MIL-G-26988C
20 August 1971
Supersession data see section 6

MILITARY SPECIFICATION

GAGE, LIQUID QUANTITY, CAPACITOR TYPE, TRANSISTORIZED GENERAL SPECIFICATION FOR

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for transistorized, capacitor-type, liquid-quantity gages.

1.2 Classification. Gages shall be of the following classes and shall produce the specified accuracies when installed in accordance with MIL-G-7940 (see 6.2):

Class I: ±4 percent of indication, ±2 percent of full scale
Class II: ±2 percent of indication, ±0.75 percent of full scale
Class III: ±1 percent of indication, ±0.5 percent of full scale.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONS

Federal

QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-Z-325	Zinc Plating, Electrodeposited, Requirements for

Military

MIL-C-17/94	Cable, Radio Frequency, Coaxial, RG-179B/U
MIL-P-116	Preservation, Methods of
MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
MIL-G-5572	Gasoline, Aviation, Grades 80/87, 100/130, 115/145
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-W-7139	Wire, Electrical, Polytetrafluoroethylene-Insulated, Copper, 600-Volt

FSC 6680

MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-G-7940	Gage, Liquid Quantity, Capacitor Type, Installation and Calibration of
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-C-14806	Coating, Reflection Reducing, for Instrument Cover Glasses and Lighting Wedges
MIL-W-16878/1	Wire, Electrical, Type B, 105°C, 600 Volts (Insulated, High Temperature)
MIL-L-25467	Lighting, Integral, Aircraft Instrument, General Specification for
MIL-C-25516	Connector, Electrical, Miniature, Coaxial, Environment Resistant Type, General Specification for
MIL-C-26482	Connector, Electric, Circular, Miniature, Quick Disconnect, Environment Resisting
MIL-C-26500	Connector, General Purpose, Electrical Miniature, Circular, Environment Resisting, 200°C Ambient
MIL-L-27160	Lighting, Instrument, Integral, White, General Specification for
MIL-C-81511	Connector, Electric, Circular, High Density, Quick Disconnect, Environment Resisting
MIL-G-81704	Glass, Aircraft Instrument, Lighting Wedge and Cover

STANDARDS

Federal

FED-STD-595	Colors

Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U. S. Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-781	Reliability Tests Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipments Development and Production
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of
MIL-STD-810	Environmental Test Methods

MIL-STD-838	Lubrication of Military Equipment
MS29576	Flange, Attachment, Molded Tank, Flush and Recessed, Full Molded, Circular
MS33585	Pointer, Dial, Standard Design of Aircraft Instrument
MS33639	Cases, Instrument, Clamp-Mounted, Aircraft

(Copies of documents required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Preproduction. This specification makes provisions for preproduction testing.

3.2 Components

3.2.1 Class I and class II gages. Class I and class II gages shall consist of one or more characterized-type tank units, an indicator, totalizer indicator, and the associated compensating device which shall be incorporated into the tank unit and housed as a single unit unless otherwise approved by the procuring activity.

3.2.2 Class III gage. The class III gage shall consist, as necessary, of one or more tank units, an indicator, a totalizer indicator, a fuel-attitude sensor, a correction computer, and a compensating device. Tank units for class III gages may be either characterized (see 3.11.1) or uncharacterized (see 3.11.1.1). The number of tank units shall be held to a minimum.

3.3 General requirements. The requirements of this specification are generally applicable to all types of aircraft installations wherein fuel in accordance with MIL-G-5572, MIL-T-5624, or 91/96 octane fuel is used. However, due to the wide variation in fuel-tank capacities, arrangements, numbers, specific details, such as length of tank unit, and arrangement of calibration of scales shall be supplied by drawings or part number.

3.4 Selection of standards and specifications. Standards and specifications for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.5 Materials

3.5.1 Materials shall conform to applicable specifications as specified herein. When materials are used that are not specifically designated, they shall be entirely suitable for the purpose. The use of lightweight materials and weight-saving designs shall be a major consideration and shall be investigated and exploited to the greatest possible extent.

3.5.2 Fungus-proof materials. Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where used and not hermetically sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity. However, if they will be used in a hermetically sealed inclosure, fungicidal treatment will not be necessary.

3.5.3 Nonmagnetic materials. Nonmagnetic materials shall be used for all parts of the gage, except where magnetic materials are essential.

3.5.4 Metals. Metals shall be of the corrosion-resistant type or suitably treated to resist corrosion due to fuels, salt spray, or atmospheric conditions likely to be met in storage or normal service.

3.5.4.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-454, requirement 16.

3.5.5 Protective treatment. When materials are used in the construction of the gage that are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip, or scale with age or extremes of climatic and environmental conditions shall be avoided.

3.6 Design and construction

3.6.1 Class I and class II gages. Class I and class II gages shall be designed to indicate the liquid quantity in a given fuel tank by measurement of the electric capacitance between two or more plates of an electrostatic capacitor mounted in the tank. It shall consist essentially of one or more tank units and an indicating unit which shall provide linear indication. The gage shall also provide an output signal for totalization purposes, if required for specific applications as directed by the procuring activity. Incorporation of the added totalization feature shall entail the inclusion of an indicating unit which shall indicate the total amount of fuel registered by the individual gages. The tank unit (or units) shall be so characterized that a constant capacitance will be registered for each unit volume of fuel sensed.

3.6.2 Class III gage. The class III gage shall also operate on the capacitance principal. Operation of the class III gage shall be similar to that of the class I and class III gages except it shall be capable of applying sufficient corrections to the indicator reading to overcome the errors introduced by fuel attitude. The attitude which is selected as normal attitude for design purposes shall be the fuel attitude considered to be most nearly normal at the average aircraft cruise conditions under zero roll and zero acceleration.

3.6.2.1 Fuel attitude sensor. The fuel attitude sensor shall be designed to sense actual fuel attitude. Fuel attitude measurements shall be the actual pitch and roll angles, or combination of these angles, between the surface of the fuel and a reference plane through the tank which has been selected as being paralled to the surface of the fuel at zero acceleration, zero roll and at a nose-up (+) pitch angle which most nearly equals the angle of the tank at average cruise attitude.

3.6.2.2 Computer. The computer shall be designed to generate correction data to be used by the indicator in producing a corrected fuel-quantity reading. The accuracy of the corrected reading shall be as shown in table I. The magnitude of the correction shall be based upon the following:

a. Attitude of the fuel based upon fuel-attitude sensor signals

b. Fuel height based upon the signal from the fuel probes

c. Attitude correction data from stored data in the computer.

3.6.2.3 Fail-safe feature. Self-test circuitry shall be incorporated into the computer so that a test pattern will be introduced into the system to verify proper operation of the computer. If erratic operation is detected, all attitude correction signals to the indicator shall be clamped at zero and a signal circuit in the computer shall be closed. This signal circuit shall be capable of operating a 28V d-c 0.4-amp lamp load remotely located to the exterior of the computer. Power for the lamp load shall not be provided by the fuel gage.

3.6.2.4 Indicator special provisions. The indicator for the class III gage shall be designed to accept capacitance-type fuel-quantity signals from the fuel probes and to produce an indication of fuel quantity. Accuracies shall be within the tolerances specified herein based upon the basic capacitance input. The indicator shall also be designed to use fuel attitude correction signals from the computer. Accuracy of the corrected signal shall be within the tolerances specified herein based upon basic capacitance input signals and a correction table determined by the gage manufacturer as necessary for correcting the various degrees of attitude error.

3.6.3 Automatic fuel compensation. The gage shall incorporate compensation based on the measurement of the dielectric constant of the fuel and shall indicate mass of fuel when the dielectric constant and the density are related in accordance with the following formulas where K is the dielectric constant and D is the density in pounds per gallon:

a. If grade JP-4 is normally the only fuel used in the fuel tank, the following formula shall be used:

$$\frac{K-1}{D} = 0.12192 \left[1 + 0.3373 (K-1)\right]$$

Table I. Accuracy

Paragraph Number	Test	±Tolerances Class I	Class II	Class III
	Room Temperature			
4.6.2a	Indicator operation	0.5% fs	0.3% fs	0.3% fs
c	Indicator totalizer output signal	0.5% fs	0.3% fs	0.3% fs
h	Indicator dead spot	0.2% fs	0.1% fs	0.1% fs
4.6.3.1	TU dry capacitance	1.0% sv	0.5% sv	0.5% sv
4.6.3.2	CU dry capacitance	1.5%sv or 0.5 pf	0.2 pf	0.2 pf
4.6.3.3	TU calibration	1.5% sv table II	0.4% sv table II	0.4% sv table II
4.6.8	Complete gage scale error	2.0% ind ±1.0% fs	1.5% ind ------	1.0% ind ------
4.6.9	Compensation	1.0% fs	0.3% fs	0.3% fs
4.6.10	Indicator SE	0.75% sv	0.25% sv	0.25% sv
	Indicator dead spot	0.2% fs	0.1% fs	0.1% fs
4.6.10.1	Totalizer	0.75% sv	0.3% sv	0.3% sv
	Totalizer dead spot	0.20% fs	0.1% fs	0.1% fs
4.6.11.1	TU assembly	1.0% sv	0.4% sv	0.4% sv
4.6.11.2	Compensator	1.5% sv or 0.5 pf	0.3% sv or 0.1 pf	0.3% sv or 0.1 pf
4.6.12	Voltage and frequency variation	0.5% fs	0.2% fs	0.2% fs
	Dead spot	0.2% fs	0.15% fs	0.15% fs
	Low Temperature			
4.6.13	Indicator SE	0.75% rv	0.4% rv	0.4% rv
4.6.13.1	SE after return to room temperature	0.5% rv	0.3% rv	0.3% rv
4.6.14	TU dry capacitance	1.0% rc	0.4% rc	0.4% rc
	CU dry capacitance	1.0% rc	0.15 rc	0.15 rc
4.6.14.1	TU dry capacitance after return to room temperature	1.0% rc	0.3% rc	0.3% rc
	CU dry capacitance after return to room temperature	0.5% rc	0.15 rc	0.15 rc
	High Temperature			
4.6.16	Indicator SE	0.75% rv	0.5% rv	0.5% rv
4.6.16.1	SE after return to room temperature	0.5% rv	0.3% rv	0.3% rv
4.6.17	TU and CU dry capacitance	1.0% rc	0.5% rc	0.5% rc
4.6.17.1	TU dry capacitance after return to room temperature	1.0% rc	0.3% rc	0.3% rc
	CU dry capacitance after return to room temperature	0.5% rc	0.15 rc	0.15 rc

