

MIL-G-18997D(SH)
8 October 1987
SUPERSEDING
MIL-I-18997C
6 March 1967
(See 6.8)

MILITARY SPECIFICATION

GAUGE, PRESSURE, DIAL INDICATING

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

1. SCOPE

1.1 Scope. This specification covers environmentally hardened pressure gauges that utilize a mechanical elastic element to sense the pressure to provide an analog indication of the pressure on a circular dial. Depending on case size, the pressure gauge may either be stem or flush/surface mounted.

1.2 Classification. Pressure gauges shall be classified according to the following variables (see 6.2.1):

- (a) Design (see 1.2.1).
- (b) Type of pressure (see 1.2.2).
- (c) Dial size, case design (see 1.2.3).
- (d) Elastic element material and style (see 1.2.4).
- (e) Dial range and color (see 1.2.5).
- (f) Pressure connection and connection location (see 1.2.6).
- (g) Liquid fill case fluid and vibration category (see 1.2.7).
- (h) Cleanliness (see 1.2.8).

1.2.1 Design. Pressure gauge design shall be designated by one of the following symbols:

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-G-18997D(SH)

<u>Pressure gauge design</u>	<u>Symbol</u>
Simplex	S
Simplex - special applications	
Caisson	K
Cruising range	C
Oxygen	X
Refrigerant	R
Duplex	D

1.2.2 Type of pressure. Type of pressure that the pressure gauge shall indicate shall be designated by one of the following symbols:

<u>Type of pressure</u>	<u>Symbol</u>
Gauge pressure	G
Vacuum	V
Compound	C
Suppressed, gauge pressure	S
Retarded, gauge pressure	R
Retarded, compound pressure	T

1.2.3 Dial size and case design. The dial size and case design shall be designated by one of the following symbols:

<u>Dial size</u>	<u>Case design</u>	<u>Symbol</u>
2	Stem mounted	1
2-1/2	Stem mounted	2
3-1/2	Flush/surface mounted	3
4-1/2	Flush/surface mounted	4
8-1/2	Flush/surface mounted	8

1.2.4 Elastic element. The elastic element shall be designated by two symbols as provided below. The first symbol shall designate the elastic element material. The second symbol shall designate the elastic element style.

<u>Elastic element material</u>	<u>Symbol</u>
K-monel	M
Inconel	I

<u>Elastic element style</u>	<u>Symbol</u>
C-type bourdon tube (gear drive)	C
Helical (also helical-spiral) bourdon tube (gear drive)	H
Helical (also helical-spiral) bourdon tube (direct drive)	D

MIL-G-18997D(SH)

1.2.5 Dial range and color. The range and color of the pressure gauge dial shall be designated by a sequence of symbols for the range followed by a single symbol for the color of the dial. The sequence of symbols for the range shall be selected from the appropriate table in 3.3.10.4. The single symbol for the color of the dial shall be designated by one of the following symbols:

<u>Dial color</u>	<u>Symbol</u>
White background dial with black graduations and markings	W
Special (see 6.2.1)	S

1.2.6 Pressure connection and connection location. The type of pressure connection and its location for connection shall be designated by two symbols as provided below. The first symbol shall designate the type of connection fitting. The second symbol shall designate the location of the pressure connection.

<u>Pressure connection</u>	<u>Symbol</u>
O-ring union	R
1/4 NPT (male)	P
Welded nipple	W
Brazed nipple	B
Threaded vent (caisson only)	K

<u>Connection location</u>	<u>Symbol</u>
Back	A
Bottom	O
5 o'clock	C

1.2.7 Liquid fill case fluid and vibration category. The option for the pressure gauge case containing a liquid fill and the vibration category shall be designated by the two symbols as provided below. The first symbol shall designate whether a fill fluid is required (see 3.3.8). The second symbol shall designate the vibration category (see 4.4.9.1).

<u>Liquid fill</u>	<u>Symbol</u>
None	N
Silicone	S

<u>Vibration category</u>	<u>Symbol</u>
Category A	A
Category B	B
Category C	C

MIL-G-18997D(SH)

1.2.8 Cleanliness. The cleanliness shall be designated by the symbols as specified below. The symbol shall designate the method of cleaning the pressure element assembly (see 3.3.4).

<u>Cleanliness</u>	<u>Symbol</u>
General applications	G
Oxygen applications	X

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

- QQ-A-250 - Aluminum and Aluminum Alloy Plate and Sheet: General Specification For.
- QQ-A-250/6 - Aluminum Alloy 5083, Plate and Sheet.
- QQ-N-281 - Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections.
- QQ-S-763 - Steel Bars, Wire, Shapes, and Forgings, Corrosion Resisting.
- QQ-S-766 - Steel Plates, Sheets, and Strip - Corrosion Resisting.
- UU-P-268 - Paper, Kraft, Wrapping.
- PPP-B-566 - Boxes, Folding, Paperboard.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall.
- PPP-B-665 - Boxes: Paperboard, Metal Edged and Components.
- PPP-B-676 - Boxes, Setup.
- PPP-C-850 - Cushioning Material, Polystyrene, Expanded, Resilient (For Packaging Uses).
- PPP-C-1120 - Cushioning Material, Uncompressed Bound Fiber For Packaging.

MILITARY

- MIL-B-117 - Bags, Sleeves and Tubing - Interior Packaging.
- MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
- MIL-T-1368 - Tube and Pipe, Nickel-Copper Alloy, Seamless and Welded.
- MIL-P-5425 - Plastic Sheet, Acrylic, Heat Resistant.
- MIL-C-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
- MIL-R-6130 - Rubber, Cellular, Chemically Blown.

MIL-G-18997D(SH)

MILITARY (Continued)

- MIL-B-7883 - Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys.
- MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys.
- MIL-E-15090 - Enamel, Equipment, Light-Gray (Formula No. 111).
- MIL-C-15726 - Copper-Nickel Alloy, Rod, Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate) and Forgings.
- MIL-T-16420 - Tube, Copper-Nickel Alloy, Seamless and Welded (Copper Alloy Numbers 715 and 706).
- MIL-R-20092 - Rubber or Plastic Sheets and Assembled and Molded Shapes, Synthetic, Foam or Sponge, Open Cell.
- MIL-S-22473 - Sealing, Locking, and Retaining Compounds: (Single-Component).
- MIL-P-25732 - Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Limited Service at 275°F (135°C).
- MIL-P-26514 - Polyurethane Foam, Rigid or Flexible, for Packaging.
- MIL-T-28800 - Test Equipment for Use with Electrical and Electronic Equipment, General Specification for.
- MIL-R-83248 - Rubber, Fluorocarbon Elastomer, High Temperature, Fluid, and Compression Set Resistant.
- MIL-P-83461 - Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Improved Performance at 275°F (135°C).

STANDARDS

FEDERAL

- FED-STD-H28 - Screw-Thread Standards for Federal Services.
- FED-STD-595 - Colors.

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-130 - Identification Marking of US Military Property.
- MIL-STD-278 - Welding and Casting Standard.
- MIL-STD-777 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships.
- MIL-STD-1330 - Cleaning and Testing of Shipboard Oxygen, Nitrogen and Hydrogen Gas Piping Systems.
- MIL-STD-1622 - Cleaning of Shipboard Compressed Air Systems.
- MIL-STD-45662 - Calibration Systems Requirements.

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

MIL-G-18997D(SH)

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

- 5000-S8700-841569 - Ring, Steel, for Flush Mounted Plastic Case, Gauges and Thermometers.
- 5000-S8700-1385799 - Cases, Plastic for Pressure Gauges and Thermometers.
- 803-1385850 - Piping, Instrument, Pressure, for all Services.

PUBLICATION

NAVSEA

- NAVSHIPS 0900-001-7000 - Fabrication and Inspection of Brazed Piping Systems.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip. (DoD adopted)
- A 276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes. (DoD adopted)
- A 473 - Standard Specification for Stainless and Heat-Resisting Steel Forgings. (DoD adopted)
- A 480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip. (DoD adopted)
- A 581 - Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Wire. (DoD adopted)
- A 582 - Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold Finished. (DoD adopted)
- B 26 - Standard Specification for Aluminum-Alloy Sand Castings. (DoD adopted)
- B 36 - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar. (DoD adopted).

MIL-G-18997D(SH)

- B 85 - Standard Specification for Aluminum-Alloy Die Castings. (DoD adopted)
- B 117 - Standard Method of Salt Spray (Fog) Testing. (DoD adopted)
- B 124 - Standard Specification for Copper and Copper-Alloy Forgings Rod, Bar, and Shapes. (DoD adopted)
- B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate. (DoD adopted)
- B 443 - Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip.
- B 637 - Standard Specification for Precipitation-Hardening Nickel-Alloy Bars, Forgings, and Forging Stock for High-Temperature Service.
- D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

UNDERWRITERS LABORATORIES INC. (UL)

404 - Gauges, Indication Pressure for Compressed Gas Service.

(Application for copies should be addressed to the Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

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

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.2.1 and 6.3).

3.2 Materials. Materials of component parts of the pressure gauges shall be as specified in table I. Cast iron or glass shall not be used.

MIL-G-18997D(SH)

TABLE I. Indicating assembly materials.

Part	Material	Material specification	Remarks
Case	Aluminum ¹	ASTM B 26 ASTM B 85	2 5 8
		ASTM B 209 (alloy 5083)	2 6
	Corrosion-resisting steel ¹	ASTM A 167 (300 series)	2 6
	Corrosion-resisting steel ¹	ASTM A 473 (300 series)	2 5
	Brass ¹	ASTM B 36 ASTM B 124	2 6
Dial	Aluminum ¹	ASTM B 209	See 1.2.3, 1.2.5
	Corrosion-resisting steel ¹	ASTM A 167	
Window	Plastic	MIL-P-5425	
Movement	Corrosion-resisting steel	ASTM A 276 (300 or 400 series)	Bearings may be of special material as approved
Pointer	Aluminum	ASTM B 209	3
	Corrosion-resisting steel ¹	ASTM A 167	
Threaded fasteners	Corrosion-resisting steel	ASTM A 276 ASTM A 581 ASTM A 582 (300 or 400 series)	7
Washers	Corrosion-resisting steel	ASTM A 276 ASTM A 480	
Gaskets	Fluorocarbon rubber (250°F max)	MIL-R-83248	Flat gaskets, type 2

See footnotes at end of table.

MIL-G-18997D(SH)

TABLE I. Indicating assembly materials. - Continued

Part	Material	Material specification ⁹	Remarks
O-rings	Fluorocarbon rubber	MIL-R-83248	O-rings, type 1
	Nitrile rubber (Buna N) (180°F max)	MIL-P-25732 MIL-P-83461	
Elastic element ¹⁰	K-monel UNS-N07500	ASTM B 637	
	Inconel UNS-N07750	ASTM B 637	Inconel X750
	Inconel UNS-N06625	ASTM B 443	Inconel 625
Pressure element assembly ⁴	Monel	QQ-N-281 MIL-T-1368	
	Copper-nickel	MIL-T-16420 MIL-C-15726	Cu-Ni 70-30 Cu-Ni 90-10
	Nickel-copper	MIL-T-1368	

- ¹ Aluminum shall be prepared for protection against corrosion by chromate conversion coatings in accordance with MIL-C-5541, or by anodizing in accordance with type I or II of MIL-A-8625. Corrosion-resisting steel and brass shall be prepared by providing a 0.001 to 0.002 inch surface profile.
- ² Case finish shall include a flash air-dry primer and a gray enamel finish coat. The finish coat shall be in accordance with type II of MIL-E-15090.
- ³ Indicating pointers shall be dull black color with white background dials and white color when dials have black backgrounds. Red index (see 6.6) shall be painted red and adjustable to any pressure on the scale. Duplex indicator pointers shall be orange and green. Pointer tip shall be in accordance with ANSI B40.1.
- ⁴ Pressure element assembly shall include elastic element, pressure connection, stem, tip, intermediate parts (capillary, and so forth), joints, and other components which are exposed to the process fluid. These components shall be in accordance with ANSI B40.1. Note: The elastic element material is specified separately.
- ⁵ Flush/surface mounted pressure gauge case material shall be aluminum or corrosion-resisting steel.
- ⁶ Stem mounted pressure gauge case material shall be aluminum, corrosion-resisting steel or brass. Brass shall only be used for ranges 0/100 pounds per square inch (lb/in²) and below.
- ⁷ Unless otherwise specified herein, retaining compound in accordance with grade C of MIL-S-22473 shall be used.
- ⁸ Aluminum alloy shall be selected to meet shock test requirements (see 3.4.10).
- ⁹ The following Federal specifications are compatible to and can be used in lieu of the ASTM specification listed:

Federal	ASTM	Remarks
QQ-A-250/6	ASTM B 209	alloy 5083
QQ-S-763	ASTM A 276	300 or 400 series
QQ-S-766	ASTM A 167	300 series

¹⁰ The elastic element material for oxygen service shall be K-monel.

