

INCH-POUND

MIL-G-16356D

18 December 1987

SUPERSEDING

MIL-G-16356C(SH)

26 November 1973

MIL-G-18498C(SH)

15 July 1982

(See 6.7 and 6.8)

## MILITARY SPECIFICATION

## GAUGES, BOILER-WATER, DIRECT READING

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

## 1. SCOPE

1.1 Scope. This specification covers direct reading boiler-water gauges including replacement glass sets.

1.2 Classification. Gauges shall be of the following types and classes, as specified (see 6.2.1):

Type A - Continuous vision, plain, double, flat glass.

Class I - For designed pressure to 700 pounds per square inch gauge (lb/in<sup>2</sup>) (600 lb/in<sup>2</sup> nominal) using 1500 lb/in<sup>2</sup> glass.

Class II - For designed pressure to 1050 lb/in<sup>2</sup> (900 lb/in<sup>2</sup> nominal) using 1500 lb/in<sup>2</sup> glass.

Class IV - For designed pressure to 2550 lb/in<sup>2</sup> (2500 lb/in<sup>2</sup> nominal) using 2500 lb/in<sup>2</sup> glass.

Type B - Reflex glass, pressures of 300 lb/in<sup>2</sup> and under.

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.

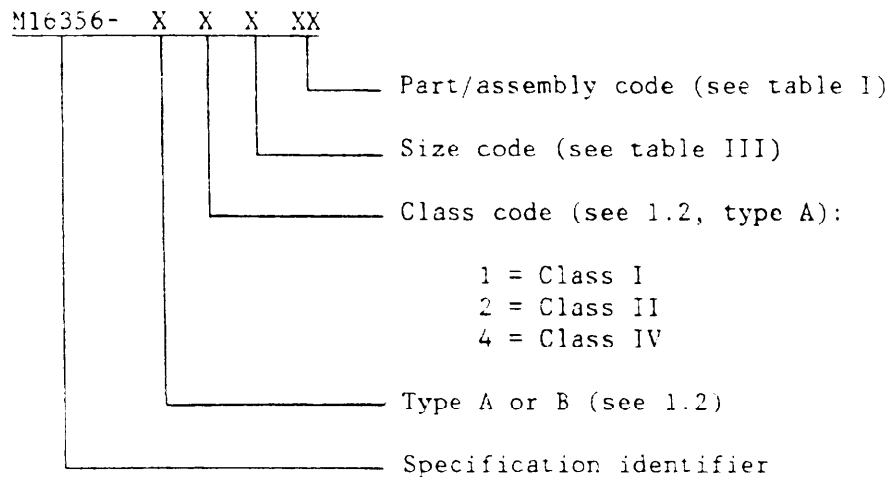
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1.3 Part numbers. For gauges and component gauge parts furnished under this specification, the complete gauges and replaceable component gauge parts shall be identified by part numbers in accordance with the following and as shown in table I:



Example: M16356-A1500 8-5/8 inch type A, class I gauge, complete.

TABLE I. Part/assembly codes.

Code	Item	Code	Item
00	Gauge, complete	60	Chain, sprocket, 40-foot
11	Glasses	61	Sprocket wheel - 7 inch
12	Mica shields	62	Sprocket wheel - 8 inch
21	Glass positioners	63	Sprocket wheel - 9 inch
22	Spacers	64	Sprocket wheel - 10 inch
23	Gaskets	65	Sprocket wheel - 11 inch
24	Cover plates	66	Sprocket wheel - 12 inch
31	Frame body	71	Hand wheel - 7 inch
32	Clamping devices	72	Hand wheel - 8 inch
41	Top connectors	73	Hand wheel - 9 inch
42	Bottom connectors	74	Hand wheel - 10 inch
51	Shutoff valves	75	Hand wheel - 11 inch
52	Drain valves	76	Hand wheel - 12 inch

## 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.

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## SPECIFICATIONS

## FEDERAL

- FF-S-85 - Screw, Cap, Slotted and Hexagon Head.
- FF-S-86 - Screws, Cap, Socket-Head.
- FF-S-92 - Screw, Machine: Slotted, Cross-Recessed or Hexagon Head.
- FF-S-200 - Setscrews: Hexagon Socket and Spline Socket, Headless.
- FF-W-84 - Washers, Lock (Spring).
- PPP-F-320 - Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.