Table I. Accuracy (Cont)

Paragraph Number	Test	±Tolerances Class I	Class II	Class III
	Vibration			
4.6.19.2	Indicator vibration failure	0.5% rv	0.3% rv	0.3% rv
4.6.19.3	TU and CU resonance	0.5%fs po	0.3%fs po	0.3%fs po
4.6.19.3.1	TU dry capacitance after resonance	0.5% rc	0.3% rc	0.3% rc
	CU dry capacitance after resonance	0.5% rc	0.15%rc	0.15% rc
	Extreme Low Temperature			
4.6.23.1	Indicator SE	1.0% rv	0.6% rv	0.6% rv
4.6.23.1.1	SE after return to room temperature	0.5% rv	0.3% rv	0.3% rv
4.6.23.2	TU dry capacitance	1.0% rc	0.6% rc	0.6% rc
	CU dry capacitance	1.0% rc	0.3 rc	0.3 rc
4.6.23.2.1	TU dry capacitance after return to room temperature	1.0% rc	0.3% rc	0.3% rc
	CU dry capacitance after return to room temperature	0.5% rc	0.15% rc	0.15% rc
	High Temperature Exposure			
4.6.24.1	TU dry capacitance	1.0% rc	0.4% rc	0.4% rc
	CU dry capacitance	0.5% rc	0.15 rc	0.15 rc
	Water Immersion			
4.6.25	TU dry capacitance	2.0% rc	1.0% rc	1.0% rc
	CU dry capacitance	0.70 rc	0.35 rc	0.35 rc
	Humidity			
4.6.26.1	TU and CU dry capacitance 1 hour after exposure	2.0% rc	0.5% rc	0.5% rc
4.6.26.1.1	TU and CU dry capacitance 24 to 48 hours after exposure	1.0% rc	0.3% rc	0.3% rc
	Fungus			
4.6.27.1	TU dry capacitance 1 hour after exposure		1.0% rc	1.0% rc
	CU dry capacitance 1 hour after exposure		0.35 rc	0.35 rc
4.6.27.2	TU dry capacitance 24 to 48 hours after exposure		0.3 rc	0.3 rc

Table I. Accuracy (Cont)

Paragraph Number	Test	±Tolerances Class I	Class II	Class III
4.6.27.2	CU dry capacitance 24 to 48 hours after exposure		0.15 rc	0.15 rc
	Salt Fog			
4.6.28.1	Indicator SE 1 hour after exposure	2.0% rv	0.4% rv	0.4% rv
4.6.28.2	TU dry capacitance 1 hour after exposure	2.0% rc	0.6% rc	0.6% rc
	TU dry capacitance 24 to 48 hours after exposure		0.5% rc	0.5% rc
	CU dry capacitance 1 hour after exposure		0.25 rc	0.25 rc
	CU dry capacitance 24 to 48 hours after exposure		0.2 rc	0.2 rc
	Indicator Cycling			
4.6.29	After cycling	0.5% rv fpr	0.1% rv fpr	0.1% rv fpr

<u>Legend</u>

rc = reference capacitance
rv = reference values
fpr = from readings prior to test
po = total pointer oscillation
CU = compensator unit
TU = tank unit
sv = specified value
fs = full scale
pf = picofarad
ind = indication
SE = scale error

b. If grade JP-4 or JP-5 turbine fuel and type 91/96, 100/130, and 115/145 octane fuels are normally used interchangeably in the fuel tank, the following formula shall be used:

$$\frac{K-1}{D} = 0.12700 \left[1 + 0.28953 (K-1)\right]$$

3.6.4 Fire hazard. The electrical circuit of the gage shall be so designed that the value and magnitude of the potentials applied to the tank unit (or units) will not create a fire hazard in the airplane fuel tank.

3.6.4.1 The circuit shall be such that the current in the leads running to the sensing electrodes of tank units and compensator sensing units shall in no case exceed 0.2 amp. This shall apply both to normal operating conditions and to any combination of the following abnormal conditions:

a. Short circuiting of any combination of electrodes in the tank unit or compensator sensing unit

b. Short circuiting of any capacitor or combination of capacitors elsewhere in the bridge circuit

c. All switches and other adjustments in the bridge circuit set to any desired position.

3.6.5 Reliability program. The contractor shall establish a reliability assurance program in accordance with MIL-STD-785.

3.6.5.1 Reliability. The gage shall have a minimum acceptable mean-time-between-failures (MTBF) of 3,000 hours during its service life demonstrated to a 90 percent confidence level.

3.6.6 Longevity. The gage shall have an operating life span (equipment longevity as defined in MIL-STD-781) of not less than 5,000 hours before wearout failures occur or before the equipment consistently fails to meet the MTBF index. Parts requiring replacement within this time and the normal operating period of such parts shall be reported by the contractor to the procuring activity.

3.6.7 Maintainability. Maintainability of gage components shall be at depot-level repair facilities only except for gage calibration, removal of defective components, and replacement of such components which may be accomplished at field maintenance level. Each component shall be so designed as to require the least repair time economically feasible as determined by weighing the probable savings due to low maintenance time against the cost of producing a low-maintenance-time component. The gage shall be so designed that after it has been calibrated, the calibration will not drift to limits outside the specified tolerance during the system MTBF period.

3.6.8 Construction. The gage shall be so constructed that no parts will work loose in service. It shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service. Insofar as practicable, pivots, bearings, and gears shall neither bind nor shake and shall be frictionless.

3.7 Performance. Unless otherwise specified by the procuring activity, the gage shall be capable of meeting the requirements specified herein when subjected to the following conditions:

a. Temperatures - Temperatures ranging from -65° to +71°C for cockpit indicators, and temperatures ranging from -65° to +132°C for fuselage, wing, and external tank components

b. Vibration - Vibration incident to service use

c. Humidity - Relative humidity up to 95 percent including conditions wherein condensation takes place in the form of both water and frost

d. Fungus - Fungus growth as encountered in tropical climates

e. Salt fog - Exposure to salt fog for a period of not less than 48 hour

f. Explosive atmosphere - Operation in an explosive vapor within or surrounding the equipment.

3.7.1 Electromagnetic interference and supppression. The gage shall meet the electromagnetic interference and suppression requirements of MIL-STD-461, class A1, except as specified herein.

3.7.2 Tank unit immersion. The gage shall operate as specified herein after the tank units have been immersed in water.

3.8 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and drawing number requirements of MIL-STD-100 shall govern the manufacturer's part numbers and changes thereto.

3.9 Standard electronic parts. Unless otherwise specified, electronic parts and the application thereof shall be in accordance with MIL-E-5400

3.10 Totalizer. The totalizer shall consist basically of an indicator and, by electrical means, shall total the indications of two or more individual linear indicating gages. The individual gages associated with the totalizing gage shall be designed to provide suitable electrical output signals for summation by the totalizer.

3.11 Tank unit. The basic tank unit shall consist of a suitable capacitative arrangement of metallic conductors, such as a pair of concentric cylinders electrically insulated from each other and forming a three-wire capacitor. The design shall be such that the tank unit can be disassembled and reassembled without the use of special tools, except as approved by the procuring activity. It shall be so constructed as to permit fuel, into which the unit has been immersed, to rise freely to its natural level between the conductors so that up to this level, the fuel will serve as the dielectric substance. Above the level of the fuel, a mixture of air and vapor will be the dielectric substance. Unless otherwise approved, nonsensing portions of the sensing element shall not exceed the following dimensions: 0.600 inch at the flange end and 0.400 inch at the opposite end for externally mounted tank units, except that 0.850 inch shall be allowed for the flange end only for tank units including the compensator capacitors, and 0.400 inch at both ends for internally mounted tank units. It shall be so constructed as to preclude the formation of deposits and sediments between the conductors. The minimum allowable distance between the conductors shall be 0.125 inch. The tank unit shall be designed to make electrical connections readily accessible for testing it and for making calibration adjustments using a substitute precision capacitance. The materials used in the construction of the tank unit shall be impervious to water and aircraft fuels.

3.11.1 Characterized tank units. Characterized tank units shall be designed to provide a linear relationship between the electrical capacitance and the volume of fuel sensed. The basic design shall be suitable for producing high-capacitance ratios (as a large ratio between the maximum and minimum capacitance per unit (length)) and for following calibration curves with a high degree of accuracy. The basic design shall possess good production adaptability. The size and weight shall be kept to the minimum consistent with high-quality aircraft instrument design.

3.11.1.1 Uncharacterized tank units. When specified by the procuring activity (see 6.2), tank units for class III gages shall be uncharacterized (possess a linear relationship between the capacitance and tank-unit height).

3.11.2 Mounting types. Tank unit designs shall be external top-mounted, external bottom-mounted, internally mounted, and any other type as required for specific installations.

3.11.3 Mounting flange. The external top- and botton-mounted types shall be designed and constructed for installation in a fuel tank fitting which has dimensions conforming to MS29576-6, or as otherwise specified by the procuring activity. The means provided for mounting the internally mounted tank unit shall be entirely suitable for the purpose and shall be subject to approval by the procuring activity.

3.11.4 Connector housing. For externally mounted type tank units, the projection of the connector housing beyond the flange surface shall be held to the minimum practicable to facilitate mounting.

3.11.5 Seal. The external-mounting type tank-unit connector head shall be an enclosed compartment so sealed as to prevent the entrance of fuel and moisture.