MIL-G-18997D(SH)

3.2.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.2.2 Restricted materials. The pressure gauge shall not contain restricted material as defined in MIL-T-28800.

3.2.3 Liquid fill pressure gauge gaskets and O-rings. Gaskets and O-rings used in liquid filled pressure gauges as the case seals shall show no discoloration of the liquid fill case fluid (see 4.6).

3.3 Construction. Pressure gauges shall mount as specified in 1.2.3. The gauges shall not be damaged or affected by applying vacuum pressure or overpressure (see 4.4.4). "Zero" adjustment shall be made to the pressure gauges from the front of the gauge.

3.3.1 Parts interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance and strength.

3.3.2 Oxygen service. Oxygen pressure gauges shall be simplex for indicating gauge pressure and have a bleeder-tip bourdon tube consisting of a capillary bleeder tip $1\text{-}1/4 \pm 1/4$ inches long, 0.020 inch minimum bore welded to the bourdon tube tip at one end of the capillary and the other end welded closed. The gauge shall be cleaned as specified herein (see 3.3.4) without disassembly (except removal of the backplate) and without damage during sealing of the capillary by welding. Only pressure gauges utilizing a C-type bourdon tube as the elastic element shall be used for oxygen service. Minimum bore diameter throughout the pressure element assembly shall be not less than 0.025 inch (excluding capillary bleeder tip).

3.3.3 Non-oxygen service. Minimum bore diameter throughout the pressure element assembly shall be not less than 0.030 inch when the elastic element is a C-type bourdon tube.

3.3.4 Cleaning. Pressure element assembly and associated parts in contact with the service fluid shall be free of loose scale, rust, grit, filings, mercury, calibration liquids, oil, grease, solvents, or other organic materials.

3.3.5 Welding and brazing. Internal pressure containing parts shall be joined by welding or brazing. Welding shall be in accordance with MIL-STD-278 and brazing in accordance with NAVSHIPS 0900-001-7000 and MIL-B-7883.

3.3.5.1 General applications. Joints shall be either welded or microbrazed. Depending on the pressure range, MIL-STD-278, class P-1 or P-2 shall apply for welding. Class P-3 shall apply for microbrazing.

MIL-G-18997D(SH)

3.3.5.2 Oxygen applications. Joints shall be welded for all ranges, MIL-STD-278, class P-1 shall apply.

3.3.6 Threads. Threads shall be in accordance with FED-STD-H28. Tapered threads shall not be used except on 2- and 2-1/2 inch dial sizes for ranges 0/100 lb/in² and below.

3.3.7 Case. Pressure gauge shall be safety solid front as defined in ANSI B40.1. Nonsolid front is permitted for gauges with elastic element styles H and D (see 1.2.4). Nonsolid front gauges shall be so constructed that no parts of the gauge shall be propelled or thrown from the assembly due to an application of excessive pressure (see 4.4.13). Pressure shall be relieved out the back or side of the case should slow leakage or rupture of the pressure element assembly occur.

3.3.7.1 Flush/surface mounted case. Cases with the flush/surface mounted configuration shall be interchangeable for mounting purposes with the cases shown on Drawing 5000-S8700-1385799. Case mounting dimensions shall be in accordance with table II. Dimensions A, A1, A8, A10, A15, A17 and A29 shall be critical dimensions of the case and shall be in strict accordance with Drawing 5000-S8700-1385799. Dimension A30 may be greater than indicated in Drawing 5000-S8700-1385799 but shall not exceed 4 inches. Flush mounting rings for pressure gauge cases shall be similar to and interchangeable with those shown on Drawing 5000-S8700-841569. Dimensions A2, A3, A4, A5, C12, H1 and H2 shall be critical dimensions of the flush mounting ring and shall be in strict accordance with Drawing 5000-S8700-841569. Unless otherwise specified (see 6.2.1), flush/surface mounted gauges shall be provided with this flush mounting ring and the associated mounting hardware.

TABLE II. Mounting dimensions.

Size (inches)	Panel hole diameters (inches)	Bolt circle (inches)	Bolt hole diameter (inch)	Bolt size and threads
3-1/2	4-15/32	4-1/4	7/32	10-24
4-1/2	5-19/32	5-3/8	7/32	10-24
8-1/2	9-29/32	9-5/8	9/32	1/4-20

3.3.7.2 Stem mounted case. Cases with the stem mounted configuration shall be only used with 2- and 2-1/2 inch dial sizes. The 2- and 2-1/2 inch dial size pressure gauges shall have a maximum case diameter of 2-1/4 and 2-3/4 inches respectively. The pressure gauge case shall prevent pressure buildup within the case as specified in 3.4.12. The case shall be fitted with a window of not less than 1/16-inch thickness which is free from blemishes and scratches. The window shall be secured to the case with a threaded ring. The case shall have fine threads that match the ring. The first two threads shall be turned down to the root diameter of the threads. The case shall have a minimum thread engagement of 1/4 inch. Pressure gauge materials shall be as specified in table I. The ring shall be made from the same material as the case. This pressure gauge case configuration shall be for non-oxygen service. For ranges of 0/150 lb/in² and above, the case shall be of a solid front configuration.

MIL-G-18997D(SH)

3.3.8 Liquid fill case fluid. When liquid filled cases are required, the fill fluid shall be Dow Corning DC-200, or equal. The case shall be filled to 75 to 85 percent of the case volume. Liquid filled gauges shall not be used on oxygen systems, and shall have a warning label on the rear of the case which states:

"WARNING
DO NOT USE ON OXYGEN SYSTEMS.
CONTAINS SILICONE LIQUID FILL."

3.3.9 Connections. Connections shall be in accordance with 3.3.9.1 through 3.3.9.4.2.

3.3.9.1 Non-oxygen service. Unless otherwise specified (see 6.2.1), the pressure connection shall be in accordance with Drawing 803-1385850 for the figures showing "connectors for gauges with male straight thread O-ring connections". A complete assembly, including the threaded end, the union nut, the tail piece and the O-ring shall be provided with each gauge. The threaded end shall be integral with the gauge. Alternative pressure connection shall be selected from the pressure connections specified in table III. The pressure connection specified shall be configured to permit wrench tightening.

TABLE III. Pressure connection requirements and applications.

Pressure connection	Threads	Documents	Intended use
O-ring union	9/16-18UNF-2A	Drawing 803-1385850	For new construction, retrofit, and replacement.
Taper pipe thread	1/4-18NPT-2A	FED-STD-H28	For use in stem mounted pressure gauges with ranges 0/100 lb/in ² or below (see MIL-STD-777).
1/4-inch nps, nickel-copper pipe nipple, 6 inches long	Welded (see MIL-STD-278)	MIL-T-1368, schedule 80	For oxygen systems for welding the pressure connection to adjacent piping.

3.3.9.1.1 Caisson gauge vent configuration. Caisson gauge case shall be open to the ambient pressure through a vent in the bottom of the case. The vent shall be threaded to accept a 1/4-inch NPT male fitting.

3.3.9.1.2 Stem mounted case. The pressure connection shall be threaded with 1/4-inch NPT male threads as specified in table III for ranges 0/100 lb/in² and below.

3.3.9.2 Oxygen service. Pressure connection shall be a monel pipe nipple, 1/4-inch nominal pipe size (nps) with 0.109-inch minimum wall thickness, 6 inches long, welded to the socket in accordance with MIL-STD-278. Connection location shall be at the lower back or bottom of the case.

MIL-G-18997D(SH)

3.3.9.3 Connection location. Connection location shall be in accordance with 3.3.9.3.1 and 3.3.9.3.2.

3.3.9.3.1 Flush/surface mounted case. The pressure connection for flush/surface mounted cases shall be located at the lower back or bottom of the case or at the 5 o'clock position (except for caisson gauges). The 5 o'clock position shall be for non-oxygen service.

3.3.9.3.2 Stem mounted case. The pressure connection for stem mounted cases shall be located at the bottom or center back of the case.

3.3.9.4 Connection length. The connection length requirements shall only pertain to flush/surface mounted pressure gauges.

3.3.9.4.1 Back connection location. The protrusion length of the pressure connection from the back of the case shall be 1.2 ± 0.3 inches.

3.3.9.4.2 Bottom connection location (also 5 o'clock position). The interchangeability length is the distance from the horizontal center line of the pressure gauge dial to the free end of the pressure connection (not including the union meet and tailpiece for the O-ring union type). The interchangeability length shall be 3.2 ± 0.3 inches for the 3-1/2 inch dial size, 3.2 ± 0.3 inches for the 4-1/2 inch dial size, and 5.8 ± 0.3 inches for the 8-1/2 inch dial size.

3.3.10 Dial. Dial configuration, style, pointer rotation and pointer interface shall be in accordance with the practices specified in ANSI B40.1.

3.3.10.1 Dimensions. Dial numerals and scale dimensions shall be in accordance with table IV.

TABLE IV. Dial dimensions.

Size (inches)	Numeral height (min) (inch)	Diameter scale base line (min) (inches)	Dial blank diameter (min) (inches)
2	1/8	1-13/16	2
2-1/2	5/32	2-5/16	2-9/16
3-1/2	7/32	3	3-5/16
4-1/2	9/32	4-1/8	4-5/16
8-1/2	1/2	7-3/4	8-1/4

3.3.10.2 Markings. Dial markings shall include:

- (a) Manufacturer's name or trademark.
- (b) Manufacturer's part number.
- (c) National stock number.
- (d) Elastic element material symbol or name.
- (e) Scale graduations, numerals and units of graduations.
- (f) The words "OXYGEN CLEAN" in red printing, when applicable.
- (g) Pressure gauges with scales calibrated in lb/in² gauge shall be marked "PSIG".

MIL-G-18997D(SH)

- (h) Markings for submarine seawater service shall be single scale. Depth gauges shall be graduated in feet; other submarine seawater gauges shall be graduated in lb/in².
- (i) Cruising range gauges shall contain the words "cruising turbine exhaust pressure".
- (j) Unless otherwise specified (see 6.2.1), dial color markings shall be white background with black graduations and markings.

3.3.10.3 Scale. Scales for circular dials shall cover an arc of not less than 270 degrees central angle. Graduations shall consist of minor, intermediate and numbered graduations.

3.3.10.3.1 Cruising range gauge. Scales for the cruising range gauge shall contain the information shown on figure 1 and shall appear on the dial in the form of arcs in the format as shown on figure 1.

