than 3 resonant modes and/or minimum performance points are noted for any one axis, the three most severe shall be used for each axis. At the completion of this step, the counting accelerometer group shall be inspected for evidence of any mechanical failure. Any counting accelerometer counts recorded during the vibration tests shall constitute a failure.

Step 3, cycling - The counting accelerometer group shall be vibrated in accordance with the requirements of figure 2 over the frequency range of 5 to 500 Hz. The variation in frequency shall be at a logarithmic rate; however, if logarithmic cycling is not available, a linear rate of frequency change may be used. The cycle from 5 to 500 Hz and return to 5 Hz shall be accomplished in approximately 15 minutes including at least 3/4 minute in the region below 25 Hz if the linear rate of frequency change is used. The vibration test schedule in table V indicates the times required for cycling. At the completion of this step, the counting accelerometer group shall be inspected for evidence of any mechanical failure. Any accelerometer counts recorded during this test shall constitute a failure.

Steps 1 through 3, above, shall be repeated for each of three mutually perpendicular axes of the counting accelerometer group.

4.5.2.3 Temperature shock test: The counting accelerometer group shall be subjected to the temperature shock test of MIL-STD-810, Method 503.3, except that the high temperature shall be 125°C and low temperature shall be -54°C. Upon completion of the above test, the accelerometer group shall be subjected to the static calibration test.

4.5.2.4 Dynamic test: Counting accelerometer groups shall be subjected to the dynamic tests as specified herein. The transducers and indicators shall be randomly interchanged on subsequent tests following each environmental test.

4.5.2.4.1 Dynamic calibration: The transducer shall be calibrated against known sinusoidal acceleration inputs of 1, 2 and 2.5 Hz. The counting accelerometer group shall count at the single-amplitude, load-factor levels prescribed in table I within the limits specified in 3.4.1.6. The calibrations shall remain within these specified limits before and after the counting accelerometer group has been subjected to the environmental tests. This test shall be performed by subjecting the counting accelerometer group to the stated frequencies of this specification and shall be accomplished upon a suitable mechanical dual centrifuge or by approved electrical acceleration simulations.

4.5.2.4.2 Calibration with superimposed vibration: The test shall be conducted with the transducer and indicator connected electrically as a group. The transducer shall be subjected to static load-factor levels upon which are superimposed sinusoidal inputs along the sensitive axis of the transducer. The superimposed vibration shall be applied at a rate varying logarithmically or linearly at a rate over the range of 5 to 120 Hz at the amplitude specified in table VI for a duration of 5 minutes for each sweep of the specified range. The following sequence shall apply:

a. Apply a static load-factor level to the transducer until the reset level as determined by the static calibration (see 4.5.1.4) is reached. Apply the superimposed vibration as specified above. There shall be no counts nor storage of counts.

b. Increase the static load-factor level to a level 0.20g below the value of the first load-factor level of table I. Apply the superimposed vibration as specified above. There shall be no counts nor storage of counts.

c. Increase the static load-factor level in increments of 0.05g and apply the superimposed vibration as specified above, at each increment until the load level with vibration is determined. This load level shall be within ±0.15g of the load-factor level values in table I for the specified range of the transducer.

d. Repeat b and c for each of the next three load-factor levels.

e. Decrease the static load-factor level until the reset level of the transducer is reached. Apply the superimposed vibration as specified above. There shall be only one count registered on the indicator for each of the four load-factor levels. Figure 3 is a typical example of the superimposed vibration.

f. The static load-factor level may be applied by an electrical signal, but the superimposed vibrations of table VI must be applied by actual mechanical vibration of the transducer as a unit.

TABLE VI. Amplitude ratings.

Frequency (Hz)	Amplitude (inch or "g")
5 to 30	0.10 inch double amplitude
31 to 120	4.5g single amplitude

4.5.2.5 Low temperature test: The accelerometer group shall be subjected to a temperature of -54°C for 8 hours. At the end of the 8 hours and at -54°C, the indicator counting rate test, the indicator circuit test, the static calibration test, and the dynamic tests shall be performed.