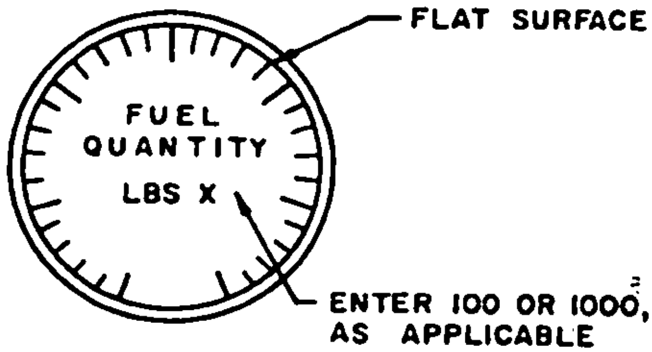
3.11.6 Compensator sensing unit. The compensator sensing unit shall meet the same general requirements as the tank unit. It shall be designed to extend a minimum distance from the bottom of the fuel tank in which it will be installed. The unit shall be designed to make electrical terminals readily accessible for testing the unit and for making calibration adjustments using a substitute precision capacitance. The compensator sensing unit may be contained within the tank or may be a separate component. The requirements of 3.11.3, 3.11.4, and 3.11.5 shall apply to flange-mounted compensator sensing units which are separate components.

3.11.7 Tank-unit coating. Each tank unit and each compensator unit shall be coated to prevent moisture absorption. The coating shall completely cover all surfaces that would otherwise be exposed to aircraft fuel and shall not be affected by fuel or normal fuel additives. The coating material shall be applied in uniform thickness and shall not affect the empty capacitance or linearity of the probe. Electrical connectors or terminals shall not be coated. When necessary, the coating shall be baked in accordance with the material manufacturer's standard practice.

3.12 Indicator

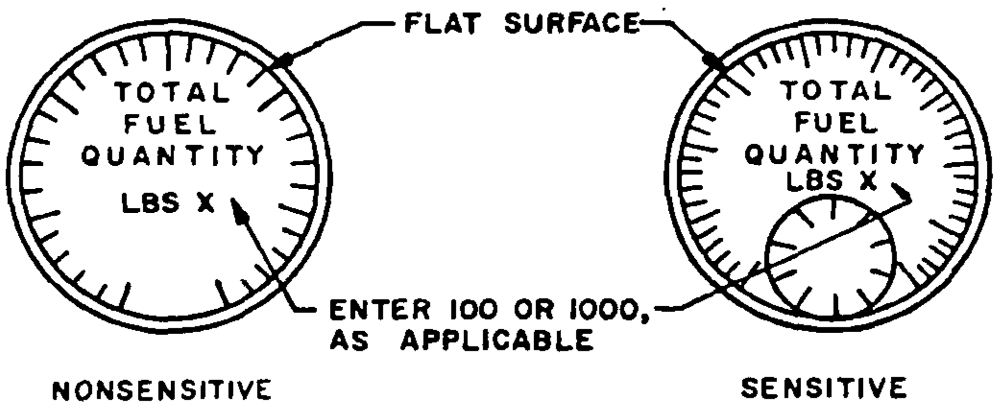
3.12.1 The indicator shall be an electrical receiver which shall continuously indicate the quantity of fuel in pounds. The indicator designs shall conform to the sensitive and nonsensitive dial presentations shown on figures 1, 2, and 3. Provisions shall be incorporated to permit the addition of level warning switching mechanisms and output signal controls, such as potentiometers, as required for specific applications.

3.12.2 Indicator case. The case design shall be in accordance with MS33639. The case shall be constructed of a material suitable for hermetic sealing. The material shall be uniform in texture and shall have a smooth external surface. The case shall be so designed that the internal mechanism may be removed from the case, replaced, and the case resealed without using special tools and fixtures unless approved by the procuring activity. The hermetic

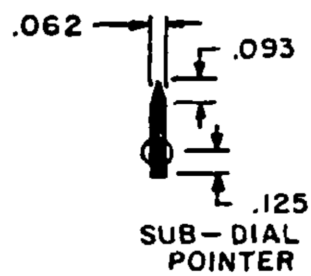


Markings	Height or Length ±.010	Width of Line or Graduation ±.005
Main Dial:		
Numerals	0.140	0.025
Fuel Quantity	0.140	0.020
Major Grad	0.188	0.031
Minor Grad	0.125	0.015
LBS X	0.100	0.015

FIGURE 1. Indicator, 2-Inch Case

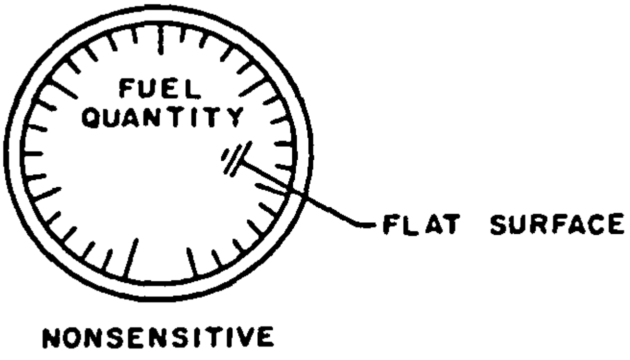


DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED,
TOLERANCES: DECIMALS ±.005



Markings	Height or Length ±.010	Width of Line or Graduation ±.005
Main Dial:		
Numerals	0.140	0.025
Total Fuel Quan	0.110	0.020
Major Grad	0.188	0.031
Minor Grad	0.125	0.015
LBS X	0.100	0.015
Sub-Dial:		
Numerals	0.100	0.015
Major Grad	0.094	0.010
Minor Grad	0.062	0.010
100 X	0.046	0.010
Circle Dia	0.718	0.015

FIGURE 2. Indicator, Totalizer, 2-Inch Case



Markings	Height or Length ±0.010	Width of Line Or Graduation ±0.005
Main Dial:		
Numerals	0.140	0.025
Fuel Quantity	0.110	0.015
Major Grads	0.140	0.025
Minor Grads	0.100	0.015

FIGURE 3. Indicator, 1-1/2-Inch Case

sealing shall be so accomplished that the seal will not be dependent upon materials which might be affected by the action of any atmosphere to which the indicator may be subjected. The length of the case for the nonsensitive indicator (see figures 1 and 2) shall not exceed 4.25 inches and the length of the case for the sensitive indicator (see figures 1 and 2) shall not exceed 5.0 inches. The length of the case for the indicator conforming to figure 3 shall not exceed 6.5 inches.

3.12.2.1 Filling medium. The filling medium shall be of at least 98 percent purity, free of dust particles, and shall contain not more than 0.006 milligram of water vapor per liter (dewpoint -65°C) at the filling pressure. The filling medium shall be a mixture of 88 to 92 percent nitrogen and the remainder helium. The absolute pressure of the filling medium in the case shall be approximately 1 atmosphere.

3.12.2.2 Thermal shock. The indicator shall withstand repeated sudden temperature changes ranging from 85° ±5°C to 5° ±5°C and return to 85° ±5°C without damage to the indicator or evidence of moisture penetration within the indicator.

3.12.2.3 Indicator lighting. The indicator shall be integrally lighted. The lighting system shall be in accordance with MIL-L-25467 for red lighting or MIL-L-27160 for white lighting. The color of the lighting shall be as specified by the procuring activity (see 6.2).

3.12.2.4 Lamp location. The lamps shall be located inside the instrument case and shall be so installed that replacement may be accomplished only at a repair depot. No provisions shall be made for field replacement.

3.12.3 Cover glass. The cover glass shall be suitable for hermetic sealing and shall be clear, flat, and free from flaws which would interfere with the normal reading of the instrument. The thickness of the cover glass shall be the minimum practicable and shall be entirely suitable for the purpose intended. The cover glass shall be in accordance with MIL-G-81704 and shall be coated in accordance with MIL-C-14806.

3.12.4 Dial. The indicator dial shall be fastened securely to the case or to the frame of the indicator mechanism in such a manner that it will not loosen nor turn when the instrument is subjected to environmental conditions specified herein. The dial material shall be suitable for the application and subject to the approval of the procuring activity. For subdial sensitive indicators of the types shown on figure 2, the inner portion of the subdial shall be recessed a distance sufficient to assure that the outer surface of the pointer will be on approximately the same plane as the numerals placed on the main dial.

3.12.4.1 Dial and cover glass location. The distance between the front surface of the bezel and the outside surface of the cover glass shall not exceed 0.062 inch. The distance between the inside surface of the cover glass and the dial shall not exceed 0.125 inch.

3.12.4.2 Dial scale. The dial scale shall be graduated and numbered at even intervals to indicate quantities in pounds. The intervals shall be determined by the capacity of the tank and the scale length in order to obtain a scale having sufficient graduations and numerals for easy reading without overcrowding. For nonsensitive type indicators, the indicating scale shall provide a minimum scale angle of 320°. The main indicating scale for subdial sensitive-type indicators shall provide a minimum scale angle of 225° and a maximum scale up to 270°. The zero position shall be at approximately 7 o'clock (see 6.4).

3.12.4.2.1 The dial scale shall be marked according to the following procedure:

a. Indicator dials shall be calibrated in pounds

b. Dial graduations shall be uniformly spaced

c. The end point of the calibration shall be the number of pounds obtained by multiplying the tank volume in gallons by the end point density. (Tank volume means that part of the total volume which is measured by the gage)

d. The scale end shall be the last division before the end point (for example, if the weight of fuel at the end point is 4,480 pounds and the minor graduations represent 200 pounds, the scale end will be the minor graduation representing 4,400 pounds).

3.12.4.3 Dial markings. All markings shall be so durable as to withstand service usage and shall be marked as shown on figures 1, 2, and 3. The graduation markings for the main dial shall be linear within ±0°30' and the graduation markings for the subdial shall be linear within ±1° for indicators conforming to figures 1 and 2. Wherever practicable, each major graduation shall be identified by a single numeral.