3.3.10.4 Ranges and minor graduations. Ranges and minor graduations shall be in accordance with tables V through XIII, as specified (see 6.2.1). Ranges shall apply only to the case sizes specified.

TABLE V. Gauge pressure ranges and minor graduations.

Gauge pressure ranges ³ (lb/in ²)	Minor graduations					Range designator (see 1.2.5)
	2-inch size	2-1/2 inch size	3-1/2 inch size	4-1/2 inch size	8-1/2 inch size	
¹ 0/15	1/2	1/2	1/2	1/4	1/4	15P
¹ 0/30	1	1/2	1/2	1/2	1/4	30P
¹ 0/60	2	1	1	1	1/2	60P
¹ 0/100	2	2	2	1	1	1hP
¹ 0/200	-	5	5	2	1	2hP
¹ 0/300	-	5	5	5	2	3hP
¹ 0/400	-	10	10	5	2	4hP
¹ 0/600	-	10	10	10	5	6hP
¹ 0/800	-	20	20	10	5	8hP
¹ 0/1000	-	20	20	10	5	1kP
² 0/1500	-	20	25	20	10	15hP
² 0/2000	-	50	50	20	10	2kP
² 0/3000	-	50	50	50	20	3kP
² 0/5000	-	-	100	50	25	5kP
² 0/8000	-	-	100	100	50	8kP
² 0/10000	-	-	200	100	50	10kP

¹ Applicable to simplex and duplex indicators.

² Applicable to simplex only.

³ If the minor graduation is not provided, that particular range is not covered by this specification.

MIL-G-18997D(SH)

TABLE VI. Vacuum pressure ranges and minor graduations.

Range (inches of mercury (Hg))	Minor graduations					Range designator (see 1.2.5)
	2-inch size	2-1/2 inch size	3-1/2 inch size	4-1/2 inch size	8-1/2 inch size	
0/30	1	1/2	1/2	1/2	1/4	V

TABLE VII. Compound pressure ranges and minor graduations.

Ranges		Minor graduations				Range designator ^{1 2} (see 1.2.5)
		3-1/2 inch and 4-1/2 inch		8-1/2 inch		
Vacuum scale (inches Hg)	Gauge pressure scale (lb/in ²)	Vacuum	lb/in ²	Vacuum	lb/in ²	
30	0/15	1	1/2	1/2	1/4	15C
30	0/30	1	1/2	1/2	1/4	30C
30	0/60	2	1	1	1/2	60C
30	0/100	2	1	1	1	1hC
30	0/150	5	2	2	1	150C
30	0/200	5	2	2	2	2hC
30	0/300	10	5	5	2	3hC
30	0/400	10	5	5	2	4hC
30	0/600	10	10	10	5	6hC
30	0/800	10	10	10	5	8hC
30	0/1000	30	10	15	10	1kC

¹ Refrigerant identification symbol and a separate temperature degrees Fahrenheit (°F) equivalent scale in red printing in addition to the pressure scale in lb/in², when applicable.

² When applicable, the type of refrigerant used with the pressure gauge shall be designated by the appropriate numeral following the letter "C":

<u>Refrigerant</u>	<u>Numeral</u>
R11	1
R12	2
R22	3
R114	4

TABLE VIII. Suppressed pressure ranges and minor graduations,
8-1/2 inch size.

Pressure range lb/in ²	Minor graduation	Range designator (see 1.2.5)
1000/1500	5	S

MIL-G-18997D(SH)

TABLE IX. Retarded pressure ranges and minor graduations, 4-1/2 inch size.

Ranges		Minor graduation				Range designator (see 1.2.5)
Vacuum scale (inches Hg)	Gauge pressure scale (lb/in ²)	Expanded portion of scale		Retarded portion of scale		
		Range	Graduation	Range (lb/in ²)	Graduation (lb/in ²)	
---	0/30	0/10 lb/in ²	1/4 lb/in ²	10/30	5	R1
30	0/30	30 inches	1 inch	5/30	5	R2
30	0/150	0/5 lb/in ²	1/4 lb/in ²	75/150	5	R3
		30 inches	1 inch			
		0/75 lb/in ²	1 lb/in ²			

TABLE X. Caisson pressure ranges and minor graduations.

Ranges ¹	Minor graduations						Range designator (see 1.2.5)
	3-1/2 inch		4-1/2 inch		8-1/2 inch		
	lb/in ²	ft.dp.	lb/in ²	ft.dp.	lb/in ²	ft.dp.	
0/100 lb/in ² -0/230 ft.dp.	1	2	1	2	1	2	1hK
0/200 lb/in ² -0/450 ft.dp.	1	2	1	2	1	2	2hK
0/300 lb/in ² -0/675 ft.dp.	2	5	2	5	2	5	3hK
0/380 lb/in ² -0/850 ft.dp.	2	10	2	10	2	10	380K
0/400 lb/in ² -0/900 ft.dp.	2	10	2	10	2	10	4hK

¹ Select range that is 50 percent greater than normal operating pressure (depth).

TABLE XI. Receiver pressure ranges and minor graduations.¹

Ranges		Minor graduations (percent)		
Percent scales (percent)	Pressure ranges (lb/in ²)			Range designator (see 1.2.5)
		2-1/2 inch	3-1/2 inch	
0/100	3/15	1	1	15N
0/100	3/27	1	1	27N
0/100	0/60	1	1	60N

¹ Receiver gauges shall include five equally spaced referenced pressure graduations in lb/in² on the graduated scale in addition to the scale graduations and markings in units for the range of the primary sensing transmitter, when applicable.

MIL-G-18997D(SH)

TABLE XII. Oxygen service ranges and minor graduations.

Ranges lb/in ²	Minor graduations		Range designator (see 1.2.5)
	3-1/2 inch size	4-1/2 inch size	
0/100	2	1	1hX
0/3000	50	50	3kX
0/5000	100	50	5kX

TABLE XIII. Cruising range pressure and minor graduations,
8-1/2 inch size.

Ranges		Minor graduations		Range designator (see 1.2.5)
Vacuum scale (inches Hg)	Gauge pressure scale (lb/in ²)	Vacuum	lb/in ²	
30	0/200	1	none	T

3.3.10.4.1 Submarine depth gauges. If submarine sea water system pressure gauges which require "feet" (depth) of seawater equivalent scales are required, test depth shall be specified and the contract classified accordingly. The range designator for depth gauges shall be the letter "D".

3.3.10.5 Units of graduation. Units of graduation shall be those specified in tables V through XIII for ranges and minor graduations. Units of graduation shall be in accordance with ANSI B40.1.

3.3.11 Overrange stops. Overage stops shall be in accordance with 3.3.11.1 and 3.3.11.2.

3.3.11.1 Helical and helical-spiral bourdon tubes. Unless the pointer can be stopped without the accuracy exceeding its limits and without a permanent deformation in the bourdon tube (this being verified by a pressure integrity test), a pointer catch mechanism shall be installed on the dial for pressure gauges containing helical and helical-spiral bourdon tubes as the elastic element. The pointer catch mechanism shall capture the pointer if the pressure gauge is overranged by more than 5 percent of span. Once captured, the pointer shall slip on the shaft allowing the elastic element to expand. The pointer catch mechanism shall hold the pointer in place after the pressure returns to within the operating range of the pressure gauge. The removal of the window shall be required to release the pointer from the pointer catch mechanism. The dial shall contain the markings "If pointer in catch position, recalibrate before use". If the helical or helical-spiral bourdon tube can meet the pressure integrity test requirements with a pointer overrange stop, then this stop shall be set or placed at 105 percent of the full scale pressure.

3.3.11.2 Other elastic elements. An elastic element overrange stop shall be installed in each pressure gauge. The overrange stop shall be adjustable and shall be set for 105 percent of the full scale pressure.

3.4 Performance. Performance shall be in accordance with 3.4.1 through 3.4.12.

MIL-G-18997D(SH)

3.4.1 Accuracy. Accuracy shall be in accordance with 3.4.1.1 through 3.4.1.3

3.4.1.1 Pressure gauge. The accuracy of the pressure gauges shall be within plus or minus the percent of span listed below.

3.4.1.1.1 Dial size - 2-inch. The accuracy of 2-inch dials shall be within plus or minus 3 percent of span.

3.4.1.1.2 Dial sizes - 2-1/2 inch. The accuracy of 2-1/2 inch dials shall be within plus or minus 2 percent of span.

3.4.1.1.3 Dial sizes - 3-1/2, 4-1/2 and 8-1/2 inch. The accuracy of 3-1/2, 4-1/2 and 8-1/2 inch dials shall be within plus or minus 1 percent of span.

3.4.1.1.4 Cruising range gauge. The accuracy of cruising range gauges shall be within plus or minus 1 percent of span in the vacuum portion of the range. The pressure portion of the cruising range gauge shall be set at three points (0, 100, and 200 lb/in²) and provide a rough indication of gauge pressure (plus or minus 10 percent of span) at the three points.

3.4.1.1.5 Retarded gauges. The accuracy of retarded gauges shall be plus or minus 1 percent of the expanded portion of the span.

3.4.1.2 Friction error. For ranges above 0/60 lb/in², the friction error shall not exceed 1/2 percent of span. For ranges 0/60 lb/in² and below, the friction error shall not exceed 1 minor graduation.

3.4.1.3 Reference measurement. The accuracy of the pressure gauge shall be within plus or minus the applicable percent of span specified in 3.4.1.1.1 through 3.4.1.1.5. The friction error requirement of 3.4.1.2 shall also apply.

3.4.2 Repeatability. The repeatability of the pressure gauge shall be within plus or minus 1/2 percent of span.

3.4.3 Inclination. Maximum deviation of the pressure gauge indication resulting from inclination shall be within plus or minus 1/2 percent of span, except for ranges 0/100 lb/in² and below which shall be within 2 percent of span.

3.4.4 Pressure integrity. The pressure gauge pressure element assembly shall show no evidence of leakage and there shall be no downscale shift in the pointer position (see 4.4.4). A downscale shift indicates a loss of pressure when the pressure gauge is pressurized first to the maximum scale reading, then to the other pressures specified (see 4.4.4). The pressure gauge shall be exposed to the pressure conditions without damage or a change in accuracy exceeding that specified in 3.4.1.3 (see 4.4.4).

3.4.4.1 Leakage. The pressure gauge pressure element assembly shall show no evidence of leakage and there shall be no downscale shift in the pointer position (see 4.4.4.1).

MIL-G-18997D(SH)

3.4.5 Temperature. Temperature shall be in accordance with 3.4.5.1 through 3.4.5.5.

3.4.5.1 High temperature. Pressure gauges shall be exposed continuously to a 145°F ambient temperature without damage. Accuracy of the pressure gauge indication, found from the reference measurements taken during the test specified in 4.4.5.1, shall be within plus or minus twice the specified accuracy. Accuracy of the pressure gauge indication, found from a reference measurement taken after the high temperature test, shall be in accordance with 3.4.1.3.

3.4.5.2 Low temperature. The pressure gauge shall be exposed continuously to a 40°F ambient temperature without damage. Accuracy of the pressure gauge indication, found from the reference measurements taken during the test specified in 4.4.5.2, shall be within plus or minus twice the specified accuracy. Accuracy of the pressure gauge indication, found from a reference measurement taken after the low temperature test, shall be in accordance with 3.4.1.3.

3.4.5.3 Seal integrity. The pressure gauge shall be exposed cyclically to a varying ambient temperature without damage or leakage of fill fluid. Accuracy of the pressure gauge indication shall be in accordance with 3.4.1.3 (see 4.4.5.3).

3.4.5.4 Storage and temperature. The pressure gauge shall be exposed cyclically to a varying ambient temperature without damage. Accuracy of the pressure gauge indication shall be in accordance with 3.4.1.3 (see 4.4.5.4).