4.5.2.6 High temperature test: The accelerometer group shall be subjected to a temperature of 125°C for 4 hours. At the end of 4 hours, and at 125°C, the counting rate test, the indicator circuit test, the static calibration test, and the dynamic tests shall be performed.

4.5.3 Reliability assurance tests: Reliability assurance tests shall be conducted in accordance with MIL-STD-781. For the applicable test plan, 50,000 operations shall be considered one "MTBF." An operation shall be the cycling of the transducer from zero load-factor level to maximum load-factor level and return to below the reset load-factor level. Tests as required by both the Qualification Phase and the Sampling Phase shall be conducted.

4.5.3.1 Qualification phase: Prior to acceptance of equipments under the contract or order, a minimum of three equipments (transducers and indicators) shall be tested as specified in MIL-STD-781, under the section entitled "Qualification Phase of Production Reliability Tests." The type designation and the quantities of the equipment together with assigned load-factor levels for the tests shall be designated by the acquisition activity (see 6.3). The maximum number of equipments to be used are listed in table V of MIL-STD-781. For the Qualification Phase, Test Level F shall be used. The Accept-Reject Criteria for Test Plan IV shall be used.

4.5.3.2 Reliability sampling phase tests: Samples of the equipment shall be tested as specified in MIL-STD-781, under the section entitled "Sampling Phase of Product on Reliability Tests." For the Sampling Phase, Test Level F shall be used. The Accept-Reject Criteria for Test Plan VI shall be used to determine the length of the tests until the accept-or-reject decision is reached. The type designation and the quantities of the equipment, together with assigned load-factor levels for the tests, shall be designated by the Government Inspector.

4.5.3.2.1 Lot size for sampling phase: The equipments constructed during one month shall be one lot. Unless otherwise specified in the contract or order, no equipments shall be shipped until an Accept decision is reached under each lot.

4.5.3.3 Temperature cycle: Each accelerometer group undergoing test shall be subjected to a minimum of three complete temperature cycles as required by the specified test level. At least once during the high temperature cycle, at the stabilization portion of each temperature cycle, the dynamic test shall be performed.

4.5.3.4 Performance characteristics to be measured: The performance characteristics to be measured shall be as specified as follows:

a. The transducers when subjected to nominal load-factor levels shown in table I within the limits specified in 4.5.1.4 and 4.5.3.4 shall generate signal outputs to the indicator. The indicator shall receive these signals and display on its four counters the exact number of times this has occurred. This transducer output signal generation together with the related indication signal receipt and exact counter display for a nominal load-factor level, as described herein, shall constitute an operation.

4.5.3.5 Failure criteria: In addition to the requirements of MIL-STD-781, the following requirements shall be used to determine when a failure has occurred during the test:

a. Whenever performance characteristics fall below the acceptance requirement specified in 4.5.3.4, at least one failure has occurred. If subsequent analysis reveals that several parts have deteriorated, each shall be counted as a failure, unless one caused other parts to fail.

b. Whenever a complete operation of the counting accelerometer group does not count on the appropriate indicator counter, it is a failure. Under the same condition, an excessive number of counts is a failure.

4.5.3.6 Preventive maintenance: During the tests, no preventive maintenance may be performed upon the equipment.

4.5.4 Special tests: Special tests shall be conducted on a quantity of equipments for the purpose of checking the effect of any design or material change on the performance of the equipment and to ensure adequate quality control. The equipment selected for special tests may be selected from equipments previously subjected to the sampling or reliability assurance tests.

4.5.4.1 Special test schedule: Selection of equipments for special tests shall be made as follows:

a. On an early equipment after an approved engineering or material change.

b. Whenever failure reports or other information indicate additional tests are required. (This shall be authorized by the acquisition activity.)

4.5.4.2 Scope of tests: Special tests shall consist of such tests as approved by the acquisition activity. Test procedures previously approved for the first article inspections shall be used where applicable. When not applicable, the contractor shall prepare a test procedure and submit it to the acquisition activity for approval prior to conducting the tests.

4.6 Environmental tests:

4.6.1 Humidity: The equipment shall be subjected to the humidity test of MIL-STD-810, Method 507.3, except that in steps 1 and 2, the temperature of 50°C shall be replaced by a temperature of 72°C.