3.12.4.3.1 Marking dimensions. Dial marking dimensions shall be as shown on figures 1, 2, and 3.

3.12.4.4 Dial finish. The dial background, mounting bezel, gaskets, and spacer ring shall be finished in black, color No. 37038 of FED-STD-595. White markings shall be in accordance with color No. 37875 of FED-STD-595.

3.12.5 Pointers. Unless otherwise specified herein, the indicator pointer shall conform to MS33585. The pointer shall be light and sufficiently rigid to prevent oscillation under vibration and shall be firmly attached to the associated mechanism. A single pointer shall be used and shall move clockwise to show an increase in contents (see 6.4).

3.12.5.1 Pointer length. The pointer length shall be such that the pointer tip will extend into the scale a distance equal to 1/5 the length of the shortest graduation ±1/64 inch.

3.13 Electrical cable. External unshielded connector cable wire shall be Type RM-22 in accordance with MIL-W-7139. Coaxial cable shall be Type RG-179/U in accordance with MIL-C-17/94. Internal hookup wire shall be type B in accordance with MIL-W-16878/1. Electrical cable used within the fuel tank subject to the action of the fuel shall be entirely suitable for the purpose intended. In applications where the temperature may exceed 70°C in compartments of the aircraft structure through which the electrical interconnecting cables will be routed, the cables shall be a type designed for high temperature use and shall be subject to approval of the procuring activity. Internal wiring shall be neat and shall be accomplished in such a manner that individual wires may be easily traced. Wires shall be tied to the terminals prior to soldering.

3.13.1 Cable length. Accuracy and sensitivity of the gage shall not be adversely affected by increasing or decreasing the tank unit interconnecting cables within the limit of from 5 to 200 feet.

3.14 Electrical connectors (new design). For Army and Air Force new designs, electrical connectors shall conform to MIL-C-81511. Individual coaxial-type connectors shall not be used. Where coaxial contacts are required, they shall be a part of the connector special insert arrangement. Tank probe electrical connections shall either terminate at terminal studs or pigtail leads may be used. Unless otherwise specified, connectors for new Navy designs shall conform to MIL-C-26500, MIL-C-26482, or MIL-C-81511, with MIL-C-81511 connectors preferred. Connectors on bulkheads or fuel probes exposed to fuel or fuel vapors shall be hermetically sealed, fuel-resistant types conforming to MIL-C-25516.

3.14.1 Electrical connectors (old design). Electrical connectors for replacement parts for existing designs or previously designed gage components shall be compatible with existing equipment.

3.15 Input electrical power. Unless otherwise specified, the gage shall operate in accordance with the aircraft electrical power characteristics specified in MIL-STD-704.

3.16 Pointer overshoot. The gage shall be designed to provide steady indication of the pointer. In approaching null, the pointer shall not overshoot the final position more than one time and shall return to the final position within 2 seconds.

3.17 Calibration adjustment. Means shall be provided for adjusting the electrical circuit for range and calibration of the indicator. Adjustments of the indicator pointer shall be such that a change in the full adjustment will not appreciably affect the position of the indicator pointer at the zero point. The empty and full adjustments shall provide such sensitivity that adjustments can be easily accomplished under service operations. The adjustments shall be located in the bridge section of the indicator and not in the tank units. The adjustments shall be of sufficient range to compensate for all manufacturing tolerances in the gage and the fuel tanks, and shall provide such a sensitivity that adjustments can be easily accomplished under service operations. The design shall be such that the gage, including the compensator, can be accurately and easily checked, when the gage is installed in the airplane, by means of suitable test equipment.

3.18 Gage failure indication. The gage shall be provided with a readily accessible terminal connection for use with a remote test switch to indicate failure of gage operation. Operation of the external test switch shall cause the indicator pointer to rotate counterclockwise from a balance point on any portion of the dial.

3.19 Threaded fasteners. Unless otherwise specified, threaded fasteners shall conform to MIL-S-7742 and MIL-STD-454, requirement 12.

3.20 Lubrication. Lubrication, if required, shall be accomplished in accordance with MIL-STD-838. Lubricants shall conform to applicable Government specifications, unless otherwise approved by the procuring activity.

3.21 Finishes and protective coatings

3.21.1 Aluminum-alloy parts. Aluminum-alloy parts, where practicable, shall be covered with an anodic film conforming to MIL-A-8625.

3.21.2 Steel parts. Steel parts shall be cadmium plated in accordance with QQ-P-416, type II or III, as applicable, and of a class that is adequate to achieve the degree of protection required, or zinc plated in accordance with QQ-Z-325.

3.22 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130.

3.23 Workmanship. Workmanship shall be in accordance with MIL-STD-454, requirement 9.

3.23.1 Screw assemblies. Assembly screws and bolts shall be tight. The word tight means that the screw or bolt cannot be appreciably tightened further, without damage or injury to the screw or bolt or threads.

3.23.2 Riveting. Riveting operations shall be carefully performed to insure that the rivets are tight and satisfactorily headed.

3.23.3 Gears. Gear assemblies shall be properly alined and meshed, and shall be operable without interference, tight spots, loose spots, or other irregularities. Where required, gear assemblies shall be free from backlash.

3.23.4 Cleaning. The gage shall be thoroughly cleaned of loose, spattered, or excess solder, metal chips, and other foreign material after final assembly. Burrs, sharp edges, and resin flash shall be removed.

3.23.5 Dimensions. Dimensions and tolerances not specified shall be as close as is consistent with best shop practices. Where dimensions and tolerances may affect the interchangeability, operation, or performance of the gage, they shall be held or limited accordingly.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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.

4.2 Classification of tests. The inspection and testing of gages shall be classified as follows:

a. Preproduction tests

b. Quality conformance tests.

4.3 Test conditions

4.3.1 Item tests. Gage tests shall apply only when complete systems (indicators and tank units) are on the contract or order. When only individual units are on order (indicators, tank units and compensators, or tank units or compensators), the testing specified herein that applies only to the unit shall be conducted.

4.3.1.1 Tank unit tests. When order calls for a variety of tank units, the test units selected shall represent as many of the following categories as are represented on the order: (1) Each type mounting; (2) longest and shortest units; (3) intermediate lengths; and (4) tank units representing those equipped with each different type of discrete level sensing devices (thermistors, float switches, et cetera).

4.3.2 Standard atmospheric conditions. Whenever the pressure and temperature existing at the time of the test are not specified definitely, it is understood that the test is to be made at atmospheric pressure (approximately 29.92 inches Hg) and at room temperature (approximately 25°C). When tests are made with atmospheric pressure or room temperature differing materially from the above values, proper allowance shall be made for the difference from the specified condition.

4.3.3 Position. Unless otherwise specified, the indicator shall be tested with the dial in the normal operating position.

4.3.4 Test power. Unless otherwise specified herein, the gages shall be tested with 115V 400-Hz single-phase a-c power or 28V d-c power, as applicable.

4.3.5 Master test standards

4.3.5.1 Master test instrument. When testing of the indicator requires the use of auxiliary capacitance (other than supplied by the tank units or compensator units), such capacitance shall be supplied by precision variable or fixed capacitors. The accuracy of the precision capacitors at 25°C shall be 0.2 percent for capacitances in excess of 50 pf and 0.1 pf for capacitances less than 50 pf.

4.3.5.2 Master capacitance bridge. When testing of the tank unit or compensator unit re uires measurement of their capacitances, a master capacitance bridge shall be used. The accuracy of the bridge at an ambient temperature of 25°C shall be 0.2 percent for capacitances in excess of 50 pf and 0.1 pf for capacitances less than 50 pf.

4.3.5.3 Totalizer inputs. The contractor shall furnish, with the totalizer, a set of three gages and suitable calibration charts to serve as inputs for testing the totalizer, or, in lieu of the gages, the contractor may submit artificial devices simulating the totalizer input signal. If artificial devices are submitted, the contractor shall provide sufficient data to verify that the signals from these devices are equivalent to the totalizer output signals from the indicators.

4.3.5.4 Master test standard tolerance correction. The test standards shall be calibrated against precision laboratory standards. Error curves shall be established so that the error attributable to the test standards can be subtracted algebraically from the test data. Thus, the test data will represent true readings determined down to the extent of the accuracy tolerances of the calibration standards.

4.3.6 Nominal fuel. Nominal and end point fuels specified herein shall be suitable fuels having the following characteristics:

	Dielectric Constant (Nominal)	Density (Nominal) Lbs Per Gal.	Dielectric Constant (End Point)	Density (End Point) Lbs Per Gal.
JP-4	2.090	6.539	2.245	7.191
JP-4 and Octane	2.041	6.299	2.242	7.191
JP-5	2.156	6.854	2.236	7.191
Octane	1.990	6.000	2.088	6.593

4.4 Preproduction testing

4.4.1 Test samples. When tests are required for a specific application, the test samples shall consist of two gages composed of the following components, as applicable. When the contract or order is for other than a complete gage, the test samples shall consist of two of each component on the contract or order. If testing requires the use of components not on the contract or order, the output signals for such components may be simulated within the accuracy of the actual component tolerance allowance.

a. Tank units necessary to operate the system

b. The indicator designed to operate with the system

c. A totalizer indicator if the two gages are designed to operate with the totalizer; otherwise, one totalizer will be required for each gage

d. For class III gages, the computer and fuel attitude sensor

e. Intermediate devices, such as selector switches, relays, and equivalent capacitors used as simulators for individual tanks, et cetera.

4.4.2 Preproduction tests. The preproduction tests shall consist of all the tests specified under 4.6.

4.5 Quality conformance tests. Quality conformance tests shall consist of:

a. Individual tests

b. Sampling tests.

4.5.1 Individual tests. Each component or gage, as applicable, shall be subjected to the following tests as described under 4.6:

a. Examination of product

b. Indicator operation as room temperature

c. Tank unit and compensator sensing unit electrical capacitance

d. Tank unit and compensator sensing unit leakage

e. Dielectric strength

f. Individual tests of applicable lighting specification.

