INCH-POUND

MIL-PRF-25435D
3 July 2008
SUPERSEDING
MIL-PRF-25435C
1 April 1997

PERFORMANCE SPECIFICATION

TRANSMITTERS, PRESSURE, AIRCRAFT
GENERAL SPECIFICATION FOR

Comments, suggestions, or questions on this document should be addressed to: Oklahoma City Air Logistics Center/ENSDAA, 3001 Staff Drive, Tinker AFB, OK 73145-3036 or emailed to af71@tinker.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

AMSC N/A

FSC 6620

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for aircraft pressure transmitters.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are cited in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of these lists, document users are cautioned that they must meet the requirements specified in the documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL STANDARDIZATION AGREEMENTS

STANAG 3209	-	Tyre Valve Couplings

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-I-25437	-	Indicators, Aircraft, Pressure, Voltage Ratio Type, General Specification For
MIL-PRF-7808	-	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MS33678	-	Connector, Receptacle, Electrical, Integral Mounting

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-704	-	Aircraft Electric Power Characteristics
MIL-STD-810	-	Environmental Test Methods

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3. Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Testing Apparatus

(ASTM documents may be obtained at www.astm.org <http://www.astm.org> or addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AS8879 - Screw Threads - UNJ Profile, Inch
Controlled Radius Root with Increased Minor Diameter

SAE AS5202A - Port or Fitting End, Internal Straight Thread

(SAE documents may be obtained at www.sae.org <http://www.sae.org/> or from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale PA 15096.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the test 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 6.2), the transmitter shall be subjected to first article inspection in accordance with 4.2.

3.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the materials meet or exceed the operational and maintenance requirements, and promote economically advantageous life cycle cost.

3.3 Materials. Unless otherwise specified, materials shall be nonmagnetic, nonferrous, and shall be compatible with titanium alloys. Materials shall not produce deleterious fumes, and shall be treated to resist corrosion due to electrolytic decomposition, fungus, salt spray, alcohol, fuels, oils, hydraulic fluids, and any other conditions that may be encountered during operational use or storage. No liquid such as silicone oil is to be used to fill the transmitter without the specific approval of the preparing activity.

3.4 Interface.

3.4.1 Dimensions. The transmitter case shall conform to the dimensions in Figure 1.

3.4.2 Pressure indicator. The transmitter shall be designed for operation with indicators conforming to the requirements of MIL-I-25437.

3.4.3 Vent connection. The vent pressure connection shall have a threaded boss in accordance with SAE AS5202-04 shown in Figure 1. The connection shall withstand a 25 foot-pound bending moment applied in any direction perpendicular to the longitudinal axis of the connection without distortion of the base plate, damage to welds, or change in calibration.

3.4.3.1 Vent markings. The vent connection shall be permanently marked VENT, with the letters clearly visible and easily readable.

3.4.4 Electrical connector. The transmitter shall have an MS33678R10SL-3P electrical connector. The connector shall withstand a 25 foot-pound bending moment applied in any direction perpendicular to the longitudinal axis of the connector without distortion of the base plate, damage to welds and electrical connections, or change in calibration.

3.4.5 Power supply. The transmitter shall operate from a 25 ± 2 V, 400 ± 10 Hz, single-phase power source. The positive side of the power supply shall be connected to pin B of the transmitter connector and the ground side connected to pin A. The power supplied shall conform to MIL-STD-704.

3.5 Environmental conditions. The transmitter shall operate under the following conditions:

a. Operational temperatures ranging from -65 to 330°F and storage temperatures from - 80 to 450°F

b. Sinusoidal vibration up to 30g at frequencies from 5 to 2,000 Hz.

c. Pressure equivalent to an altitude of 100,000 feet and temperature of -65°F

d. Relative humidity up to 95%

3.6 Performance.

3.6.1 Operating position. The transmitter shall operate in either the vertical or horizontal position.

3.6.2 Dielectric strength. There shall be no insulation breakdown when a potential of 200 Volt root mean square (Vrms) at 60 Hz is applied between any electrical connector pin and any metal part of the transmitter case.

3.6.3 Damping. The transmitter shall drive the pressure indicator from full scale deflection to 14% of full scale deflection in 2 ± 1 seconds.

3.6.4 Overpressure. The transmitter shall withstand a 100% overpressure for a period of 10 minutes without being damaged.

3.6.5 Overpressure stop. An overpressure device shall be provided to restrain the pressure sensing element within the range of 105 to 130% of full scale deflection on the pressure indicator.