## MILITARY

- MIL-P-116 - Preservation, Methods of.
- MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements For.
- MIL-S-1222 - Studs, Bolts, Hex Cap Screws, and Nuts.
- MIL-P-17303 - Packing Materials, Plastic Metallic and Plastic Non-Metallic.
- MIL-L-19140 - Lumber and Plywood, Fire Retardant Treated.

## STANDARDS

## FEDERAL

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

## MILITARY

- MIL-STD-22 - Welded Joint Designs.
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
- MIL-STD-271 - Requirements for Nondestructive Testing Methods.
- MIL-STD-278 - Welding and Casting Standard.
- MIL-STD-2073-1 - DoD Material Procedures for Development and Application of Packaging Requirements.

2.1.2 Other Government drawings. The following other Government drawings 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.

## DRAWINGS

## NAVAL SEA SYSTEMS COMMAND (NAVSEA)

- 5000-S5100-841604 - Gage, Boiler Water, 18 IN DIM STD for.
- 803-2177525 - Valve Assemblies 1/4-2 BW, SW900LB.
- 803-5184193 - Valves 1/4 to 2 IN N.P.S., ANSI.

## US NAVY SHIPS PARTS CONTROL CENTER (SPCC)

- 6685-798-5485 - Shield Assembly.

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

2.2 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, INC. (ANSI)

B16.5 - Pipe Flanges and Flanged Fittings. (DoD adopted)

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code Section I - Rules  
for Construction of Pressure Vessels Division I.

(Application for copies should be addressed to the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 105 - Standard Specification for Forgings, Carbon Steel, for Piping Components.
- A 106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service. (DoD adopted)
- A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service. (DoD adopted)
- A 194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service. (DoD adopted)
- A 216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service. (DoD adopted)
- A 217 - Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts, Suitable for High-Temperature Service. (DoD adopted)
- A 276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes. (DoD adopted)
- A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength. (DoD adopted)
- A 352 - Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low Temperature Service.
- A 536 - Standard Specification for Ductile Iron Castings. (DoD adopted)
- B 163 - Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes. (DoD adopted)

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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) - Continued

- B 165 - Standard Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube. (DoD adopted)
- D 351 - Standard Classification for Natural Muscovite Block Mica and Thins Based on Visual Quality. (DoD adopted)
- D 3951 - Standard Practice for Commercial Packaging.
- F 36 - Standard Test Method for Compressibility and Recovery of Gasket Materials. (DoD adopted)

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

(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 4.3 and 6.3).

3.2 Materials. Material used in the construction shall be the lightest practicable consistent with the strength required for safety and reliability and shall meet all the requirements of this specification.

3.2.1 Recovered materials. Unless otherwise specified herein, all equipment 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.

3.3 General construction. The gauge and as-assembled fittings, valves and water connection piping shall conform to the requirements of this specification, and, where applicable, to ASME section I of the Boiler and Pressure Vessel Code. The gauge assembly shall indicate variations in liquid level over the full range as specified (see 3.9.3, 3.12.2, and 3.13.1). The gauge shall withstand frequent blowdown and rapid cut-in and shall provide ample strength for the pressure at which gauge is to operate.

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3.4 Parts. A water gauge shall consist of the following parts:

(a) Gauge frames consisting of:

- (1) Body sections containing water and steam chamber with stem, nipples, or tube assemblies.
- (2) Coverplates.
- (3) Glasses, mica shields, gaskets and glass positioners or spacers, if used.
- (4) Clamping devices.

(b) Top and bottom connectors (if separate from shut-off valves).

(c) Top and bottom shut-off valves.

(d) Drain valves.

3.5 Threaded parts. Minimum commercial standards for threaded parts shall be in accordance with FED-STD-H28.

3.6 Bolts, studs, nuts and screws. Unless otherwise specified (see 6.2.1), lockwashers, bolts, studs, nuts and cap screws shall conform to ASTM A 193, ASTM A 194, ASTM A 307, FF-S-85, FF-S-86, FF-S-92, FF-S-200, FF-W-84, or MIL-S-1222, as applicable. Any of these units that fasten on moving parts or which may be subject to vibration during operation shall be secured by a locking device. Minimum fits shall be UNC2A and 2B for type A. Studs shall be tack-welded to the body on assembly if minimum fits are used.

3.7 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.

3.8 Welding. Joining of steel parts of the frame bodies or valves by welding shall be required for type A gauges, optional for type B. Such welding shall be in accordance with MIL-STD-278. Weld fittings, where used, shall conform to MIL-STD-22.