4.5.2 Sampling tests

4.5.2.1 Sampling plan A. The components of one gage shall be selected at random from each 100 or less produced on the contract or order and subjected to the following tests as described under 4.6, as applicable:

Indicator

a. Individual tests

b. Sealing

c. Complete gage scale error at room temperature

d. Indicator scale error at room temperature

e. Voltage and frequency variation

f. Indicator scale error at low temperature

g. Indicator scale error at high temperature

h. Sampling plan A tests of applicable lighting specification.

Tank units and compensators

a. Individual tests

b. Compensation

c. Tank unit and compensator sensing unit dry capacitance

d. Tank unit and compensator sensing unit capacitance at low temperature

e. Tank unit and compensator sensing unit capacitance at high temperature (see 4.3.1).

4.5.2.2 Sampling plan B. Unless otherwise specified (see 6.2), the components of two gages shall be selected at random from the first 10 produced on the contract or order and subjected to the following tests as described under 4.6, as applicable:

a. Sampling plan A tests

b. Vibration

c. Speed of response

d. Electromagnetic interference and supression

e. Indicator magnetic effect

f. Extreme low temperature exposure

g. High temperature exposure

h. Tank unit water immersion test

i. Humidity

j. Fungus

k. Salt fog

l. Indicator cycling

m. Thermal shock

n. Explosive atmosphere

o. Reliability

p. Longevity

q. Sampling plan B tests of applicable lighting specification except life, contrast, and lamp circuit tests may be performed earlier at the discretion of the testing activity.

4.5.2.3 Rejection and retest. When one item selected from a production run fails to meet the specification, no items still on hand or later produced shall be accepted until the extent and cause of failure are determined.

4.5.2.3.1 Individual tests may continue. For operational reasons, individual tests may be continued pending the investigation of a sampling test failure. But final acceptance of items on hand or later produced shall not be made until it is determined that items meet all the requirements of the specification.

4.5.3 Defects in items already accepted. The investigation of a test failure could indicate that defects may exist in items already accepted. If so, the contractor shall fully advise the procuring activity of all defects likely to be found and methods of correcting them.

4.6 Test methods

4.6.1 Examination of product. The gage shall be examined to determine compliance with the requirements specified herein with respect to dimensions, materials, workmanship, polyurethane coating, marking, and all other requirements not covered by tests.

4.6.2 Indicator operation at room temperature. The individual and totalizer indicators identified by the same manufacturer's part number shall be checked individually against fixed design calibration data to determine:

a. That the scale error at each major graduation is within the tolerance specified in table I. The scale error of each indicator shall be determined under conditions of both increasing and decreasing readings

b. That the pointer will travel from zero to full scale indication in 1 minute or less for nonsensitive-type indicators and 2 minutes or less for sensitive-type indicators

c. That, where applicable, the output signal at each major graduation is within the tolerance specified in table I. This test is required only for those indicators that provide signals for totalizers

d. That level switching mechanisms and other items such as potentiometers incorporated in the design for specific applications operate properly

e. That the pointer moves smoothly over the complete range of the indicator

f. That all external adjustments function correctly

g. That all adjustments associated with compensation are properly set

h. That the dead spot does not exceed the tolerance specified in table I for dead spot at room temperature. The dead spot shall be determined as follows: The input capacitance of the gage system shall be slowly varied by means of the master test instrument, first in one direction and then in the other. The capacitance change required to produce indicator rotation shall be noted and shall be computed as a percentage of the total input capacitance range for which the gage is calibrated; this percentage is defined as the dead spot. For totalizers, a suitable input signal provided by the master test instrument shall be employed in lieu of input capacitance

i. That the pointer does not overshoot the null position more than once.

4.6.3 Tank unit and compensator sensing unit electrical capacitance

4.6.3.1 Tank unit. The dry capacitance of each tank unit shall be determined by a master capacitance bridge. The capacitance value established shall not differ from the respective value specified by more than the tolerance shown in table I. This test may be combined with the tank unit calibration test.

4.6.3.2 Compensator sensing unit. The dry capacitance of each compensator sensing unit shall be determined by means of the master capacitance bridge. The capacitance value established shall not differ from the value specified by more than the tolerance shown in table I.

4.6.3.3 Tank unit calibration. The empty capacitance of each of the tank units shall be determined by means of the master capacitance bridge. Each tank unit shall be individually immersed in a representative fuel sample to the levels specified in table II and the added capacitance attributable to fuel shall be measured. The added capacitance values shall agree with the specified values within the tolerances shown in table I. The unit shall then be subjected to and shall meet a 3-wire electrical leakage test in accordance with MIL-G-7940. Each tank unit shall measure in excess of 10 times the values specified for the complete tank unit (probe) circuitry.

Table II. Individual Tank Unit Calibration Data

Height of Fuel Level in Inches from Bottom of Tank Unit	Added Capacitance Attributable to Fuel, Expressed in Percent of Total Added Capacitance For Complete Immersion		
	Tank Unit No. 1	Tank Unit No. 2	Additional Tank Units, as applicable

NOTE: The data required to complete the above table shall be added by the manufacturer.

4.6.4 Attitude sensor and computer. When complete gage error tests are not called for, attitude sensor and computer accuracy shall be determined by comparing the magnitude of the actual attitude correction output of the attitude correction system with the required correction necessary for that particular pitch and roll attitude and tank quantity. To perform this test, the attitude sensor and computer shall be electrically connected and a calibration run made at the attitudes and tank capacities shown in table III. The fuel gage manufacturer shall fill in appropriate pitch and roll attitudes and correction columns as determined by his design data. Actual correction and percent error shall be as determined by test. At least four typical pitch and roll attitudes shall be selected at each tank capacity listed. The percent error shall be the required correction minus the actual correction divided by the required correction and expressed in percent. This error shall be no greater than 1 percent.

TABLE III. Attitude Correction Calibration Data

TANK # ____________

Tank Percent Full	Attitude		Required Correction	Actual Correction	Percent Error
	Pitch	Roll			
0					
20					
40					
60					
80					
100					

4.6.5 Tank unit and compensator sensing unit leakage. Tank units and compensator units of the externally mounted type shall be installed in a suitable pressure chamber equipped with the proper size flange fittings. A pressure of 30 ±5 psi shall be applied within the pressure chamber, and no leak shall be detected on the outer side of the tank unit mounting flange and connector head assembly. A suitable liquid shall be used for detecting the presence of air bubbles. The duration of this test shall be 5 minutes. A leak shall be considered as a periodic bubbling from a specific area at a frequency of at least one bubble each minute.

4.6.6 Dielectric strength. There shall be no breakdown of insulation of any of the equipment when it is subjected for 1 minute to a test voltage of 500V rms ac at a commercial frequency applied between any pair of points desired by the testing activity. If the design of the gage is such that there exists between the test points a number of electrical circuit elements which form a conducting path for alternating current which would be damaged by the test voltage, these elements shall be removed prior to application of the test voltage. Where hermetically sealed enclosures are employed, the above test shall be conducted prior to sealing the enclosures. After the enclosures are sealed and pressurized with helium, the same test shall be repeated with the exception that the voltage shall be reduced to 200V and shall not be conducted between points where circuit elements would be damaged by the test voltage.

4.6.7 Sealing. Hermetically sealed components of the gage shall be tested for leaks by means of a mass spectrometer-type helium leak detector. The leak rate shall not exceed 0.01 micron cubic foot per hour at a pressure differential of approximately 1 atmosphere.

4.6.8 Complete gage scale error at room temperature (classes I and II). The gage shall be electrically connected and the tank unit (or units) shall be installed in a suitable test chamber. The external compensator sensing unit, if used, shall be installed in the correct position with the tank unit (or units) in the test chamber. The gage shall be set to read zero with the dry tank unit (or units) and the compensator sensing unit, and set to the added capacitance values specified for complete immersion in nominal fuel. The gage shall be set to read nominal full. The master test instruments shall be removed, nominal fuel shall be poured into the test chamber to the levels specified in table II, or IV, as applicable, and the indicator readings shall be noted. The difference between the observed readings the the specified readings shall not exceed the tolerances of table I.

Table IV. Gage System Calibration Data

Height of Fuel Level in Inches from Bottom of Lowest Tank Unit	Total Tank Unit Capacitance for Nominal Fuel, pf	Capacitance of Compensator Sensing Unit for Nominal Fuel, pf	Indicator Reading in Pounds (All Major Dial Graduations)	Output Signal Where Applicable

NOTE: The data required to complete the above table shall be added by the manufacturer. The last four columns of this table shall be extended to include capacitance values and totalizer output signals up to and including the highest major dial graduation. The capacitance values listed in the extended portion of the second column are to be interpreted as applicable to those tests on which master test instruments are connected in lieu of the tank units.

4.6.8.1 Complete gage scale error (class III). The class III gage shall be electrically connected as specified in 4.6.8. If an actual fuel tank is not available for this test, an alternate test method may be used which shall simulate the various altitudes by inflicting the appropriate fuel levels on the individual probes and tilting the fuel attitude sensor to the proper attitude. The gate shall be tested within the range of attitudes for which it is designed to operate at normal-ground, normal-cruise, at each full degree of pitch and roll attitude, and at combinations of these attitudes. If the contract or order does not include the probes associated with the system, the probe capacitances may be simulated by use of precision variable capacitors. The accuracy shall be within the tolerance specified in table I for class III complete gage scale error.

4.6.8.2 In lieu of nominal fuel, any suitable fuel may be used the dielectric constant of which has a known value between 2.00 and 2.10. If the dielectric constant differs from the nominal value, the specified indicator readings shall be multiplied by the correction factor listed in table V or VI corresponding to the actual dielectric constant of the fuel.