3.4.5.5 Seal stability. The pressure gauge shall be exposed continuously to a 145°F ambient temperature without damage, without signs of visible chemical attack on the materials, without visible discoloration in the fill fluid and without deterioration of the pressure gauge seals. Accuracy of the pressure gauge indication shall be in accordance with 3.4.1.3 (see 4.4.5.5).

3.4.6 Enclosure. The pressure gauge shall show no evidence of water leakage into the case between the dial and window. A reference measurement shall meet the accuracy requirements of 3.4.1.3 (see 4.4.6).

3.4.7 Load (for stem mounted pressure gauges). The stem mounted pressure gauge shall show no evidence of improper operation, distortion of the case, damage or failure (see 4.4.7). A reference measurement shall exhibit no change in the accuracy and shall meet the requirements of 3.4.1.3 (see 4.4.7).

3.4.8 Salt spray. The pressure gauge shall show no evidence of visible corrosion or other damage, or exhibit improper operation. The reference measurement shall meet the accuracy requirements of 3.4.1.3 (see 4.4.8).

3.4.9 Vibration. The pressure gauge shall show no evidence of improper operation, failure, or damage (see 4.4.9). Total pointer oscillation shall not exceed plus or minus 5 percent of span (plus or minus 10 percent of span for ranges 0/100 lb/in² and below), peak to peak, at any test frequency. Center of pointer oscillation shall remain within plus or minus 1 minor graduation of the reading obtained under static conditions. The red index (see 6.6) shall not shift during the vibration test. A reference measurement shall meet the accuracy requirements of 3.4.1.3 (see 4.4.9). There shall be no significant wear on any vital part. Significant wear is defined as wear which causes

MIL-G-18997D(SH)

dimensional changes to gear teeth visible to the naked eye or which causes increased gearing backlash. Wear to other parts is significant if it affects pressure gauge performance. Any pressure gauge behavior not covered herein which could be a serious vibration performance defect shall be cause for failure.

3.4.10 Shock. The pressure gauge shall show no evidence of improper operation, failure, or damage (see 4.4.10). A shift in the pointer indication shall not exceed plus or minus 2 percent of span (plus or minus 10 percent of span for ranges 0/30 lb/in² and below) for any single blow or a total shift of plus or minus 3 percent of span for each set of nine blows. The red index (see 6.6) shall not shift during the shock test. A reference measurement performed after the conclusion of each set of nine blows, but before a zero adjustment is made, shall not exceed plus or minus 3 percent of span (plus or minus 25 percent of span for ranges 0/30 lb/in² and below). A reference measurement performed after the conclusion of each set of nine blows shall meet the accuracy requirements of 3.4.1.3 after a zero adjustment is made. A leakage test shall be performed after each set of nine blows and the pressure gauge shall meet the requirements of 3.4.4.1.

3.4.11 Pressure cycling. The pressure gauge shall show no evidence of improper operation, failure or damage (see 4.4.11). A reference measurement shall be within plus or minus 3 percent of span. The pressure gauge shall meet the requirements of 3.4.4.1.

3.4.12 Case pressure relief. The pressure relief device (pressure relief plug, blowout disc, or pressure relief back) shall be blown from the case (pressure relief plug or blowout disc), successfully open (pressure relief back), or relieve pressure from the case without causing a failure in either the case or the window (see 4.4.12).

3.5 Drawings. When specified in the contract or order, drawings shall be prepared (see 6.2.2).

3.6 Instruction sheets. Unless otherwise specified (see 6.2.1), an 8 by 11-inch instruction sheet shall be prepared for each pressure gauge.

3.7 Identification of product. Pressure gauges and parts shall be marked for identification in accordance with MIL-STD-130.

3.8 Workmanship. Pressure gauges shall be in accordance with the dimensions, design, colors, accuracy, markings and materials specified herein. Pressure gauges shall withstand the tests specified herein without permanent deformation or malfunction, and shall be clean and free of cracks and burrs.

3.8.1 Cleaning and surface finishes. Surfaces of castings, forgings, molded parts, stampings, machined, and welded parts shall be clean and free from sand, dirt, sharp edges, scales, flux, and other harmful or extraneous materials. These surfaces shall also be free of defects such as cracks, porosity, undercuts, voids, and gaps. External surfaces shall be smooth and edges shall be either rounded or beveled. There shall be no burn through.

MIL-G-18997D(SH)

There shall be no warpage or dimensional change due to heat from welding operations. There shall also be no damage to adjacent parts resulting from the welding.

3.8.2 Assembled pressure gauge interchangeability. Dimensions; mounting; pressure connection type, length and location; scale numerals and graduations; and other interchangeability requirements shall be verified during the inspection process.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

4.1.2 Inspection system. When specified in the contract or order, an inspection system shall be provided and maintained (see 6.2.2).

4.1.3 Calibration system. When specified in the contract or order, a calibration system shall be provided and maintained (see 6.2.2).

4.1.4 Production inspection. Samples obtained to perform any of the inspections set forth in the specification may be selected by the Government from the contractor's production line at the time of assembly any time during the contract period.

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

- (a) First article inspection (see 4.2.1).
- (b) Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. First article inspection shall be performed prior to production. First article inspection shall be performed on samples which have been produced with equipment and procedures normally used in production. First article inspection shall consist of the examination and tests specified in table XIV. When specified in the contract or order, a first article inspection report shall be prepared (see 6.2.2).

MIL-G-18997D(SH)

TABLE XIV. Examination and tests.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection
General examination	3.2, 3.3, 3.7, 3.8	4.3.1 or 4.3.2	X	X
Accuracy	3.4.1	4.4.1	X	X
Repeatability	3.4.2	4.4.2	X	---
Inclination	3.4.3	4.4.3	X	---
Pressure integrity ¹	3.4.4	4.4.4	X	X
High temperature ¹	3.4.5.1	4.4.5.1	X	---
Low temperature ¹	3.4.5.2	4.4.5.2	X	---
Seal integrity ¹	3.4.5.3	4.4.5.3	X	---
Storage and temperature cycling ¹	3.4.5.4	4.4.5.4	X	---
Seal stability ¹	3.4.5.5	4.4.5.5	X	---
Enclosure ¹	3.4.6	4.4.6	X	---
Load ¹	3.4.7	4.4.7	X	---
Salt spray ¹	3.4.8	4.4.8	X	---
Vibration ^{1 2}	3.4.9	4.4.9	X	---
Shock ^{1 2}	3.4.10	4.4.10	X	---
Pressure cycling ^{1 2}	3.4.11	4.4.11	X	---
Case pressure relief	3.4.12	4.4.12	X	---
Elastic element or joining means failure	3.3.7	4.4.13	X	---

See footnotes at top of next page.

MIL-G-18997D(SH)

- ¹ A reference measurement (see 4.4.1.3) shall be performed just prior to and after the conclusion of this test and the pressure gauge performance shall meet the accuracy requirements specified in 3.4.1.3.
- ² A leakage test (see 4.4.4.1) shall be performed before the reference measurement prior to this test and before the reference measurement after the conclusion of this test. The pressure gauge performance shall meet the requirements specified in 3.4.4.1.

4.2.1.1 Sample size. Two pressure gauge samples of each configuration shall be subjected to first article qualification inspection. Each configuration shall include, but may not be limited to, the same elastic element and case.

4.2.1.2 Order of inspection. The sample pressure gauges shall be subjected to the inspections specified in table XIV in the order listed. Any deviation in the test order shall first be approved by NAVSEA.

4.2.2 Quality conformance inspection. A quality conformance inspection shall be performed in accordance with the examination and tests specified in table XIV. When specified in the contract or order, a quality conformance inspection report shall be prepared (see 6.2.2)

4.2.2.1 Inspection lot. An inspection lot shall consist of all pressure gauges of the same classification (see 1.2), produced under the same conditions and offered for delivery at the same time.

4.2.2.2 Sampling for quality conformance inspection. A random sample of pressure gauges shall be selected from each lot (see 4.2.2.1) in accordance with MIL-STD-105 for the examination and tests specified in table XIV. For assembled pressure gauges, inspection level I, acceptable quality level (AQL) of 1-1/2 percent shall apply.

4.3 General examination. General examination shall be performed in accordance with 4.3.1 through 4.3.2.1.

4.3.1 First article inspection examination. The pressure gauge shall be examined to ascertain that the material, finish, workmanship, construction, assembly, dimensions and markings conform to the requirements of this specification. Examinations shall be limited to the examinations that may be performed without disassembling the pressure gauge in such a manner that its performance, durability or appearance will be affected. Examination shall also include a check of all adjustments, as applicable.

4.3.2 Quality conformance inspection examination. The pressure gauges selected in accordance with 4.2.2.2 shall be examined to determine conformance to the requirements of this specification and the classification of defects specified in table XV. The AQL for each defect shall be as specified in table XV in accordance with MIL-STD-105.

MIL-G-18997D(SH)

TABLE XV. Classification of defects.

Categories	Defects	Requirements	AQL
Critical			
1	Evidence that pressure gauges for oxygen applications are not cleaned, properly marked, or properly packaged.	3.3.4 and 3.3.10.2	0
2	Pressure gauge does not meet the pressure integrity test (see 4.4.4).	3.4.4	0
3	Safety features on the case inadequate; does not prevent blow out of window; glass window installed in lieu of plastic.	3.2, table I, 3.3.7, 3.4.12	1-1/2
Major			
101	Evidence of unauthorized material.	3.2 and table I	1-1/2
102	Inspection system not provided, dimensional tolerances not maintained, mounting dimensions not interchangeable, pressure connection wrong design, or dimensions erroneous.	3.3.7, 3.3.9, 4.1.2	1-1/2
103	Pressure gauge does not meet accuracy test (see 4.4.1).	3.4.1	1-1/2
104	Dial markings not provided or erroneous; part number, national stock number, and so forth, not provided on dial.	3.3.10	1-1/2
Minor			
201	Workmanship unsatisfactory.	3.8	1-1/2
202	Evidence that pressure gauges for general applications are not cleaned.	3.3.4	1-1/2
204	Packing and packaging non-conforming.		4

MIL-G-18997D(SH)

4.3.2.1 Dimensional verification. Pressure gauge samples selected in accordance with 4.2.2.2 shall be subjected to dimensional verifications of the pressure connection threaded end to verify conformance to Drawing 803-1385850 (O-ring union connection), or the applicable document for the type threaded end or connection specified (see table III). Dimensions, concentricities, and perpendicularities affecting interchangeability of parts, sealing effectiveness and strength shall be measured to verify conformance to the applicable document. For a pressure gauge having an O-ring union pressure connection, samples of the tail piece and union nut shall also be subjected to this dimensional verification. An AQL of 4 percent defective shall apply for the threaded end of the pressure gauge. For the tail piece and union nut, inspection level II, AQL 1.0 percent defective shall apply when the pressure connection is the O-ring union type.

4.4 Test procedures. Unless otherwise specified herein, the tests shall be conducted with the equipment and instrumentation operating under the following conditions:

- (a) Ambient temperature shall be $75 \pm 10^{\circ}\text{F}$.
- (b) Relative humidity shall be 50 ± 10 percent.
- (c) Supply voltage shall be 115 ± 5 volts.
- (d) Supply frequency shall be 60 ± 2 hertz (Hz).

Terminology for these test procedures shall be in accordance with ANSI B40.1.

4.4.1 Accuracy. Accuracy shall be determined in accordance with 4.4.1.1 through 4.4.1.3.

4.4.1.1 Precycling. The precycling procedure shall be performed before the start of the accuracy test.

4.4.1.1.1 General procedure. To remove friction in the movement, the pressure gauge shall be cycled over the entire span by slowly increasing then decreasing the applied pressure three times.