3.6.6 Case. The case shall conform to Figure 1. The case internal pressure shall be between 24.50 and 29.92 in Hg absolute.

3.6.6.1 Nonhermetically sealed leakage. There shall be no leakage out of the case with the transmitter submerged in water to a depth of 18 inches maximum and with an absolute water surface pressure of 2.5 in Hg.

3.6.6.2 Hermetically sealed leakage. The transmitter fill medium shall be clean 10±2 percent helium with a moisture content of less than 0.006 milligram of water vapor per liter. The leakage rate measured with a helium mass spectrometer shall be less than 0.1 micron cubic feet per hour.

3.6.7 Electrical characteristics.

3.6.7.1 Transducer. The transducer pressure sensing element shall provide an output voltage that varies linearly with variations in the difference in pressure between the two ports. (See Figure 2.)

3.6.7.2 Transmitter. The transmitter shall meet the following requirements when a single-phase excitation voltage of 26 V, 400 Hz, is applied across pins A and B.

3.6.7.2.1 No load current. When pin C is open, the transmitter current shall not exceed 160 milliamperes (mA).

3.6.7.2.2 Power consumption. The transmitter power usage shall not exceed 0.9 watt (W).

3.6.7.2.3 Terminal voltage. The voltage measured between pins A and C and between B and C shall not exceed 18 V.

3.6.8 Weight. The transmitter shall not exceed 1.5 pounds.

3.6.9 Maintainability. The transmitter shall not require periodic lubrication or adjustment during service. The transmitter shall be adjustable and capable of correcting indicator readings over 10% of full scale with no special tools.

3.6.10 Endurance. The transmitter shall withstand 60,000 cycles of operation from a 0 indicator reading to 80 ± 5% of full scale and back to a 0 reading at a rate of 30 ± 10 minute (cpm).

3.6.11 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable.

3.6.12 Electromagnetic interference. The transmitter shall neither cause nor be susceptible to electromagnetic interference.

4. VERIFICATION

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

a. First article inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed on five transmitters of each part number ordered. Four transmitters shall be subjected to all tests in 4.5 and one shall be used for the fungus test (see 4.5.16).

4.3 Conformance inspection. Conformance inspection shall consist of tests indicated in 4.3.1 and 4.3.2.

4.3.1 Individual tests. Each transmitter shall be subjected to tests indicated in 4.5.1 through 4.5.5.

4.3.2 Sampling tests. For the first 100 transmitters, 3 shall be selected randomly, and for each additional 100 transmitters, 1 shall be selected randomly and subjected to the tests in 4.5.1 through 4.5.8.

4.4 Test conditions.

4.4.1 Atmospheric conditions. Unless otherwise specified, all tests shall be performed at an ambient temperature of 75 ± 9 °F (25 ± 5 °C) and at site ambient pressure.

4.4.2 Voltage. Voltage applied shall be 25 V, 400 Hz, from a single-phase power source. Voltage and frequency shall be within ±1% of the nominal value.

4.4.3 Test standard. The transmitter shall be tested with an indicating test standard consisting of a standard indicating unit calibrated to a maximum error of 0.25 percent with a standard ratio transformer circuit as shown in Figure 2.

4.4.4 Tapping. Unless otherwise specified, the transmitter shall be lightly tapped or vibrated after initial indicator readings are taken and the difference recorded. The difference between readings before and after transmitter vibration is friction error.

4.5 Tests.

4.5.1 Examination. The transmitter shall be examined for compliance with requirements for dimensions, materials, weight, electrical connector, pressure connections, markings, and maintainability.

4.5.2 Dielectric strength. A potential of 200 Vrms and 60 Hz shall be applied between any pin of the electrical connector and any metal part of the transmitter case for 5 seconds. There shall be no insulation breakdown.

4.5.3 Scale and friction error. The transmitter shall be connected to pressure and electrical power sources and to the standard indicating unit. The transmitter at ambient temperature shall be tested for scale error, both up-scale and down-scale, at the test points specified in the contract. Two readings shall be taken: the first before, and the second after, the transmitter is tapped or vibrated. Scale and friction errors shall not exceed the tolerances in the contract (see 6.2).

4.5.4 Position error. The transmitter shall be energized to obtain a reading of one-half scale on the standard indicating unit. The transmitter then shall be rotated from the normal operating position to a position 90° clockwise and then 90° counterclockwise (longitudinal axis vertical). The indicating unit reading change shall not exceed the position error tolerance in the contract (see 6.2).