Table V. Compensator Calibration Table (JP-4 Fuel Only)

Dielectric Constant	Indicator Reading Percent Full Scale	Correction Factor	Dielectric Constant	Indicator Reading Percent Full Scale	Correction Factor
1.85	75.34	0.8286	2.07	89.67	0.9862
1.86	76.03	0.8362	2.08	90.28	0.9929
1.87	76.71	0.8437	2.09	90.93	1.0000
1.88	77.40	0.8512	2.10	91.50	1.0063
1.89	78.07	0.8586	2.11	92.11	1.0130
1.90	78.74	0.8660	2.12	92.71	1.0196
1.91	79.41	0.8734	2.13	93.31	1.0262
1.92	80.07	0.8807	2.14	93.91	1.0328
1.93	80.74	0.8880	2.15	94.50	1.0393
1.94	81.40	0.8953	2.16	95.09	1.0458
1.95	82.06	0.9024	2.17	95.67	1.0522
1.96	82.71	0.9097	2.18	96.26	1.0587
1.97	83.36	0.9168	2.19	96.85	1.0651
1.98	84.00	0.9239	2.20	97.42	1.0714
1.99	84.65	0.9310	2.21	98.00	1.0778
2.00	85.29	0.9380	2.22	98.57	1.0841
2.01	85.93	0.9450	2.23	99.14	1.0903
2.02	86.55	0.9519	2.24	99.72	1.0967
2.03	87.19	0.9589	2.245	100.00	1.0998
2.04	87.81	0.9657	2.25	100.28	1.1029
2.05	88.43	0.9726	—	—	—
2.06	89.06	0.9794	—	—	—

Table VI. Compensator Calibration Table (JP-4 Fuel and Octane Fuels)

Dielectric Constant	Indicator Reading Percent Full Scale	Correction Factor	Dielectric Constant	Indicator Reading Percent Full Scale	Correction Factor
1.85	74.70	0.8527	2.07	89.45	1.0211
1.86	75.40	0.8607	2.08	90.09	1.0284
1.87	76.10	0.8687	2.09	90.72	1.0356
1.88	76.80	0.8767	2.10	91.35	1.0428
1.89	77.49	0.8846	2.11	91.98	1.0500
1.90	78.18	0.8925	2.12	92.61	1.0572
1.91	78.87	0.9003	2.13	93.23	1.0643
1.92	79.55	0.9081	2.14	93.85	1.0714
1.93	80.23	0.9159	2.15	94.48	1.0785
1.94	80.92	0.9237	2.16	95.09	1.0855
1.95	81.59	0.9314	2.17	95.70	1.0925
1.96	82.26	0.9390	2.18	96.31	1.0994
1.97	82.93	0.9467	2.19	96.92	1.1064
1.98	83.60	0.9543	2.20	97.53	1.1133
1.99	84.25	0.9618	2.21	98.12	1.1201
2.00	84.92	0.9693	2.22	98.73	1.1270
2.01	85.58	0.9768	2.23	99.32	1.1338
2.02	86.23	0.9843	2.24	99.92	1.1406
2.03	86.88	0.9918	2.242	100.00	1.1419
2.04	87.53	0.9992	2.25	100.50	1.1473
2.041	87.60	1.0000	———	———	———
2.05	88.17	1.0065	———	———	———
2.06	88.81	1.0138	———	———	———

4.6.9 Compensation. With the empty and full adjustments set as in the gage scale error at room temperature test, the tank unit (or units) and compensator sensing unit shall be completely immersed in each of two fuels, and one having a known dielectric constant less than 1.95 and the other having a known dielectric constant greater than 2.15. The difference between the two readings shall not exceed the tolerance specified in table I.

4.6.10 Indicator scale error at room temperature. The indicator shall be assembled and connected to master test instruments in lieu of the tank unit (or units) and compensator sensing unit. The master test instruments shall be set respectively to the specified capacitance values corresponding to empty tank and complete immersion in nominal fuel, and the indicator shall be adjusted to read zero and nominal full. Once set, the adjustments shall not be altered during the remainder of the tests. The master test instruments shall then be set to the capacitance values specified in table IV. The observed readings shall be recorded. Indicator scale error and the dead spot shall not exceed the tolerances shown in table I. Where applicable, the output signals for the totalizer shall be recorded for each test point.

4.6.10.1 The indicator associated with the totalizer shall be tested by means of a master test instrument. The observed readings shall be recorded. Scale errors and the dead spot tolerances shall not exceed the values specified in table I for the totalizer at room temperature.

4.6.10.2 Reference values. The reference values specified herein are the original scale error and dead-spot readings of each indicator after being properly adjusted to read zero and nominal full. (See 4.6.10 and 4.6.10.1.)

4.6.11 Tank unit assembly and compensator sensing unit dry capacitance

4.6.11.1 Tank unit dry capacitance. The dry capacitance of the assembled tank units providing a single indication shall be measured at room temperature with the master capacitance bridge. The value obtained shall agree with the specified value within the room-temperature tolerance specified in table I for the tank unit assembly.

4.6.11.2 The dry capacitance of the compensator sensing unit determined in the compensator sensing unit test shall be recorded. The capacitance value established shall not differ from the value specified by the manufacturer by more than the tolerance specified in table I.

4.6.11.3 Reference capacitance. The observed readings specified in 4.6.11.1 and 4.6.11.2 will be referred to hereafter as reference capacitances.

4.6.12 Voltage and frequency variation. The completely assembled gage shall be tested at three different positions on the indicator dial, approximately

5, 50, and 90 percent of maximum indication, under the following voltage and frequency combinations:

D-C Voltage	A-C Voltage	Frequency
a. 28	115	400
b. 25	105	360
c. 25	125	440
d. 29	115	400
e. 29	105	360
f. 29	125	440

The change in indication from that observed under condition "a" shall not exceed the amount specified for voltage and frequency variation in table I. The dead spot of the gage shall be determined at midscale indication under conditions "b" and "f" and shall not exceed the total input capacitance range by more than the amount specified in table I for voltage and frequency variation dead spot.

4.6.13 Indicator scale error at low temperature. The indicator shall be placed in a temperature chamber and subjected to -54° ±2°C for a minimum period of 4 hours. The master test instrument shall be maintained at room temperature. At the end of this period and while the unit is still at the low temperature, scale readings shall be determined by means of the master test instrument. The scale readings shall not differ from the reference values by more than the tolerance specified in table I for low temperature. This test and other tests hereafter specified covering the same equipment shall apply to indicators associated with gages (with and without the totalizing feature) and totalizers.

4.6.13.1 When the unit has returned to room temperature, scale readings shall again be determined by means of the master test instrument. The scale readings shall not differ from the reference values by more than the tolerance specified in table I after the indicator has returned to room temperature.

4.6.14 Tank unit and compensator sensing unit capacitance at low temperature. The tank unit assembly (see 4.3.1.1), including the compensator sensing unit, shall be placed in a temperature chamber and subjected to -54° ±2°C for a minimum period of 4 hours. At the end of this period and while the tank unit assembly is still at this temperature, the dry capacitance shall be determined and shall not differ from the respective reference capacitance by more than the tolerances specified in table I for the tank unit and compensator unit under low temperature.

4.6.14.1 When the units have returned to room temperature, the dry capacitance shall again be determined and shall not differ from the respective reference capacitance by more than the tolerances specified in table I for the tank and compensator units after they have returned to room temperature.

4.6.15 Attitude sensor and computer (low temperature). Where applicable, the attitude sensor and computer shall be placed in a temperature chamber and subjected to -54° ±2°C for a minimum period of 4 hours. At the end of this period and while the units are still at this temperature, the test specified in 4.6.4 shall be performed. The percent error (table III) shall not be greater than 1.5 percent.

4.6.15 When the units have returned to room temperature, the calibration test (4.6.4) shall again be performed. The error (table III) shall not be greater than 1.0 percent.

4.6.16 Indicator scale error at high temperature. The indicator shall be placed in a temperature chamber and subjected to a temperature of 71° ±2°C for a minimum period of 4 hours. The master test instrument shall be maintained at room temperature. At the end of this period and while the indicator is still at the high temperature, scale readings shall be determined by means of the master test instrument. The scale readings shall not differ from the reference values by more than the tolerance specified in table I for the indicator under high temperature.

4.6.16.1 After the unit has returned to room temperature, scale readings shall again be determined by means of the master test instrument. The scale readings shall not differ from the reference values by more than the tolerances shown in table I for the indicator after it has returned to room temperature.

4.6.17 Tank unit and compensator sensing unit capacitance at high temperature. The tank unit assembly (see 4.3.1.1), including the compensator sensing unit, shall be placed in a temperature chamber and subjected to a temperature of 71° ±2°C for a minimum period of 4 hours. At the end of this period and while the tank unit assembly is still at this temperature, the dry capacitance shall be determined and shall not differ from the respective reference capacitance by more than the tolerances specified in table I for the tank and compensator units at high temperature.

4.6.17.1 When the units have returned to room temperature, the dry capacitance shall again be determined and shall not differ from the respective reference capacitance by more than the tolerances shown in table I for the tank and compensator units after they have returned to room temperature.

4.6.18 Attitude sensor and computer (high temperature). Where applicable, the attitude sensor and computer shall be placed in a temperature chamber and subjected to a temperature of 71° ±2°C for a minimum period of 4 hours. At the end of this period and while the units are still at this temperature, the test specified in 4.6.4 shall be performed. The error (table III) shall not be greater than 1.5 percent.

4.6.18.1 When the units have returned to room temperature, the test specified in 4.6.4 shall again be conducted. The error (table III) shall not be greater than 1.0 percent.

4.6.19 Vibration

4.6.19.1 Vibration error. The vibration error tests shall be conducted on the components of the gage as follows:

4.6.19.1.1 Indicator vibration resonance. The indicator shall be electrically connected to a master test instrument. The indicator shall be subjected to a resonance search in accordance with MIL-STD-810, method 514, procedure I, part 1, equipment category (a), curve B, except if the indicator is to be installed unisolated panels, curve Z shall apply. The frequency of applied vibration shall be varied slowly throughout the range specified. The maximum double amplitude of the pointer oscillation shall not exceed 0.5 percent of full scale indication, and the pointer variation from its original position shall not be greater than 0.5 percent of full scale indication. The test shall be conducted at an indicator reading of zero and at a minimum of two additional points selected by the procuring activity.