4.4.1.1.2 Compound pressure gauge procedure. To remove friction in the movement, a compound pressure gauge shall first be cycled three times over the vacuum portion of the span followed by the gauge being cycled three times over the pressure portion of the span. Each cycle shall consist of slowly increasing then decreasing the applied pressure over the entire span.

4.4.1.2 Accuracy procedure. Accuracy test procedure shall be in accordance with 4.4.1.2.1 through 4.4.1.2.2.

4.4.1.2.1 General procedure. The accuracy test shall consist of a set of readings at five equally spaced points over the entire span for one cycle. This cycle shall consist of reading the five equally spaced points while increasing the pressure throughout the span, then reading the same five equally spaced points in the reverse order while decreasing the pressure throughout the span. These five equally spaced points shall include the high and low limits of the span. For a retarded pressure gauge, the five equally spaced points shall include the high and low limits of the expanded portion of the span. Readings shall be

MIL-G-18997D(SH)

taken both before and after the pressure gauge is lightly tapped in the center of the dial. The pressure gauge indications, after tapping, for each of the five equally spaced points read while both increasing and decreasing the pressure, shall meet the accuracy requirements specified in 3.4.1.

4.4.1.2.1.1 Friction error. The difference in each reading before and after tapping shall be the friction error. The friction error shall not exceed the requirements specified in 3.4.1.2.

4.4.1.2.2 Compound pressure gauge procedure. The general procedure specified in 4.4.1.2.1 shall be used. The span of a compound pressure gauge shall be considered as the algebraic difference between the limits of the vacuum and pressure scales, when both are expressed in the same units. For example, the span of a 30-inch Hg vacuum (approximately minus 15 lb/in²) to 30 lb/in² pressure scale is approximately 45 lb/in². The compound pressure gauge shall meet the accuracy requirements specified in 3.4.1 and shall not exceed the friction error requirements specified in 3.4.1.2.

4.4.1.3 Reference measurement. The accuracy test procedure, including the friction error, as specified in 4.4.1.2 shall be referred to as a "reference measurement" when the test is conducted after the conclusion of another test as specified in table XIV.

4.4.2 Repeatability. The accuracy test, including the friction error, as specified in 4.4.1.2 shall be performed two additional times. The difference between any two readings, after tapping, at the same pressure, approached from the same direction, taken during the accuracy and during the repeatability tests, shall be referred to as the repeatability. The data taken during the accuracy and repeatability tests shall meet the repeatability requirements specified in 3.4.2.

4.4.3 Inclination. The pressure gauge shall be pressurized to midspan so that the pointer is in a vertical position. The pressure gauge shall be positioned such that the dial faces the operator. The pressure gauge shall then be inclined 60 degrees to the right, left, front and back. The pressure gauge shall remain at each of these inclined positions for at least 1 minute and shall meet the requirements specified in 3.4.3 at each of these inclined positions.

4.4.4 Pressure integrity. The pressure gauge shall be pressurized to the maximum scale value for 5 minutes and a reference measurement shall then be performed. If the pressure gauge meets the requirements specified in 3.4.4, the pressure gauge shall then be subjected to each of the applicable test conditions specified in table XVI for 1 hour. A reference measurement shall be performed after each applicable test condition specified in table XVI. The pressure gauge performance shall meet the requirements specified in 3.4.4.1.

MIL-G-18997D(SH)

TABLE XVI. Conditions for pressure integrity testing.

Range	Test condition
All ranges	Under pressure to equivalent of 29 inches Hg vacuum.
Up to and including 0/1000 lb/in ²	Overpressure to 50 percent of span above maximum scale value.
Above 0/1000 up to and including 0/5000 lb/in ²	Overpressure to 15 percent of span above maximum scale value.
Above 0/5000 lb/in ²	Overpressure to maximum scale valve.

4.4.4.1 Leakage. The pressure gauge shall be pressurized to the maximum scale value for 5 minutes. The pressure gauge performance shall meet the requirements specified in 3.4.4.1.

4.4.5 Temperature. Temperature shall be tested in accordance with 4.4.5.1 through 4.4.5.4.

4.4.5.1 High temperature. The pressure gauge shall be placed in a temperature test chamber and shall be pressurized to midspan. The temperature test chamber shall be brought to $145 \pm 5^{\circ}\text{F}$ and allowed to stabilize. After the temperature test chamber has stabilized at $145 \pm 5^{\circ}\text{F}$, the pressure gauge shall remain in the temperature test chamber for at least 4 hours while pressurized at midspan. After this minimum 4-hour period, a reference measurement shall be performed while the pressure gauge remains at $145 \pm 5^{\circ}\text{F}$ inside the temperature test chamber. The pressure gauge shall then be unpressurized and removed from the temperature chamber, and allowed to stabilize at the ambient conditions (see 4.4) for at least 4 hours. A second reference measurement shall then be performed. The pressure gauge performance shall meet the requirements specified in 3.4.5.1.

4.4.5.2 Low temperature. The pressure gauge shall be subjected to the same test procedure as 4.4.5.1 except that the temperature chamber shall be set for a temperature of $40 \pm 5^{\circ}\text{F}$. The pressure gauge performance shall meet the requirements specified in 3.4.5.2.

4.4.5.3 Seal integrity. The seal integrity test shall be performed on liquid filled pressure gauges. The pressure gauge shall be placed in the temperature test chamber and shall remain unpressurized. The pressure gauge shall be subjected to 20 complete temperature cycles of 20 hours in duration. Each cycle shall consist of 10 hours at the higher temperature and 10 hours at the different temperature conditions specified in 3.4.5.1. At the termination of the twentieth temperature cycle, the pressure gauge shall be removed from the temperature test chamber and allowed to stabilize at the ambient conditions (see 4.4) for at least 4 hours. A reference measurement shall then be performed. The pressure gauge shall meet the requirements specified in 3.4.5.3.

MIL-G-18997D(SH)

TABLE XVII. Seal integrity test cycle.

Step	Temperature condition	Step duration
1	Increasing temperature ¹ from 75 ± 5°F to 145 ± 5°F	0.75 hour maximum
2	Constant temperature of 145 ± 5°F	2 hours minimum
3	Decreasing temperature from 145 ± 5°F to 0 ± 5°F	1.5 hours maximum
4	Constant temperature of 0 ± 5°F	2 hours minimum
5	Increasing temperature from 0 ± 5°F to 75 ± 5°F	0.75 hour maximum

¹ Ambient temperature for the first cycle.

4.4.5.4 Storage and temperature cycling. The pressure gauge shall be placed in a temperature test chamber and shall remain unpressurized during this test. This test shall subject the pressure gauge to five complete temperature cycles, each of which is 48 hours in duration. Each cycle shall consist of the pressure gauge being subjected to the temperature conditions specified in table XVIII. The steps in each cycle shall be performed in the sequences specified in table XVIII. After completion of the fifth temperature cycle, the pressure gauge shall be removed from the temperature test chamber and allowed to stabilize at the ambient conditions (see 4.4) for at least 4 hours. A reference measurement shall then be performed. The pressure gauge shall meet the requirements specified in 3.4.5.3.

TABLE XVIII. Storage and temperature cycling test variables.

Step	Temperature condition ²	Step duration cycle 1	Step duration cycles 2-5
1	Increasing temperature ¹ from 75 ± 5°F to 145 ± 5°F	3 hours maximum	1 hour maximum
2	Constant temperature of 145 ± 5°F	18 hours minimum	22 hours minimum
3	Decreasing temperature from 145 ± 5°F to TMIN	6 hours maximum	2 hours maximum
4	Constant temperature of TMIN	18 hours minimum	22 hours minimum
5	Increasing temperature from TMIN to 75 ± 5°F	3 hours maximum	1 hour maximum

¹ Ambient temperature for the first cycle.

² Cycle 1: TMIN = minus 10 ± 5°F, Cycles 2-5: TMIN = 40 ± 5°F

MIL-G-18997D(SH)

4.4.5.5 Seal stability. The seal stability test shall only be performed on liquid filled pressure gauges. The pressure gauge shall be placed in a temperature test chamber and shall remain unpressurized during this test. The temperature test chamber shall be brought to $145 \pm 5^{\circ}\text{F}$ and allowed to stabilize at this temperature. After the temperature test chamber has stabilized at $145 \pm 5^{\circ}\text{F}$, the pressure gauge shall remain in the temperature test chamber for at least 480 hours. After this minimum 480-hour period, the pressure gauge shall be removed from the temperature test chamber and allowed to stabilize at the ambient conditions of the room for at least 4 hours. A reference measurement shall then be performed. The pressure gauge shall meet the requirements specified in 3.4.5.5.

4.4.6 Enclosure. The pressure gauge shall be subjected to a splashproof enclosure test as specified in MIL-STD-108 using the test criteria specified in MIL-STD-108 for the splashproof degree of enclosure. This test shall be performed with the pressure gauge secured to the mounting surface in the surface mounted configuration. A reference measurement shall be performed after the conclusion of this test. The pressure gauge shall meet the requirements specified in 3.4.6.

4.4.7 Load. The load test shall only be performed on stem mounted pressure gauges for range 150 lb/in^2 and above. The pressure gauge shall be threaded into a plate and securely held in place. A constant load of 150 pounds shall be applied to the pressure gauge case as shown on figure 2 for 5 minutes. A reference measurement shall be performed after the conclusion of this test. The pressure gauge shall meet the requirements specified in 3.4.7.

4.4.8 Salt spray. The pressure gauge shall be subjected to a salt spray test in accordance with ASTM B 117. The test shall be conducted for a duration of 96 hours. The salt solution shall consist of a 5 ± 1 percent concentration (five parts by weight of salt in 95 parts by weight of water). The pressure gauge pressure connection shall be sealed by any suitable means that does not prevent future use of the pressure connection. The sealed pressure connection shall not permit salt spray penetration into the interior of the pressure element assembly. A reference measurement shall be performed after the conclusion of this test. The pressure gauge shall meet the requirements specified in 3.4.8.

4.4.9 Vibration. The vibration test shall consist of the exploratory test, the variable frequency test, the endurance test and, when applicable, the component wear test. Three categories (see 4.4.9.1) are defined for different pressure gauge configurations or applications.

4.4.9.1 Test categories. Each pressure gauge shall be tested under the conditions designated for its category. The three categories are:

(a) Category A:

(1) Flush/surface mounted pressure gauges with the exception of those pressure gauges contained in category C.

(b) Category B:

(1) Flush/surface mounted pressure gauges that contain electrical contacts or other electrical devices.

MIL-G-18997D(SH)

(c) Category C:

- (1) All stem mounted pressure gauges.
- (2) Flush/surface mounted pressure gauges that are liquid filled or mounted directly to machinery without resilient mounts.
- (3) All liquid filled pressure gauges.

4.4.9.2 Test classification. Vibration testing shall consist of a series of tests which shall identify resonant frequencies and those frequencies which cause wear. These tests shall also determine if the equipment will withstand the imposed vibratory conditions.

4.4.9.2.1 Exploratory test. The pressure gauge shall be subjected to an exploratory test to identify and quantify resonant behavior likely to occur during subsequent portions of the vibration test. Cover plates, and so forth, shall be removed during this test so that the pressure gauge interior components can be observed. A determination shall be made during this test as to the locations where additional vibration measurements or observations shall be taken and what instrumentation is required to conduct these measurements. This instrumentation shall then be used during the variable frequency test.