4.5.5 Leakage.

4.5.5.1 Nonhermetically sealed case. The pressure and vent connections shall be sealed and the transmitter immersed in water inside an enclosure to a depth of 18 inches maximum. The absolute pressure of the air above the liquid shall be reduced to 2.5 in Hg. Any bubbles coming from within the case indicates a leakage and shall be cause for rejection.

4.5.5.2 Hermetically sealed case. The leakage rate measured with a helium mass spectrometer with a differential pressure of 24 in Hg minimum shall be 0.1 micron cubic foot per hour maximum.

4.5.6 Vibration. See MIL-STD-810 Method 514.2 for further guidance. The transmitter shall be mounted directly to a vibration exciter without vibration isolators. Tests shall be conducted under both resonance and cycling conditions as specified in paragraphs 4.5.6.1 and 4.5.6.2. Time consumed performing resonance tests plus time consumed cycling in cycling tests shall equal 3 hours for each axis. Vibration displacement, velocity, and acceleration shall be measured at the specific instantaneous test frequency applied. Loose transmitter components that impact each other resulting in a high noise content of the applied vibration shall be considered as vibration input. If such noise is encountered, a low pass frequency filter that cuts off at approximately twice the test frequency shall be employed to reject the noise.

4.5.6.1 Resonance test. Resonant nodes of the transmitter shall be determined by varying the frequency of applied vibration slowly through the specified range at vibrator accelerations shown in Table I. Individual resonant nodes surveys shall be conducted with vibration applied along each set of three mutually perpendicular axes of the transmitter. The transmitter shall be vibrated at the indicated resonant conditions for the times shown in Table II and the applied double amplitudes of vibrator accelerations in Table I. Vibration shall be applied along each of the three mutually perpendicular axes. If more than one resonance is encountered when vibration is applied along any one axis, each resonance shall be sustained for the time shown in the applicable portion of the vibration test schedule. If more than four resonances are encountered with vibration applied along one axis, the four most severe resonances shall be chosen for test.

TABLE I. Vibration data

Frequency (Hz)	Displacement in double amplitude (inch) and Acceleration (g), if applicable
5-10	0.2
10-18	0.2 to 0.06 at 30g
18-99	0.06
99-2,000	0.06 to 0.001 at 30g

4.5.6.2 Cycling test. The transmitter shall be connected to the standard indicating unit and the transmitter pressure adjusted to obtain a mid-scale reading on the unit. While operating, the transmitter shall be vibrated in accordance with the vibration schedule in Table II. The frequency shall be varied logarithmically from 5 to 2,000 Hz and returned to 5 Hz in 20-minute intervals at an applied acceleration of ±30g. Indicating unit pointer oscillation and variation shall not exceed the tolerances in the contract. At the end of the vibration test, the transmitter shall be subjected to the scale and friction error test (4.5.3) and shall meet the tolerances in the contract.

TABLE II. Vibration schedule

Number of resonances	0	1	2	3	4
Total vibration time at resonance (min) *(see note)	--	30	60	90	120
Cycling time (hr)	3	2.5	2	1.5	1
*Note: 30 minutes at each resonance					

4.5.7 Low temperature. After performing a scale and friction error test (4.5.3), the transmitter shall have pressure and power connections made to simulate operational conditions and shall be connected to the standard indicating unit. The transmitter shall be placed in a temperature chamber and the temperature brought to -65° ± 3°F for 4 hours. After 4 hours, with the temperature still at -65° ± 3°F, the transmitter again shall be subjected to the scale and friction error test (4.5.3).

4.5.8 High temperature. After performing a scale and friction error test (4.5.3), the transmitter shall have pressure and power connections made to simulate operational conditions and shall be connected to the standard indicating unit. The transmitter shall be placed in a temperature chamber and the temperature brought to 330° ± 3°F for 6 hours. After 6 hours, with the temperature still at 330° ± 3°F, the transmitter again shall be subjected to the scale and friction error test (4.5.3).

4.5.9 Electrical characteristics. To verify compliance with the transmitter current, power, and voltage requirements, a single-phase excitation voltage of 26V, 400 Hz shall be applied across pins A and B of the transmitter. With pin C open, the transmitter current shall not exceed 160 mA. Transmitter power usage shall not exceed 0.9 W. The voltage between pins A and C and between B and C shall not exceed 18 V.