4.6.19.2 Indicator vibration failure. The indicator shall be electrically connected as specified in the indicator vibration resonance test. The indicator shall be electrically energized and then adjusted to read approximately midscale by means of the master test unit. The indicator shall be subjected to resonance swell and vibration cycling in accordance with MIL-STD-810, method 514, procedure I, parts 2 and 3, equipment category (a), curve B, except if the indicator is to be installed in unisolated panels, curve Z shall apply. At the conclusion of this test, a scale reading shall be established by means of the master test instrument and shall not differ from the reference values by more than the tolerances specified in table I for indicator vibration failure. The indicator shall be inspected thoroughly for damage or defects resulting from this test.

4.6.19.3 Tank unit and compensator vibration. The tank unit and compensator shall be subjected to vibration in each of three mutually perpendicular axes in accordance with MIL-STD-810, method 514, equipment category (a), curve Z, except that the frequency range shall be from 5 to 2,000 Hz. All parts of the gage shall be electrically connected to each other and to the master test instrument. The gage shall be adjusted to read approximately midscale by means of the master test instrument. The tank unit and the compensator sensing unit shall be mounted as a separate item with the flange (on flange-mounted units) fixed to the vibration stand and with end and center supports substantially in accordance with types being provided for the respective airplane application. The integrally mounted tank units shall also be mounted on a test stand in a manner similar to that being followed in the respective airplane installation.

4.6.19.3.1 Resonance search, part 1. A resonance search shall be conducted in accordance with MIL-STD-810, method 514, procedure I, part 1. The resonant frequencies of the tank unit or units shall be determined by varying the frequency of the applied vibration slowly through the range of frequencies at the vibratory accelerations not exceeding those specified along three mutually perpendicular axes. The test specimen shall be vibrated at the indicated resonant conditions in accordance with the schedule and time table specified in 4.6.19.3. During vibration, the maximum double amplitude of the indicator pointer oscillation and pointer variation from its original setting shall be noted to determine that they do not exceed 0.3 percent of full scale indication. Following this test, the dry capacitance shall be determined and shall not differ from the respective reference capacitance by more than the tolerances specified in table I for tank and compensator units under resonance vibration. The tank and compensator unit, or units, shall be thoroughly inspected to determine that no damage has occurred as a result of this test.

4.6.19.3.2 Resonance dwell, part 2. A resonance dwell test shall be conducted in accordance with MIL-STD-810, method 514, procedure I, part 2.

4.6.19.3.3 Vibration cycling, part 3. A vibration cycling test shall be conducted in accordance with MIL-STD-810, method 514, procedure I, part 3.

4.6.20 Speed of response. For nonsensitive indicators, the pointer shall travel from zero to end-point or from end-point to zero within a period of 1 minute at room temperature, and for sensitive indicators of the sub-dial type the pointer travel period for the main pointer shall be within 2 minutes. After the indicator has been maintained at -55°C for a minimum period of 2 hours, the time required for the pointer to travel over the design range shall not exceed that specified for the room temperature test by more than three times.

4.6.21 Electromagnetic interference and supression. The gage shall meet an electromagnetic interference and supression test in accordance with MIL-STD-462. The methods shall be as specified in MIL-STD-461 for class A1 equipment.

4.6.22 Indicator magnetic effect. The indicator not operating, shall be rotated in a vertical plane about a short bar magnet compass with the nearest part of the indicator 5-1/2 inches from and magnetically ease or west of the center of the compass. Starting directly under the compass, the indicator shall be held in positions 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315° from the initial position. At each of these positions, the indicator shall be rotated on its own horizontal axis until it is in its normal upright position. The horizontal magnetic field intensity shall be 0.17 to 0.19 oersted. The deflection of the compass at any of the specified positions shall not exceed 5°. The test shall then be repeated with the indicator operating at rated voltage.

4.6.23 Extreme low temperature exposure

4.6.23.1 Indicator scale error. The indicator shall be tested as specified in 4.6.13, except that the unit shall be maintained at a temperature of -65° ±2°C for a period of 48 hours, and the temperature raised to -54° ±2°C for a period of 24 hours. During the last 4 hours of the 24-hour period at -54°C, the pressure shall be reduced to 0.82 inch Hg absolute, or less. At completion of the 24-hour period and while at the temperature and pressure specified, the indicator shall be tested to determine that the scale readings do not differ from the reference values by more than the tolerance specified in table I for the indicator at extreme low temperature.

4.6.23.1.1 When the indicator has returned to room temperature, scale readings shall again be determined by means of the master test instrument. The scale readings shall not differ from the reference values by more than the tolerance specified in table I for the indicator after returning to room temperature.

4.6.23.2 Tank unit and compensator sensing unit. The tank unit assembly (see 4.3.1.1), including the compensator sensing unit, shall be tested as described in 4.6.14, except that the assembly shall be maintained at a temperature of -65° ±2°C for a period of 48 hours, and the temperature then raised to -54° ±2°C for a period of 24 hours. During the last 4 hours of the 24-hour period at -54°C, the pressure shall be reduced to 0.82 inch Hg absolute, or less. At the completion of the 24-hour period, and while at the temperature and pressure specified, the dry capacitance shall be measured and shall not differ from the respective reference capacitance by more than the tolerances specified in table I for the tank and compensator units at extreme low temperature.

4.6.23.2.1 When the assembly has returned to room temperature, the dry capacitances shall again be determined and shall not differ from the reference capacitances by more than the tolerances specified in table I for tank and compensator units after they have returned to room temperature.

4.6.23.3 Attitude sensor and computer. Where applicable, the attitude sensor and computer shall be tested as specified in 4.6.4, except that the units shall be maintained at a temperature of -65° ±2°C for a period of 48 hours, and the temperature then raised to -54° ±2°C for a period of 24 hours. During the last 4 hours of the 24-hour period at -54°C, the pressure shall be reduced to 0.82 inch Hg absolute, or less. At the completion of the 24 hour period and while at the same temperature and pressure, the test specified in 4.6.4 shall be performed. The error (table III) shall not be greater than 1.5 percent.

4.6.23.3.1 When the units have returned to room temperature, the test specified in 4.6.4 shall again be performed. The error (table III) shall not exceed 1.0 percent.

4.6.24 High temperature exposure

4.6.24.1 Tank unit and compensator sensing unit. The tank unit assembly (see 4.3.1.1), and compensator sensing unit shall be tested as described in the tank unit high temperature test, except that the assembly shall be maintained at a temperature of 132° ±3°C for a period of 24 hours. When the assembly has returned to room temperature, the dry capacitance shall again be determined and shall not differ from the reference capacitance by more than the tolerances specified in table I for tank and compensator units under high temperature exposure conditions.

4.6.24.2 Attitude sensor and computer. Where applicable, the attitude sensor and computer shall be tested as described in 4.6.4 except that the units shall be maintained at a temperature of 132° ±3°C for a period of 24 hours. When the units have returned to room temperature, the error, table III, shall be no greater than 1 percent.

4.6.25 Tank unit water immersion test. The tank unit assembly shall be mounted in a suitable tank. The tank shall then be filled to approximately three-quarters of its capacity with JP-5 fuel conforming to MIL-T-5624. After the capacitance reading and the fuel level have been noted, sufficient distilled water shall be poured into the tank to cover the compensator sensing unit, if it has one or approximately one-fourth of the uncompensated tank unit, and the tank shall then be sealed. The compensator sensing unit shall remain submerged in distilled water for 1 minute. The tank shall then be inverted for 1 minute and restored to its normal upright position for 5 minutes. This procedure shall be repeated 4 times, with the time required to invert the tank being 5 seconds. The water shall be drained from the tank and, if necessary, fuel shall be added to restore the original fuel level. The capacitance reading shall be noted after 5 minutes. The change in capacitance from the original reading shall not exceed the tolerances specified in table I for water immersion. The unit shall then be subjected to and shall meet the 3-wire electrical leakage test specified in MIL-G-7940. Individual tank units shall measure in excess of 10 times the values specified for the complete tank unit (probe) circuitry. If the compensator unit is a separate unit, it shall also meet this test.

4.6.26 Humidity. All components of the gage, except those that are hermetically sealed, shall be subjected to the humidity test in accordance with MIL-STD-810, method 507, procedure I. Twenty-four to forty-eight hours following this test, the unit shall be subjected to and shall meet the 3-wire electrical leakage test specified in MIL-G-7940. Individual tank units shall measure in excess of 10 times the values specified for the complete tank unit (probe) circuitry.

4.6.26.1 Tank unit and compensator sensing unit. Within 1 hour after completion of exposure to humidity, the dry capacitance shall be determined and shall not differ from the reference capacitance by more than the tolerances specified in table I for the tank and compensator units 1 hour after exposure to humidity.

4.6.26.1.1 Between 24 and 48 hours after exposure to humidity, the dry capacitance shall again be determined and shall not differ from the reference capacitance by more than the tolernnces specified in table I for the tank and compensators 24 to 48 hours after the humidity test. There shall be no evidence of corrosion or deterioration that would affect subsequent operation of the gage.

4.6.27 Fungus. All components, except those that are completely hermetically sealed, shall be subjected to a fungus test in accordance with MIL-STD-810, method 508, procedure I, for a period of 28 days.

4.6.27.1 Tank unit and compensator sensing unit. Within 1 hour after removal from the fungus test chamber, the dry capacitance shall be determined and shall not differ from the reference capacitance by more than the tolerances specified in table I for the tank and compensator units 1 hour after the fungus test.

4.6.27.2 Between 24 and 48 hours after subjected to the fungus test, the dry capacitance of the components shall again be determined and shall not differ from the respective reference capacitances by more than the tolerances specified in table I for 24 to 48 hours after the fungus test.