4.4.9.2.2 Variable frequency test. During the variable frequency test, all of the pressure gauge components shall be observed to identify, locate and quantify specific resonances that occur on any component at any test frequency. Enough time shall be spent at each test frequency to thoroughly inspect the pressure gauge. The more complex the pressure gauge, the more time that may be required. The time duration at each frequency is given as a guideline only and may be exceeded when necessary. With the following exceptions, the cover plates, and so forth, shall not be removed during this test. As a resonance that was found during the exploratory test is approached, the cover plates, and so forth, shall be removed. After the resonance has been passed, the cover plates, and so forth, shall be reinstalled. If a resonance is suspected that was not observed during the exploratory test, the cover plates, and so forth, shall be removed. The cover plates, and so forth, shall be reinstalled after the test engineer is satisfied that there is no resonance or after the resonance has passed. Operational tests or other functional checks shall be performed as required to ensure proper pressure gauge operation. At each test frequency at which a resonance is found, the resonance site shall be located and the magnitude of the displacement determined. All resonances found shall be recorded for use in the endurance test.

4.4.9.2.3 Endurance test. The endurance test shall be performed to determine the effect of continual vibration at all resonant frequencies. A 2-hour endurance run shall be performed at each resonance that was found during either the exploratory test or during the variable frequency test. Cover plates, and so forth, shall not be removed during this test. Operational tests or other functional checks shall be performed as required to ensure proper pressure gauge operation.

4.4.9.2.4 Component wear test. The component wear test shall be performed to determine if the pressure gauge will exhibit significant wear or damage when subjected to the resonant frequency that was observed to produce the most wear or damage potential during the exploratory, variable frequency or endurance tests. For mechanical test instruments, this is generally the resonant frequency that

MIL-G-18997D(SH)

produces the greatest pointer oscillation or the most severe motion of the linkage or movement. When no resonance has been observed, this test shall be performed at a specified frequency. Normally, a frequency is selected that would either cause the most visible wear for the duration of the test or one that would simulate the conditions to be found in actual service. Operational tests or other functional checks shall be performed as required to ensure proper pressure gauge operation.

4.4.9.3 Mounting considerations. The pressure gauge under test shall be secured to the vibration table in the same manner that it will be secured in service. In the case of flush/surface mounting, the panel shall be sufficiently rigid to ensure that its motions will be essentially the same as the motion of the platform of the vibration machine. Vibration machine input (displacement) shall be monitored at a point adjacent to the pressure gauge mounting.

4.4.9.4 Operational consideration. The pressure gauge shall be pressurized to midspan during the vibration test.

4.4.9.5 Test procedures.

- (a) Category A and B tests. Category A and B tests shall consist of the exploratory test, the variable frequency test, and the endurance test, conducted in the sequence listed. Each of these three tests shall be conducted in each of the three mutually perpendicular axes. All three tests shall be completed in one axis before performing the tests in another axis. For each classification of pressure gauge samples submitted (see 4.2.1.1), one pressure gauge sample shall be secured to the fixture (panel) in a flush mounted configuration and the other pressure gauge sample in a surface mounted configuration.
- (b) Category C tests. Category C tests shall consist of the exploratory test, the variable frequency test, the endurance test and the component wear test, conducted in the sequence listed. Each of the four category C tests shall be conducted along one axis only using the mounting fixture configuration and vibration direction shown on figure 3. The exploratory test, variable frequency test, and endurance test shall be conducted in this order twice. During the first set of tests, the pressure gauge shall be oriented as shown on figure 3. During the second set of tests, the pressure gauge shall be oriented in a direction perpendicular to that shown on figure 3 so that the pressure gauge dial would be seen on the figure. The component wear test shall follow the second set of tests and shall be performed in the orientation and at the frequency that produces the most wear damage potential.

4.4.9.5.1 Exploratory test. The pressure gauge shall be subjected to an exploratory test. The frequencies and locations where resonance occur during this test shall be noted. This test shall also be performed in accordance with 4.4.9.2.1. Pressure gauge performance shall meet the requirements of 3.4.9 and testing shall be terminated if the pressure gauge exceeds the performance limits. The test criteria for the different category pressure gauges shall be as follows:

MIL-G-18997D(SH)

(a) Category A:

- (1) Each discrete frequency from 5 to 60 Hz at 1-Hz intervals shall be maintained for a minimum of 15 seconds, or a sweep rate that shall not exceed 4 Hz per minute.
- (2) Displacements shall be as specified in table XIX.

(b) Category B:

- (1) Each discrete frequency from 5 to 100 Hz at 1-Hz intervals shall be maintained for a minimum of 15 seconds, or a sweep rate that shall not exceed 4 Hz per minute.
- (2) Displacements or accelerations shall be as specified in table XX.

(c) Category C:

- (1) Each discrete frequency from 5 to 500 Hz at 1-Hz intervals shall be maintained for a minimum of 5 seconds, or a sweep rate that shall not exceed 12 Hz per minute.
- (2) Displacement or accelerations shall be as specified in table XXI.

TABLE XIX. Vibratory displacement criteria - category A.

Frequency range (Hz) (inclusive)	Table displacement (inches, peak to peak)	
	Exploratory test	Variable frequency test
5 to 15	0.020 ± 0.004	0.060 ± 0.012
16 to 25	.020 ± .004	.040 ± .008
26 to 33	.020 ± .004	.020 ± .004
34 to 40	.005 ± .001	.010 ± .002
41 to 60	.005 ± .001	.005 ± .001

TABLE XX. Vibratory displacement criteria - category B.

Frequency range (Hz) (inclusive)	Table displacement (inches, peak to peak)	
	Exploratory test	Variable frequency test
5 to 20	0.020 ± 0.004	0.060 ± 0.012
21 to 50	.010 ± .002	.040 ± .008
51 to 100	.005 ± .001	.020 ± .004

MIL-G-18997D(SH)

TABLE XXI. Vibratory displacement criteria - category C.¹

Test performed	Frequency range (Hz)	Table displacement ² (inches, peak to peak)	Table acceleration ² (g, peak)
Exploratory	5 to 20	0.030 ± 0.006	0.0383 (freq) - 0.1533
	21 to 500	2.267 (freq) ^{-1.5}	0.00395 (freq) + 7.5
Variable frequency	5 to 20	0.300 ± 0.03	0.383 (freq) - 1.533
	21 to 500	22.67 (freq) ^{-1.5}	0.0395 (freq) + 7.5

¹ Testing shall be performed to either the displacement or the acceleration criteria.

² Tolerance on displacement or acceleration shall be plus or minus 10 percent of calculated value except where otherwise specified.

4.4.9.5.2 Variable frequency test. The pressure gauge shall be subjected to a variable frequency test. The frequencies and locations where resonance occurs during this test shall be noted. This test shall also be performed in accordance with 4.4.9.2.2. Pressure gauge performance shall meet the requirements specified in 3.4.9 and testing shall be terminated if the pressure gauge exceeds the performance limits. The test criteria for the different category pressure gauges shall be as follows:

(a) Category A:

- (1) Discrete frequency interval of 1 Hz.
- (2) Frequency range from 5 to 60 Hz.
- (3) Each discrete frequency shall be maintained for a minimum of 5 minutes.
- (4) Displacements shall be as specified in table XIX.

(b) Category B:

- (1) Discrete frequency interval of 1 Hz.
- (2) Frequency range from 5 to 100 Hz.
- (3) Each discrete frequency shall be maintained for a minimum of 5 minutes.
- (4) Displacements shall be as specified in table XX.

(c) Category C:

- (1) Discrete frequency interval of 5 Hz.
- (2) Frequency range from 5 to 500 Hz.
- (3) Each discrete frequency shall be maintained for a minimum of 2 minutes.
- (4) Displacements or accelerations shall be as specified in table XXI.
- (5) For every observed resonance a detailed search shall be conducted within the 5-Hz interval to determine the resonant frequency.

MIL-G-18997D(SH)

4.4.9.5.3 Endurance test. The pressure gauge shall be subjected to a 2-hour endurance run at each resonance. This test shall also be performed in accordance with 4.4.9.2.3. Pressure gauge performance shall meet the requirements specified in 3.4.9 and testing shall be terminated if the pressure gauge exceeds the performance limits. The test criteria for the different category pressure gauges shall be as follows:

(a) Category A:

- (1) Displacements or accelerations shall be as specified for the variable frequency test specified in table XIX.
- (2) A reference measurement shall be performed after the conclusion of the endurance test.
- (3) If no resonance is found, a 2-hour endurance run shall be performed at 50 Hz.

(b) Category B:

- (1) Displacements or accelerations shall be as specified for the variable frequency test specified in table XX.
- (2) A reference measurement shall be performed after the conclusion of the endurance test.
- (3) If no resonance is found, a 2-hour endurance run shall be performed at 100 Hz.

(c) Category C:

- (1) Displacements or accelerations shall be as specified for the variable frequency test specified in table XXI.
- (2) A reference measurement shall be performed after the conclusion of the endurance test.
- (3) If no resonance is found, the endurance test shall not be performed and the vibration test shall continue with the component wear test after a reference measurement is performed.

4.4.9.5.4 Component wear test. The component wear test shall be performed on category C pressure gauges only. The pressure gauge shall be vibrated for at least 100 hours at the resonant frequency that was observed to produce the most wear or damage potential. If no resonance is found, the component wear test shall be performed at 400 Hz. The table vibration displacement for the frequency in which the pressure gauge is vibrated shall be in accordance with the variable frequency test displacements in table XXI. This test shall also be performed in accordance with 4.4.9.2.4. A reference measurement shall be performed after the conclusion of this test. Pressure gauge performance shall meet the requirements specified in 3.4.9 and testing shall be terminated if the pressure gauge exceeds the performance limits.

4.4.10 Shock. Pressure gauge shall be subjected to a shock test in accordance with MIL-S-901, grade A, class I, except for duplex pressure gauges which shall be grade B. Pressure gauges being tested for first article inspection shall be subjected to two sets of nine blows and those being tested for quality conformance inspection shall be subjected to one set of nine blows. Flush and surface mounted pressure gauges shall be mounted on a 6D-1 adapter

MIL-G-18997D(SH)

plate. Stem mounted pressure gauges shall be mounted on a 4C-2 adapter plate. The pressure gauge shall be mounted no less than 3 inches from the sides or rear of the adapter plate. For each classification of flush/surface mounted pressure gauge samples submitted (see 4.2.1.1), one pressure gauge sample shall be secured to the adapter plate in a flush mounted configuration and the other pressure gauge sample in a surface mounted configuration. Throughout this test, the pressure gauge shall be pressurized to midspan. A leakage test and a reference measurement shall be performed just prior to the first set of nine blows. A reading shall be taken after each blow. A leakage test shall be conducted after each set of nine blows. A reference measurement shall then be conducted after each set of nine blows without any adjustments performed. Pressure gauge performance and shift in pointer indication shall meet the requirements specified in 3.4.10. If the pressure gauge meets the requirements specified in 3.4.10 but is not within the accuracy requirements specified in 3.4.1.3, a zero adjustment shall be made and another reference measurement performed. Pressure gauge performance, after the zero adjustment is made, shall meet the requirements specified in 3.4.10.

4.4.11 Pressure cycling. The pressure cycling test shall be performed using a pressure cyler that shall subject the pressure gauge to the following criteria:

- (a) A cycle from 20 ± 4 to 80 ± 4 percent of span.
- (b) Unless otherwise specified, a frequency rate of 1 ± 0.5 Hz when cycling only gauge pressure (no vacuum portion).
- (c) A total of 260,000 cycles for pressure ranges 0/3000 lb/in² and below. A total of 50,000 cycles for pressure ranges 0/5000 lb/in² and above.
- (d) The application and release of pressure shall be as smooth as practicable, so as not to subject the pressure gauge pressure element assembly and movement to excessive upscale or downscale accelerations or high amplitude impulse (pressure spikes). Hydraulic pressure cycles shall have a sinusoidal pressure output with a maximum distortion of 25 percent.
- (e) Hydraulic fluid shall be used to cycle pressure gauges with ranges greater than 0/200 lb/in². Hydraulic fluid shall have a viscosity between 55 and 65 saybolt seconds universal at 104°F.