4.6.2 Fungus resistance: The equipment shall be subjected to the fungus resistance test of MIL-STD-810, Method 508.4.

4.6.3 Salt fog: The equipment shall be subjected to the salt fog test of MIL-STD-810, Method 509.3.

4.6.4 Explosive atmosphere: The equipment shall be subjected to the explosive atmosphere test of MIL-STD-810, Method 511.3.

4.7 Electromagnetic compatibility:

The equipment shall be tested in accordance with the test method defined in MIL-STD-462 to meet the requirements of 3.3.5.

4.8 Life test:

The contractor shall furnish all life test samples and shall be responsible for accomplishing the life test. The equipment shall have a total operating life of 100,000 operations with reasonable servicing and replacement of parts. A 100,000 operation life test shall be conducted on the transducer and indicator. An operation shall be the cycling of the transducer from zero load-factor level to maximum load-factor level and return to below the reset load-factor level. All four counters shall count once for each operation. The life test for the equipment shall be conducted on those samples representative of the equipment being produced (see 6.12). The equipment shall have all four load-factor levels and the reset level operated in the following sequence:

10,000 operations at -54°C
10,000 operations at +125°C
10,000 operations at room temperature
10,000 operations at -54°C
10,000 operations at +125°C
10,000 operations at room temperature
10,000 operations at -54°C
10,000 operations at +125°C
20,000 operations at room temperature

Quantity of Equipments Offered for Acceptance	Quantity to be Selected for Life Tests
First 25	1
Next 175	1
Next 300	1 for each additional 500 or fraction thereof

4.8.1 Test periods: The test may be run continuously or intermittently. Any period of operation shall be of sufficient duration to permit the equipment temperature to stabilize. Periodically, the equipment shall be turned on and off several times and put through its various phases of operation.

4.8.2 Performance check: At every 10,000 operations at the completion of the life test, a limited performance check shall be made. The performance check proposed by the contractor shall be subject to approval by the acquisition activity. This performance check shall include subjecting the equipment to and meeting the requirements of 4.5.1.4 and 4.5.2.4.

4.9 Equipment failure:

If a failure occurs during the individual tests, the sampling tests, reliability assurance tests, special tests or life tests, the following action shall be taken:

a. Determine the cause of failure.

b. Determine if the failure is an isolated case or design defect.

c. Where practical, include a new test in the individual test section to check all equipment for this requirement until reasonable assurance is obtained that the defect has been satisfactorily corrected.

4.10 Reconditioning of tested equipment:

Equipment that has been subjected to initial production, quality conformance and life tests shall be reconditioned by the contractor by replacing all worn or damaged items. After reworking, the contractor shall resubmit the equipment for acceptance.

4.11 Presubmission testing:

No equipment shall be submitted by the contractor until it has been previously tested and inspected by the contractor and complies with all applicable requirements specified herein.

4.12 Rejection and retest:

Equipment that has been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished to the Government Inspector.

5. PACKAGING:

5.1 General:

All major units and parts of the equipment shall be preserved, packaged, packed and marked for the level of shipment specified in the contract or order in accordance with MIL-E-17555 and MIL-STD-2073-1. In the event the equipment is not covered in MIL-E-17555, the method of preservation for level A shall be determined in accordance with MIL-STD-2073-1.

6. NOTES:

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use:

The counting accelerometer groups covered by this specification are intended for use on aircraft to indicate the number of times that the aircraft has experienced selected and predetermined acceleration load-factor levels during airborne operations.

6.2 Test values:

Normal and limiting values of performance data should be determined at input voltage of 27.5 ±0.5 Vdc. These data are to be used in testing the equipment at installation points for compliance with minimum acceptable standards of performance.

6.3 Acquisition requirements:

Acquisition documents must specify the following:

a. Title, number and date of the specification.

b. Selection of applicable levels of packaging and packing (see 5.1).

c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).

d. Type designation (MS part number), the quantity, and the load-factor levels for the reliability qualification phase tests.

e. The designated model, drawings and other technical data to be made available by the acquisition activity.