4.5.10 Endurance. The transmitter, connected to the standard indicating unit, shall be operated for 10,000 cycles at a rate of 30 ± 10 cycles per minute (cpm) from 0 indication to 80 ± 5% of full scale and back to 0 indication. Within 1 hour after conclusion of this test, the transmitter shall be subjected to the scale and friction error test (4.5.3). Errors shall not exceed the tolerances in the contract. After 10,000 cycles, the transmitter shall be operated for an additional 60,000 cycles. Within 1 hour after conclusion of this test, the transmitter shall be subjected to the scale and friction error test (4.5.3). Errors shall not exceed the tolerances in the contract.

4.5.11 Temperature-altitude. After performing a scale and friction error test (4.5.3), the transmitter shall have pressure and power connections made to simulate operational conditions and shall be connected to the standard indicating unit. The transmitter shall be placed in an environmental chamber at ambient temperature and atmospheric pressure. The temperature shall be reduced to -65° ± 3°F at a rate not exceeding 1.8°F per second. The chamber pressure shall be adjusted to simulate an altitude of 100,000 feet at a rate not exceeding 3 pounds per square inch (psi) per second. The transmitter shall be maintained at this temperature and pressure for 1 hour, and then a scale and friction error test (4.5.3) shall be performed.

4.5.12 Low temperature exposure. After performing a scale and friction error test (4.5.3), the transmitter shall have pressure and power connections made to simulate operational conditions and shall be connected to the standard indicating unit. The transmitter shall be placed in a chamber with the temperature at -80° ± 3°F for a minimum of 48 hours. While still at this temperature, the transmitter shall be subjected to another scale and friction error test (4.5.3). After the scale and friction error test, the temperature shall then be raised to -65° ± 3°F for a minimum 24 hours. The transmitter, while still at this temperature, again shall be subjected to the scale and friction error test (4.5.3). After the scale and friction error test, the transmitter shall be brought to ambient temperature for a minimum of 4 hours and again shall be subjected to the scale and friction error test (4.5.3).

4.5.13 High temperature exposure. The transmitter shall be placed in a chamber and the temperature brought to 450° ± 3°F for a minimum of 80 hours. After 80 hours, the transmitter then shall be brought to ambient temperature for a minimum of 4 hours and then subjected to the scale and friction error test (4.5.3)

4.5.14 Humidity. Nonhermetically sealed transmitters shall have pressure and power connections made to simulate operational conditions and shall be connected to the standard indicating unit. The transmitter shall be placed in the test chamber at ambient temperature and humidity. The chamber temperature shall gradually be raised to 150°F and the humidity to 95% over a 2-hour period. This temperature and humidity shall be maintained for 6 hours. After 6 hours, the humidity shall be maintained at a minimum of 85% and the test chamber temperature shall be reduced from 150° to 85°F over a 16 hour period. The above temperature and humidity cycle shall be repeated 10 times (240 hour test). Immediately after completion of this test, the transmitter shall be subjected to the dielectric strength test (4.5.2) and the scale and friction error test (4.5.3).

4.5.15 Salt fog. A 50-hour salt fog test shall be performed in accordance with ASTM B117. Any trace of corrosion or mechanical failure constitutes a cause for rejection.

4.5.16 Fungus. Nonhermetically sealed transmitters and any required lubricants shall be subjected to a fungus resistance test for a minimum of 28 days and a maximum of 84 days depending on the degree of certainty required in determining the existence or effect of fungal growth. The transmitter shall be configured as it would be during shipping, storage, and service. The test temperature shall be between 75° and 90°F with 95% ± 5% relative humidity. At least five different species of fungus shall be used. Additional fungi may be used based on prior knowledge of specific material deterioration characteristics. Any trace of fungus, degradation, corrosion, or mechanical failure constitutes a cause for rejection.

4.5.17 Electromagnetic interference. The transmitter shall comply with the requirements of MIL-STD-461 for Air Force Aircraft. The minimum tests required are CE102, CS101, CS114, CS115, CS116, RE102 and RSE103.

4.5.18 Power. Proof of compliance with MIL-STD-704 shall be provided.

4.5.19 Vent boss and connector strength. The transmitter shall be secured to a fixture by the engine mount connection on the transmitter. A bending moment of 25 foot-pounds shall be applied at the vent boss and then the electrical connector about any axis perpendicular to the longitudinal axis of the transmitter. There shall be no evidence of the transmitter calibration shifting-out-of tolerance, distortion of the base plate, damage to vent boss and electrical connector welds, or damage to electrical connector soldering. The transmitter shall be subjected to the sealing test (4.5.5.1 or 4.5.5.2). The transmitter then shall be subjected to the scale and friction error test (4.5.3).