A leakage test shall be performed periodically, randomly, or whenever a rupture in the pressure element assembly is suspected. A leakage test and a reference measurement shall be performed after the conclusion of the test. Pressure gauge performance shall meet the requirements specified in 3.4.11.

4.4.11.1 Vacuum gauges. The pressure gauge shall be cycled by pulling a vacuum between 20 ± 4 to 80 ± 4 percent of the span.

4.4.11.2 Compound gauges. The span for a compound pressure gauge shall be as defined in 4.4.1.2.2. For compound pressure gauges in which the range of the pressure side is 0/60 lb/in² or less, the pressure and vacuum portions shall be cycled separately. A total of 130,000 cycles shall be performed between 20 ± 4 to 80 ± 4 percent of the span for each portion.

4.4.11.3 Retarded gauges. The pressure gauge shall be cycled from 20 ± 4 to 80 ± 4 percent of the expanded portion of the span.

MIL-G-18997D(SH)

4.4.12 Case pressure relief. The pressure gauge shall be subjected to the tests specified in 4.4.12.1 and 4.4.12.2 using a pressure gauge from which the elastic element has been removed. The pressure gauge performance during both of these tests shall meet the requirements specified in 3.4.12.

4.4.12.1 Rupture. The pressure gauge shall be connected to a pressure receiver having at least 10 times the volume of the pressure gauge case. Connection shall be made using a short length of pipe or tubing of suitable wall thickness to withstand the required pressure. The pipe or tubing between the gauge and receiver shall include a union fitted with a frangible blowout disc. Sudden rupture of the elastic element in the pressure case shall be simulated by gradually raising the pressure in the receiver with nitrogen or air until the frangible disc ruptures. A quick opening valve may be substituted for the frangible blowout disc if the valve can be fully opened from the closed position in less than 25 milliseconds. Pressure in the receiver shall be monitored by another pressure gauge or pressure transducer. Gauges shall be tested to the pressures specified in table XXII.

TABLE XXII. Rupture test pressure limits.

Maximum gauge range	Pressure limit
Up to and including 1000 lb/in ²	50 percent of span above maximum scale value.
Above 1000 lb/in ² up to and including 5000 lb/in ²	15 percent of span above maximum scale value.
Above 5000 lb/in ²	Maximum scale value.

4.4.12.2 Slow leak. The pressure relief device shall be refitted properly in the pressure gauge case. The pressure gauge shall be connected to the receiver without a frangible disc in between. A slow leak in the elastic element shall be simulated by gradually raising the receiver pressure to 50 lb/in².

4.4.13 Elastic element or joining means failure The nonsolid front gauges shall be subjected to the internal explosion test as specified in UL 404. The nonsolid front gauges shall meet the requirements of 3.3.7 when subjected to this test.

4.5 Test standards. Test standards shall be in accordance with 4.5.1 through 4.5.2.

4.5.1 Test gauge. A test gauge, as specified in ANSI B40.1, shall be used to check the accuracy of the pressure gauges. The accuracy of the test gauge shall be within plus or minus 1/4 percent of span. The test gauge shall be maintained in accordance with MIL-STD-45662.

4.5.2 Other standards. Upon receiving prior approval from NAVSEA, another type of pressure standard may be used. The NAVSEA-approved pressure standard shall be at least four times more accurate than the pressure gauge being tested or shall provide results in local environment within one-fourth tolerance specified for the pressure gauge being tested. The NAVSEA-approved pressure standard shall be maintained in accordance with MIL-STD-45662.

MIL-G-18997D(SH)

4.6 Case seal material acceptance procedure. Selected gaskets and O-rings (see 3.2.3) shall be fully immersed in individual beakers containing a liquid fill case fluid in accordance with 3.3.8. The beakers shall be placed in a temperature test chamber. The temperature test chamber shall be brought to $145 \pm 5^{\circ}\text{F}$ and allowed to stabilize at this temperature. After the temperature test chamber has stabilized at $145 \pm 5^{\circ}\text{F}$, the beaker shall remain in the temperature test chamber for at least 120 hours. After this minimum 120-hour period, the fill fluid in the beaker shall be observed. Any visible discoloration of this fill fluid is sufficient cause for rejection of the entire lot of gaskets and O-rings.

4.7 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.5.)

5.1 Preservation. Preservation shall be level A, C or commercial, as specified (see 6.2.1).

5.1.1 Level A. Level A preservation shall be as specified in 5.1.1.1 through 5.1.1.3.

5.1.1.1 Cleaning and drying. Cleaning and drying shall be as follows:

5.1.1.1.1 General applications. Unless otherwise specified (see 6.2.1), cleaning and drying of pressure gauges shall be in accordance with MIL-STD-1622.

5.1.1.1.2 Oxygen applications. Pressure gauges shall be cleaned and dried in accordance with MIL-STD-1330.

5.1.1.1.3 Substitution of cleaning agents. Any cleaning agent used shall not be detrimental to the parts or materials. Written approval shall be obtained from NAVSEA to use other than the specified cleaning agent. A letter shall be written to NAVSEA requesting this approval. This letter shall contain adequate justification (such as Environmental Protection Agency requirements). Sufficient technical and health data on both the specified and recommended substitute cleaning agents shall also be provided.

5.1.1.2 Unit protection. Preservatives shall not be used.

5.1.1.2.1 Bagging. General applications pressure gauges shall be individually placed in a bag conforming to MIL-B-117, type I, class B, style 2 having a minimum thickness of 0.004 inch. Oxygen application pressure gauges shall be individually placed in a bag conforming to MIL-B-117, type I, class E, style 2

MIL-G-18997D(SH)

having a minimum thickness of 0.006 inch. Pressure gauges threads shall be protected by a plastic cap to prevent puncture of the plastic bag. Any sharp edges and protrusions of the pressure gauges shall be cushioned before placing in the plastic bag.

5.1.1.2.2 Boxing. Each bagged pressure gauge shall be individually unit packed in a box conforming to PPP-B-566, variety 2, process II, PPP-B-636 class weather-resistant, PPP-B-665 class 2 or PPP-B-676 with box selection and style at the contractor's option. Box closure and sealing shall conform to the requirements for water-proofing or weather-resistant as specified in the applicable box specification or appendix thereto.

5.1.1.2.2.1 Flush mounting ring and associated hardware. When applicable (see 3.3.7.1), the flush mounting ring and associated hardware shall be placed in either a cloth bag having a draw string or a plastic "zip-loc" bag. The bag shall be placed in the same box as the pressure gauge.

5.1.1.3 Intermediate packing. Pressure gauges, unit packed as specified in 5.1.1.2.1, shall be intermediate packed in close-fitting fiberboard boxes conforming to PPP-B-636, type CF, class weather-resistant, style optional. Intermediate packs shall contain uniform quantities. Boxes shall be closed method V in accordance with the appendix to the box specification.

5.1.2 Level C. Cleaning and drying, unit protection and boxing shall be as specified for level A (see 5.1.1) except that boxes may be of the nonwater-proof domestic class or variety.

5.1.3 Commercial. Pressure gauges shall be cleaned, dried and bagged as specified for level A (see 5.1.1) with boxing in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level B, C or commercial, as specified (see 6.2.1).

5.2.1 Level B. Pressure gauges preserved as specified in 5.1 shall be packed in fiberboard containers conforming to PPP-B-636, class weather-resistant or PPP-B-640, class 2 with container selection at the option of the contractor. Containers shall be closed, sealed and reinforced, with reinforcement utilizing nonmetallic banding or pressure sensitive reinforced tape. Box closure for PPP-B-636 containers shall conform to method V of the appendix to the box specification. Intermediate containers conforming to 5.1.1.3 herein require no further overpacking.

5.2.2 Level C. Pressure gauges preserved as specified in 5.1 shall be packed as specified for level B (see 5.2.1) except that containers shall be of the nonweather-resistant class. Containers shall be closed as specified in the appendix to the container specification with method I closure applicable to PPP-B-636 containers.

5.2.3 Commercial. Pressure gauges preserved as specified in 5.1 shall be packed in accordance with ASTM D 3951.

5.3 Cushioning, filler, dunnage and wrapping material. Cushioning, filler, dunnage and wrapping shall be as follows (see 6.2.1).

MIL-G-18997D(SH)

5.3.1 Levels A, B, and C. Use of excelsior, newspaper, shredded paper (all types, including wax paper) and similar hygroscopic or nonneutral materials and all types of loose-fill materials for applications such as cushioning, filler, stuffing and dunnage for materials destined for shipboard stowage and use is prohibited. Cushioning and wrapping materials selected shall have properties and characteristics for resistance to fire; examples are:

UU-P-268 - Paper, kraft wrapping, type II, grade C or D
 PPP-C-850 - Polystyrene, expanded, grade SE, type I or II only
 PPP-C-1120 - Bound fiber, uncompressed, type III or IV, class a
 MIL-R-6130 - Cellular rubber, grade A
 MIL-R-20092 - Cellular rubber, class 5
 MIL-P-26514 - Polyurethane foam (rigid or flexible)

5.3.2 Commercial preservation and packing. When loose fill type materials are used for preservation and packing applications such as cushioning, filler, and dunnage, all containers (unit, intermediate, and shipping) shall be marked or labelled with the following information:

"CAUTION

Contents cushioned with loose-fill material shall not be taken on board ship. Remove and discard loose-fill material. If required, recushion with cellulosic material, bound fiber, fiberboard, or transparent flexible cellular material."

Cushioning, filler, dunnage and wrapping materials selected, whenever available, shall exhibit improved performance for resistance to fire.

5.4 Marking. In addition to any special marking required (see 6.2.1), interior unit packs and exterior shipping containers for levels A, B and C shall be marked in accordance with MIL-STD-129 including the bar-code markings specified therein. Oxygen applications unit packs (see 5.1.1.2.1) shall be marked with a warning label as specified in MIL-STD-1330 inserting "oxygen" and so forth, as applicable for the system use. The labels shall be green paper and shall match FED-STD-595, color no. 14187. Lettering shall be black. Packaging and packing shall also be marked as follows:

"CONTAINS FRAGILE INSTRUMENT HANDLE WITH CARE"

"SHIPPING AND STORAGE TEMPERATURE LIMITS: -10 TO 150°F".

6. NOTES

6.1 Intended use. Pressure gauges specified herein are intended for the following applications.

6.1.1 Installation. Pressure gauges furnished under this specification are intended to be installed and connected to piping in accordance with Drawing 803-1385850.

6.1.1.1 Pressure connection. The type of pressure connections shall be selected in accordance with the intended use column of table III.

MIL-G-18997D(SH)

6.1.1.2 Pressure connection location. Back and bottom connections are the preferred configuration. The 5 o'clock connection is intended for installations where space limitations restrict the use of the back or bottom connected configurations.

6.1.2 Stem mounted case design. Pressure gauges with 2- and 2-1/2 inch dial sizes are intended for direct mounting to machinery.

6.1.3 Caisson gauge. Caisson gauges are intended for use in submarine escape trunks and decompression chambers.

6.1.4 Receiver gauge. Receiver gauges are intended for use with pneumatic transmitters.

6.1.5 Bleeder tip design. Bleeder tip design is intended for pressure gauges in oxygen applications where cleaning or flushing procedures are required.

6.1.6 Cruising range gauge. The cruising range pressure gauge contains a specially marked scale that is intended to indicate safe operating steam pressure or vacuum pressure limits on the main engine.