3.9 Frame.

3.9.1 Frame body construction. Supplemental blowdown or support water columns shall not be used. When more than one section is used in the frame, they shall not be connected in parallel, but shall have single steam and water connections to the top and bottom fittings, respectively. Sections, if used, shall overlap vertically not more than 2 inches nor less than 1-1/2 inches. The glass of the frame bodies shall be held by a removable cover secured by clamping devices sufficient in number to provide a steamwater tight joint against the pressure for which the gauge is to be used (see 3.12.7 and 3.13.3). The cover shall be removable for replacement of glass sets in the insert recesses. Tolerance of overall size of vision opening in the frame and cover shall be plus 1/8 inch, minus 0. Width of vision openings shall be not less than 1/2 inch. Material shall be carbon steel for pressure at least equal to that specified in ASTM A 105 or grade WCB of ASTM A 216.

3.9.2 Rigidity. The frame bodies and coverplates shall be sufficiently rigid to withstand the applicable pressure without dependence on overlapping parts of the covers or on the means of securing the covers to the frame.

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3.9.3 Visibility. The lowest point of the visible portion of the gauge shall be at least 1-1/2 inches above the lower edge of the opening in the bottom fitting to the boiler drum, and the highest point of the visible portion shall be at least 1-1/2 inches below the upper edge of the opening in the top fitting to the boiler drum.

3.9.4 Insert recesses. For type A classes I and II, and for type B gauges, recesses for the glasses in the frame bodies and covers shall not exceed the maximum dimensions of the glass (see 3.12.3.1 and 3.13.1.1) by more than 1/32 inch on the width and 1/16 inch on the length. The minimum width and length of the recesses shall be such that a glass having maximum dimensions as specified herein shall be easily inserted. Chambers or frames and covers for all type A and type B gauges shall be such that if a glass of minimum thickness specified in 3.12.3.1 and 3.13.1.1 as applicable is clamped into place in the gauge without gaskets and mica shields, the clearance between the surfaces of the covers and frame body, parallel to the faces of the glass, shall be not less than 1/16 inch. Joint faces for the glasses in frame bodies and covers shall be finished machined surfaces.

3.9.5 Chamber passage. Steam and water passages of the gauge shall have a clear opening of an area not less than that of a 3/8-inch diameter circle. This passage shall produce a pressure drop of less than 3 inches of water.

3.9.6 Joints. The joints between the glasses and the frame body and between the glasses and the covers shall be fitted with gaskets. Spacers as necessary shall be used to centralize the glass in the body recesses.

3.9.7 Cover plates. Vertical movement of the cover with respect to the frame shall be limited (such that the weight of the cover does not bear on the glass). Stiffening or reinforcing the covers to withstand imposed stresses shall be used, as necessary.

### 3.10 Gauge fittings and valves.

3.10.1 Nipples and gauge connectors. The frame body or bodies of the gauges shall have a minimum of 3/4 inch outside diameter tubular connecting pieces (nipples, tube assemblies, stems) and shall be made of carbon steel at least equal to or better than that used for the frame. The connecting piece shall connect the frame body assembly to the top and bottom flanges. The length of the connecting tubes shall be made to suit the distance between centers of the top and bottom fittings as installed on the boiler. The required ball check feature (see 3.10.4) of the bottom fitting shall be incorporated into a bottom gauge connector or fitting.

3.10.2 Top and bottom shut-off valves. Centers of the top and bottom shut-off valves of the gauges shall be in the same vertical centerline. Each top and bottom fitting shall include a shut-off valve to be manipulated by a chain operating a sprocket wheel. Valves shall not back off or drift open at pressures for which rated. Maximum allowable torque to seat valves under all conditions shall be limited as shown in table II.



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TABLE II. Maximum allowable torque.

Sprocket wheel or hand wheel diameter (Inches)	Equivalent torque Tolerance $\pm 5$ foot-pounds (Foot-pounds)
7	35
8	41
9	48
10	54
11	61
12	68

3.10.2.1 A minimum of 40 feet of chain shall be furnished with each gauge. Plug cocks shall not be acceptable as shut-off valves. Minimum valve size shall be 3/8 inch. Carbon steel valves in accordance with ASTM A 105, or grade WCB of ASTM A 216, shall be acceptable for pressure ratings, body, and bonnet.

3.10.2.2 Seat leakage. Seat leakage not to exceed 10 cubic centimeters ( $\text{cm}^3$ ) per hour per inch of nominal pipe size may be allowed (see 4.8.1.3).