4.6.28 Salt fog. All parts of the gage that are outside of the fuel cell shall be subjected to a salt fog test in accordance with MIL-STD-810, method 509. At the completion of this test, the components shall be subjected to the following:

4.6.28.1 Indicator scale error. Scale readings shall be determined by means of the master test transmitter. The scale readings shall be taken within 1 hour after removal of the indicator from the test chamber and shall not differ from the reference values by more than the tolerances specified in table I for the indicator 1 hour after exposure to salt fog. There shall be no evidence of corrosion or other deterioration which would affect subsequent operation of the gage.

4.6.28.2 Tank unit and compensator sensing unit. The dry capacitance shall be determined within 1 hour after the units have been removed from the test chamber and shall not differ from the reference capacitance by more than the tolerances specified in table I for the tank and compensator units 1 hour after exposure to salt fog. Between 24 and 48 hours after the units have been removed from the test chamber the dry capacitance shall again be determined and shall not differ from the reference values by more than the tolerances specified in table I for the units 24 to 48 hours after exposure to salt fog. There shall be no evidence of corrosion or deterioration that would affect subsequent operation. Twenty-four to forty-eight hours following this test, the unit shall be subjected to and shall meet the 3-wire electrical leakage test specified in MIL-G-7940. Individual tank units shall measure in excess of 10 times the values specified for the complete tank unit (probe) circuitry.

4.6.29 Indicator cycling. The indicator shall be electrically connected to the master test instrument (variable capacitor simulating the tank unit assembly). During the cycling procedure, the capacitance shall be continuously varied so that the indicator pointer will move from zero to end point and return to zero within 5 minutes ±1 minute. The total cycling period shall be a minimum of 5,000 cycles and shall be conducted in 12-cycle intervals. After each interval, the indicator shall be deenergized electrically for a minimum of 10 minutes between cycling intervals. After the cycling test, a scale error test shall be conducted. The readings established shall not differ from those established (by the last room temperature test prior to beginning this test) by more than the tolerance specified in table I for the indicator after cycling. This test is applicable to all indicators and totalizers identified by the manufacturer by different basic part numbers.

4.6.30 Thermal shock. Hermetically sealed components of the gage shall be subjected to a total of 8 cycles of alternate immersions in tap water maintained at 85° ±5°C and 5° ±5°C. The length of the time for each bath immersion shall be 30 minutes; not more than 5 seconds shall elapse between bath immersions. No evidence of moisture penetration or damage to the inclosure shall result from this test. Following this test, the test specimen shall be resubjected to the sealing test.

4.6.31 Explosive atmosphere. Each set of tank units and compensators shall be placed within the explosion chamber and connected as a complete gage system to their respective indicator or indicators. The hermetically sealed indicators may or may not be placed within the chamber at the discretion of the testing agency. With normal power applied to the gage system, an explosive atmosphere test shall be conducted in accordance with MIL-STD-810, procedure I. Provisions shall be made to measure the current in the leads of the tank unit and compensator circuitry. While the tank units and compensators are in the explosive atmosphere, and with normal operating electrical power applied to the gage system, short circuit conditions shall be induced between the tank unit and compensator capacitor poles. The current measured in the tank unit and compensator leads shall not exceed 0.2 amp. During each step specified in procedure I, the short circuits shall be applied between the capacitor plates of each tank unit and compensator unit under test for a minimum of 10 times. Any explosion resulting from this test shall be cause for rejection.

4.6.32 Reliability. A minimum of three test samples shall be subjected to a reliability test in accordance with MIL-STD-781, test level F. Accept-reject criteria shall be in accordance with test plan I. No preventive maintenance shall be performed during this test.

4.6.32.1 Duty cycle. The standard method of temperature cycling specified in MIL-STD-781 shall be used throughout the reliability test. During the heating period only, the gage shall be electrically energized with normal operating voltage and frequency and shall be operationally cycled using fuel to activate the tank units through a range of approximately 15 to 85 percent and back to 15 percent within 5 minutes ±1 minute.

4.6.32.2 The gage scale error test shall be conducted at least three times each week. The indicator shall be observed daily on regular work days for obvious failures. At least once each week, when the gage has reached approximately room temperature, the gage shall meet the tank unit and compensator water immersion test.

4.6.32.3 Failure criteria. When performance of the gage is not within the accuracy requirements specified herein, at least one failure shall be charged against this test. If subsequent analysis reveals that several parts have deteriorated, each shall be counted as a failure unless one part caused the other part to fail.

4.6.33 Longevity. Testing of two of the reliability test samples shall be continued through a longevity test in accordance with 4.6.32 and test plan XXVIII of MIL-STD-781. The operating time shall be 5,000 hours on each of the two test samples. Preventive maintenance may be performed during this test. Failures shall be recorded and the equipment shall be repaired; however, the ratio of equipment operating time to failures shall be a MTBF of 3,000 hours or better.

4.6.34 Maintainability demonstration. The ease of field-level maintainability shall be demonstrated to the extent of (a) calibrating the gage system after it has been purposefully decalibrated and (b) measuring the time required to disassemble and reassemble the tank unit for cleaning or replacement, or both, of defective parts. Recalibration of the gage system shall include adjustment at full tank, adjustment at empty tank, recheck at full tank, and recheck at empty tank. Full-tank conditions may be simulated by adding precision capacitors to the dry capacitance of the probes. Recalibration adjustment shall not require more one recheck operation at full- and at empty-tank conditions to bring the calibration sufficiently close to meet the gage system scale-error-at-room-temperature accuracy requirements specified herein. Recalibration and subsequent gage accuracy checks shall be accomplished in not more than 40 minutes. Disassembly of the tank unit and compensator shall be demonstrated by replacing the insulators between the capacitor surfaces, cleaning the capacitor surfaces, replacing the wiring, and reassembling the tank and compensator units, or both, within 20 minutes. After reassembly, the tank unit or compensator, or both, shall meet the test specified in 4.6.3.3.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing

5.1.1 Levels A and B. Preservation shall be in accordance with MIL-P-116, method II, and packaging and packing shall be in accordance with MIL-STD-794.

5.1.2 Level C. Level C packaging and packing shall be in accordance with the manufacturer's commercial practice.

5.2 Marking for shipment. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

5.2.1 Reinspection date. Reinspection date markings shall be in accordance with the instructions of the procuring activity.

6. NOTES

6.1 Intended use. The gages covered by this specification are intended for use in indicating the quantity of fuel (in pounds) contained in fuel tanks of jet and turboprop aircraft.

6.1.1 Class II or class III gages. Class II or class III gages, as specified in the contract, will be used for new aircraft design. Class I gages may be used as replacements for old designs where accuracy of the old design is comparable to class I accuracies.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification

b. Class of gage required (see 1.2)

c. When uncharacterized tank units are required (see 3.11.1.1)

d. Color of lighting required (see 3.12.2.3)

e. When sampling plan B tests will not be conducted (see 4.5.2.2)

f. Levels of packaging and packing required and reinspection date markings (see section 5).

6.2.1 Calibration data. The contractor will furnish the procuring activity, on 8 by 10-1/2-inch paper, two copies of calibration data containing the following information:

a. Type of airplane____________________Series__________________________

b. Tank or tanks for which calibration applies

c. Fuel gage system no.________________Cabling diagram_________________

d. List of all components of the gage system with the manufacturer's part numbers

e. The manufacturer's part no. and dry capacitances of all individual tank units

f. Data for tank unit assembly

(1) Dry capacitance

(2) Total capacitance for complete immersion in nominal fuel

(3) Added capacitance due to complete immersion in nominal fuel

g. Data for compensator sensing unit

(1) Dry capacitance

(2) Total capacitance for complete immersion in nominal fuel

(3) Added capacitance due to complete immersion in nominal fuel

h. Relative position of tank units corresponding to locations in the airplane

i. Data for indicator dial calibration

(1) Pounds of fuel equivalent to full scale indication

(2) Pounds of fuel equivalent to nominal full indication

j. Data to complete tables II, III, IV, and VII.

Table VII. Totalizing Indicator Calibration Data

Input Signal	Indication in Pounds of Fuel Throughout Complete Scale

6.3 Definitions. For the purpose of this specification, the following definitions will apply:

6.3.1 Amplitude. Amplitude is the distance from the mean position to either extreme. Double amplitude is two times the amplitude.

6.3.2 Zero point. Zero point is the beginning of the dial graduations which represents an indication of zero fuel quantity (dry tank unit).

6.3.3 Full scale indication. Full scale indication is the indication corresponding to a full tank of fuel having an end point density as defined herein.

6.3.4 Density. Density values are relative values and are defined as the ratio of the apparent mass of fuel to the true volume. The apparent mass is the value obtained by weighing the fuel in air at 15.6°C, 50-percent relative humidity, and 760 mm of mercury pressure against brass weight of specific gravity 8.4, with no corrections being applied for air buoyancy. The true density of aircraft fuels is about 0.009 pound per gallon greater than the apparent density.

6.3.5 Nominal full. Nominal full indication is the indication corresponding to the full tank of nominal fuel as specified herein.

6.4 International standardization agreement. Certain provisions (see 3.12.4.2 and 3.12.5) of this specification are the subject of international standardization agreements ASCCAS 10/10 and Stanag 3339. When amendment, revision, or cancellation of this specification is proposed, the departmental custodians will inform their respective Departmental Standardization Offices so that appropriate action may be taken respecting the international agreement concerned.

6.5 Marginal indicia. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.6 Supersession data. This specification supersedes MIL-G-26988B(USAF). It also supersedes MIL-G-7817, MIL-G-7818, and MIL-G-8798 (ASG) for new design of class I gages.

Custodians:
Army - AV
Navy - AS
Air Force - 11

Review activities:
Army -
Navy -
Air Force - 82

Preparing activity:
Air Force - 11

Project No. 6680-0113

☆ U. S. GOVERNMENT PRINTING OFFICE: 1971-714-158/12697

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity - Optional)*

DATE

DD FORM 1 JAN 66 1426 REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

AFLC—WPAFB—OCT 67 2M