4.5.20 Damping. The transmitter shall be placed in a test fixture with the pressure connection at the bottom, the vent at the top, and the electrical connector connected to the standard indicating unit. Oil conforming to MIL-PRF-7808, with a viscosity of 2,500 centistokes at -65°F, shall be brought to a pressure that produces full scale deflection of the indicating unit. The pressure then shall be released and the time required for the change from full scale deflection to 14% of full scale deflection shall be 2 ± 1 second.

4.5.21 Overpressure. The pressure required to produce full scale deflection of the standard indicating unit shall be determined. The transmitter shall have pressure and power connections made to simulate operational conditions and shall be connected to the standard indicating unit. The transmitter shall be subjected to 100% overpressure for 10 minutes. During this 10-minute period, the standard indicating unit reading shall not exceed 105 to 130% of full scale deflection. One hour after completion of this test, the transmitter shall be subjected to the scale and friction error test (4.5.3) using only increasing pressure.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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 transmitters covered by this specification are intended for use with variable-reluctance-type indicators conforming to MIL-I-25437 in providing remote indication of aircraft pressure functions.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. When first article inspection is required (see 3.1).

c. Test points and allowable scale and friction errors (4.5.3)

d. Position error tolerance (4.5.4).

e. Data required.

f. Packaging (see 5.1).

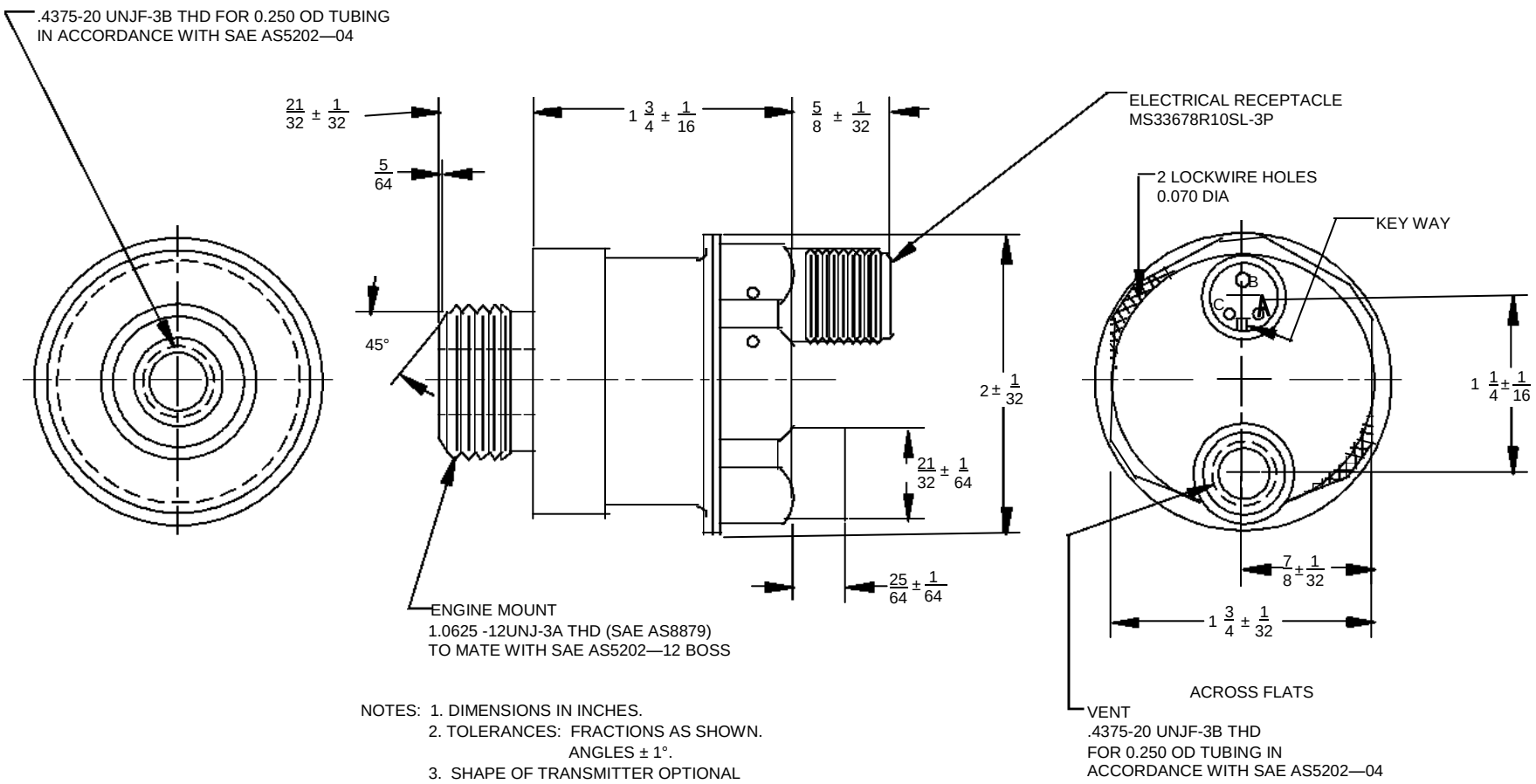
g. Item identification.