6.1.7 Dial sizes. Dial sizes should conform to the mounting configuration (case design):

<u>Dial size (inches)</u>	<u>Case design</u>
2, 2-1/2	Stem mounted
3-1/2, 4-1/2, 8-1/2	Flush/surface mounted

6.1.8 Liquid fill. Liquid filled pressure gauges are intended for the stem mounted configuration with a C-type bourdon tube. Liquid filled pressure gauges are also intended for flush and surface mounted configurations with C-type bourdon tubes that are directly mounted to machinery without resilient mounts.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of pressure gauge required (see 1.2).
- (c) When special dial color is required (see 1.2.5 and 3.3.10.2).
- (d) When first article is required (see 3.1)
- (e) When flush mounting ring is not to be provided with surface/flush mounted pressure gauge configuration (see 3.3.7.1).
- (f) Pressure connection type, if other than the type specified in Drawing 803-1385850 (see 3.3.9.1).
- (g) Ranges and minor graduations specified (see 3.3.10.4).
- (h) When instruction sheets are to be prepared (see 3.6).
- (i) Level of preservation, and packing required (see 5.1, and 5.2).
- (j) Cleaning and drying procedures required (see 5.1.1.1.1).

MIL-G-18997D(SH)

- (k) When special wrapping is specified (see 5.3).
- (l) Special marking required (see 5.4).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.5	Drawings, engineering and associated lists	DI-E-7031	Level 3
4.1.2	Inspection system program plan	DI-R-4803	
4.1.3	Calibration system description	DI-R-7064	
4.2.1	First article inspection report	DI-T-4902	
4.2.2	Inspection and test report	DI-T-5329	

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

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of two samples. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering

MIL-G-18997D(SH)

a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.4.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.5 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.6 Definitions. Terminology in this specification is consistent with ANSI B40.1.

- (a) Five o'clock position. The position of the pressure connection which is established after rotating 30 degrees counterclockwise, in the plane parallel to the dial, from the bottom connected position. This position is determined while facing the front of the pressure gauge (the dial).
- (b) $\text{lb/in}^2 = \text{psi} = \text{psig}$.
- (c) Red index. An adjustable marker (painted red) which is set at a significant system pressure value, usually the maximum expected operating pressure.

6.7 Subject term (key word) listing.

Caisson gauge
 Cruising range gauge
 Flush/surface mounted gauge
 Stem mounted gauge
 Submarine depth gauge
 Vacuum gauge

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
 Navy - SH
 (Project 6685-N781)

MIL-G-18997D(SH)



SAFE RANGE CRUISING COMBINATION	
SAFE RANGE	DANGER ZONE H.P. TURBINE COMBINATION
H.P. TURBINE COMB.	SLOW DOWN TO 200 R.P.M. SHUT CROSSOVER VALVE

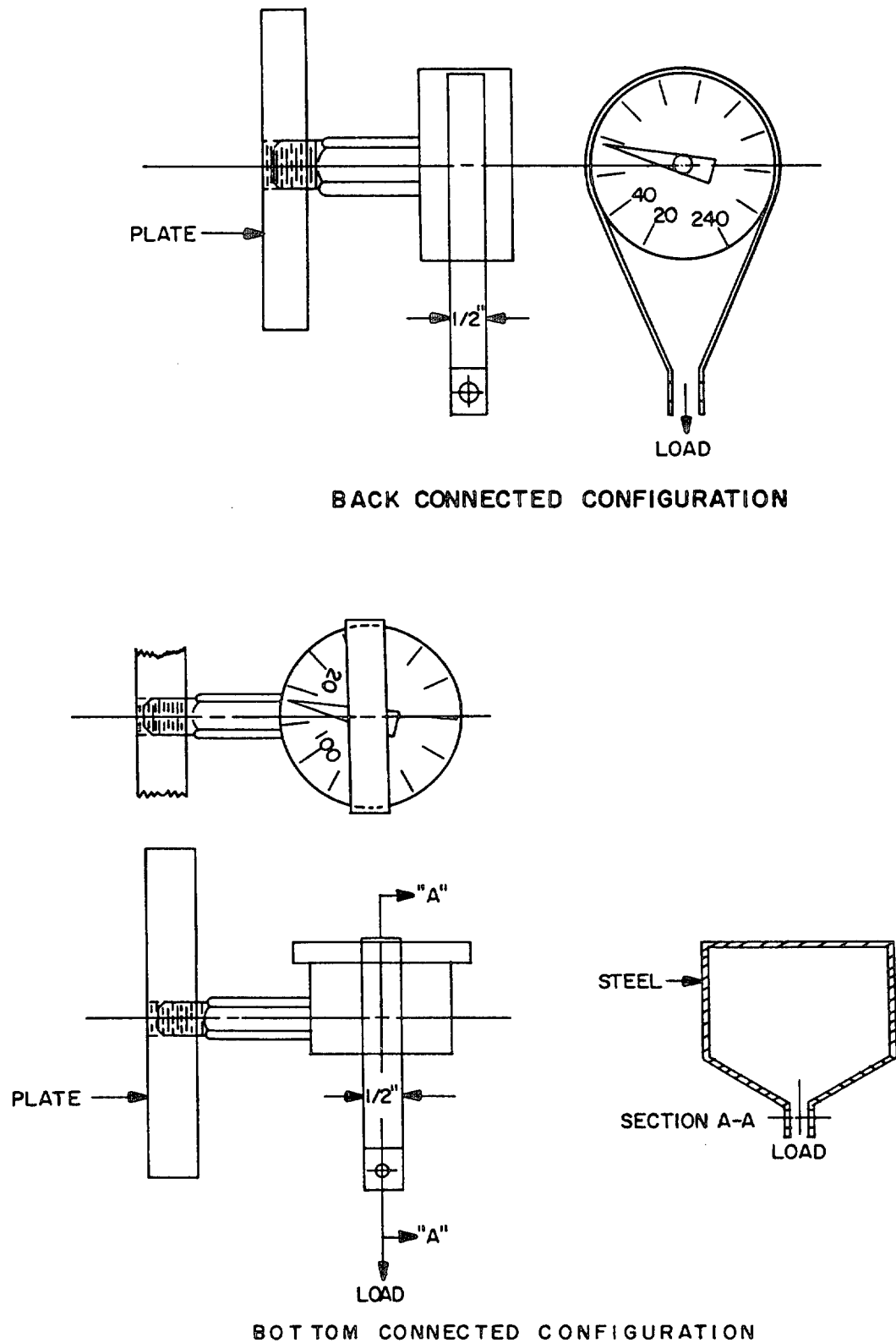
NOTES:

1. Dial shall contain a black background with white graduations.
2. "Safe range cruising combination" shall contain a black background with white letters.
3. "Safe range H.P. Turbine Comb." shall contain a green background with white letters.
4. "Danger Zone H.P. Turbine Combination. Slow down to 200 R.P.M. shut crossover valve" shall contain a red background with white letters.

SH 13202636

FIGURE 1. Cruising range gauge scale.

MIL-G-18997D(SH)



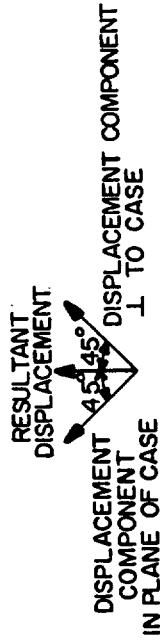
SH 13202637

FIGURE 2. Load test.

MIL-G-18997D(SH)

NOTES:

1. Method of fastening block to exciter table is optional but should not reduce setup rigidity.
2. Bottom connected pressure gauges shall be inclined 45 degrees and face up with respect to the vertical axis.
3. Back connected and 5 o'clock position pressure gauges shall be inclined 45 degrees backward and face up with respect to the vertical axis.
4. Pressure gauge mounting configuration and vibration direction shall produce the vibration components shown below:



5. Block bored to permit pressurization of gauge. Depth to suit position of pressure fitting.
6. Mounting port to suit gauge pressure connection.
7. To ensure proper orientation, short rigid adapter fittings may be used to mount pressure gauge configurations with a straight thread pressure connection.
8. Resonant frequency of block shall be at least 1000 Hz. Block shall withstand 150 percent of gauge full scale pressure rating.

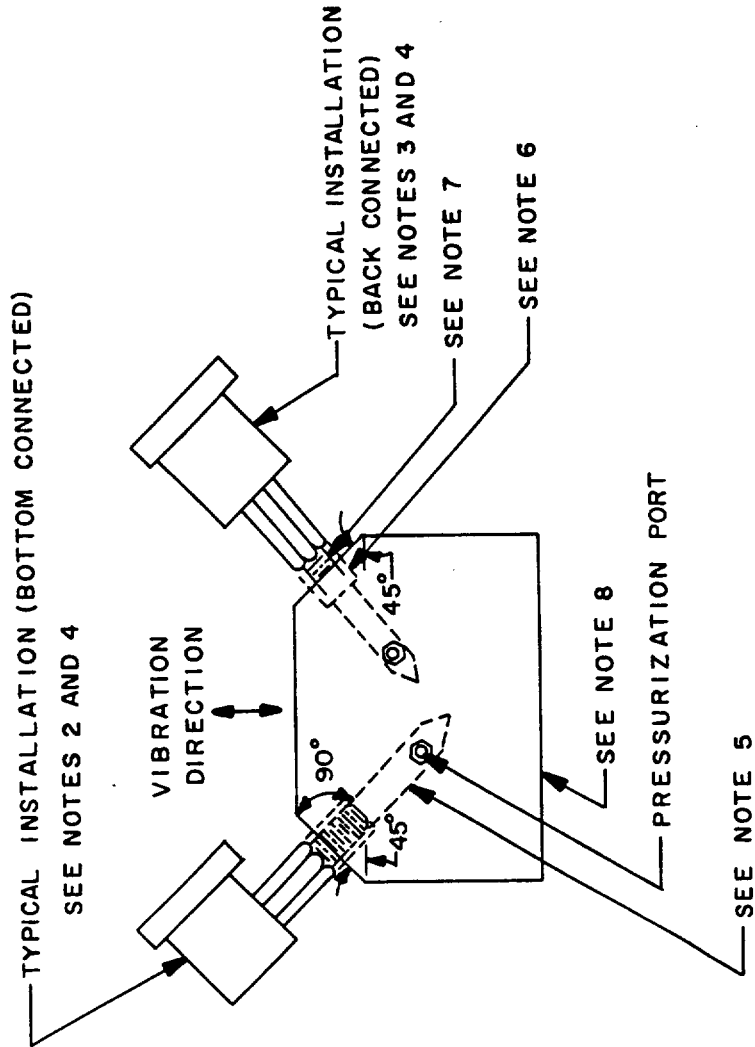


FIGURE 3. Mounting fixture and orientation for category C pressure gauges undergoing vibration testing.

SH 13202638

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER MIL-G-18997D(SH)	2. DOCUMENT TITLE GAUGE, PRESSURE, DIAL INDICATING
3a. NAME OF SUBMITTING ORGANIZATION 	4. TYPE OF ORGANIZATION (Mark one) <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____
5. PROBLEM AREAS a. Paragraph Number and Wording: b. Recommended Wording: c. Reason/Rationale for Recommendation: 	
6. REMARKS 	
7a. NAME OF SUBMITTER (Last, First, MI) – Optional 	b. WORK TELEPHONE NUMBER (Include Area Code) – Optional
c. MAILING ADDRESS (Street, City, State, ZIP Code) – Optional 	8. DATE OF SUBMISSION (YYMMDD)

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 5523)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362-5101



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12503 WASHINGTON D. C.

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 5523)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362-5101