6.3 Subject term (key word) listing.

Transducer
Sensing element
Vent

6.4 International standardization agreement implementation. This specification implements international standardization agreement STANAG 3209. When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at http://assist.daps.dla.mil

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.



NOTES: 1. DIMENSIONS IN INCHES.
2. TOLERANCES: FRACTIONS AS SHOWN.
ANGLES ± 1°.
3. SHAPE OF TRANSMITTER OPTIONAL
PROVIDED ALL DIMENSIONS ARE MET.

Figure 1. Transmitter case

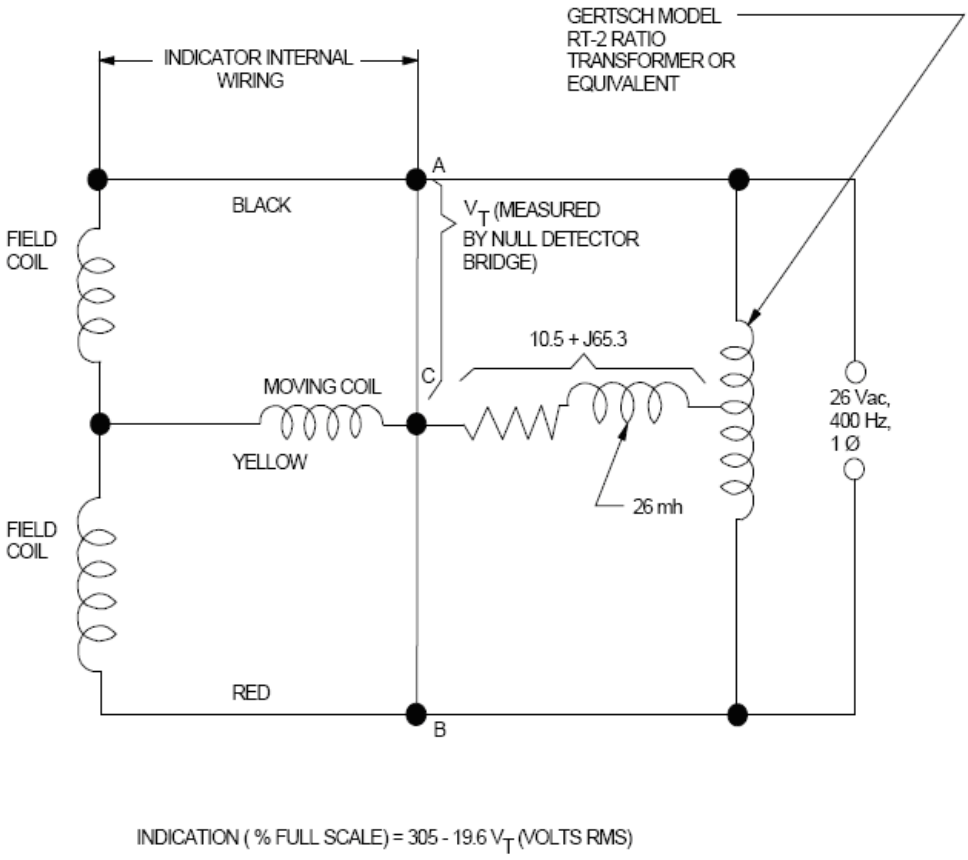


Figure 2. Standard Test Circuit

Custodians:
Air Force - 71
Army - AV
Navy - AS

Preparing Activity:
Air Force - 71

(Project 6620-2008-003)

Review Activities:
Air Force - 06
Air Force - 99
DLA - GS

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