3.10.3 Valve closure. Valves shall close by clockwise rotation of the wheel. Hand-wheels for drain valves shall be ductile iron. Sprocket wheels shall be made of the material specified in 3.12.10(e) or 3.13.8(c), as applicable, and shall be sized so that the torque specified in table II shall open or close the valves under all operating conditions.

3.10.4 Automatic ball check. An automatic ball check feature shall be included in the bottom fitting of the gauge. This ball check may be either furnished as part of the bottom shut-off valve or may be enclosed in the bottom gauge connectors or fittings. The ball check shall be of the solid ball type. Upon breakage of the gauge glass the ball check shall close automatically by vertical lift of the ball, such vertical lift not less than 3/8 inch. The ball shall be not less than 9/16 inch in diameter and the diameter of the circle of contact with the seat shall be not greater than two-thirds of the diameter of the ball. The ball shall be accessible for inspection. A ball check feature shall not be included in the top fitting.

3.10.5 Gland packing and piping gaskets. Gland packing for valve stem stuffing boxes shall be in accordance with class II, type C of MIL-P-17303 (symbol 1108) for pressure through 600 lb/in<sup>2</sup> nominal; class II, type E (symbol 111) packing for pressures 900 lb/in<sup>2</sup> nominal and up. Flange bonnet and piping gaskets within the gauge shall be spiral wound gaskets suitable for the pressures and temperatures specified herein.

3.10.6 Drain valves. Drain valves of the quantity and size as specified, shall be attached to the bottom fitting in such a manner that the gauge glass shall be drained with the shut-off valves open or closed (see 6.2.1). Valves shall conform to Drawings 803-2177525 for class 600 carbon steel and 803-5184193 for class 1500 carbon steel.



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3.11 Flanges. Mounting flanges shall conform to ANSI B16.5. Other flanges used within the gauge assembly shall meet the requirements specified herein.

3.11.1 Flange finishes. Flanges shall be prepared for use with spiral wound gaskets. Flange finishes shall be as follows:

- (a) Gasket contact surfaces of flanges for use with sheet gaskets, if used, shall have concentric or spiral serrations of 63 to 500 roughness height rating (RHR) produced by machining cuts of a minimum of 0.002 inch in depth in the minimum range of 30 serrations per inch of face width. The tips of the serrations shall not exceed 0.010 inch in width.
- (b) Gasket contact surfaces of flanges for use with spiral wound gaskets shall have a finish with a circular lay (concentric or spiral) having a roughness not exceeding 500 RHR produced by machining cuts of 0.003 inch maximum depth with not less than 40 cuts per inch of face width.

### 3.12 Type A.

3.12.1 Configuration. Type A gauges shall consist of frame body-sections, each section having a continuous vision slot viewed through single piece glass insert sets. Color shall not be used.

3.12.2 Visibility and dimensional standards. Unless otherwise specified (see 6.2.1), the gauges shall have a visibility of 18 inches. The gauges shall not use more than two sections.

3.12.3 Glass. Gauge glass shall be heat-resisting, clearly transparent, and shall withstand the minimum test requirements specified in 4.8.3. Glass shall be plain and shall be for use with steam at 1500 lb/in<sup>2</sup> for type A, class I and II and 2500 lb/in<sup>2</sup> for class IV gauges as specified in 1.2. Gauge glass shall be indelibly marked on the side with manufacturer's name and "1500 HP STEAM" or "2500 HP STEAM".

3.12.3.1 Shape and dimensions. Unless otherwise specified (see 6.2.1), 1500 lb/in<sup>2</sup> and 2500 lb/in<sup>2</sup> glass shall be shaped as shown on figure 1 and shall be 1.313 plus 0.035, minus 0.007 inches wide, 0.688 plus 0.000, minus 0.004 inch thick and of the length shown in table III. Both ends shall be rounded to a semicircle of a radius equal to one-half of the width. Glass shall have a bevel  $1/16 \pm 1/32$  inch wide by 45 degrees nominal around entire perimeter of both flat faces, except size 7 (see figure 1). Size 7 shall be furnished with a bevel of nominal size  $1/32$  inch wide by 22 degrees nominal; a minimum polished flat face width of 1.20-inch edges of semicircular ends shall be furnished with 22 or 30 degrees (nominal) by  $1/16 \pm 1/32$  inch wide bevel (see figure 1). There shall be a smooth transition from the 22- to 30-degree bevels. To facilitate removal of the glass from its mold, a draft angle of as much as 1 degree is permitted on the sides (see end view on figure 1). In this case, dimensions shall be measured at the greatest width and length.

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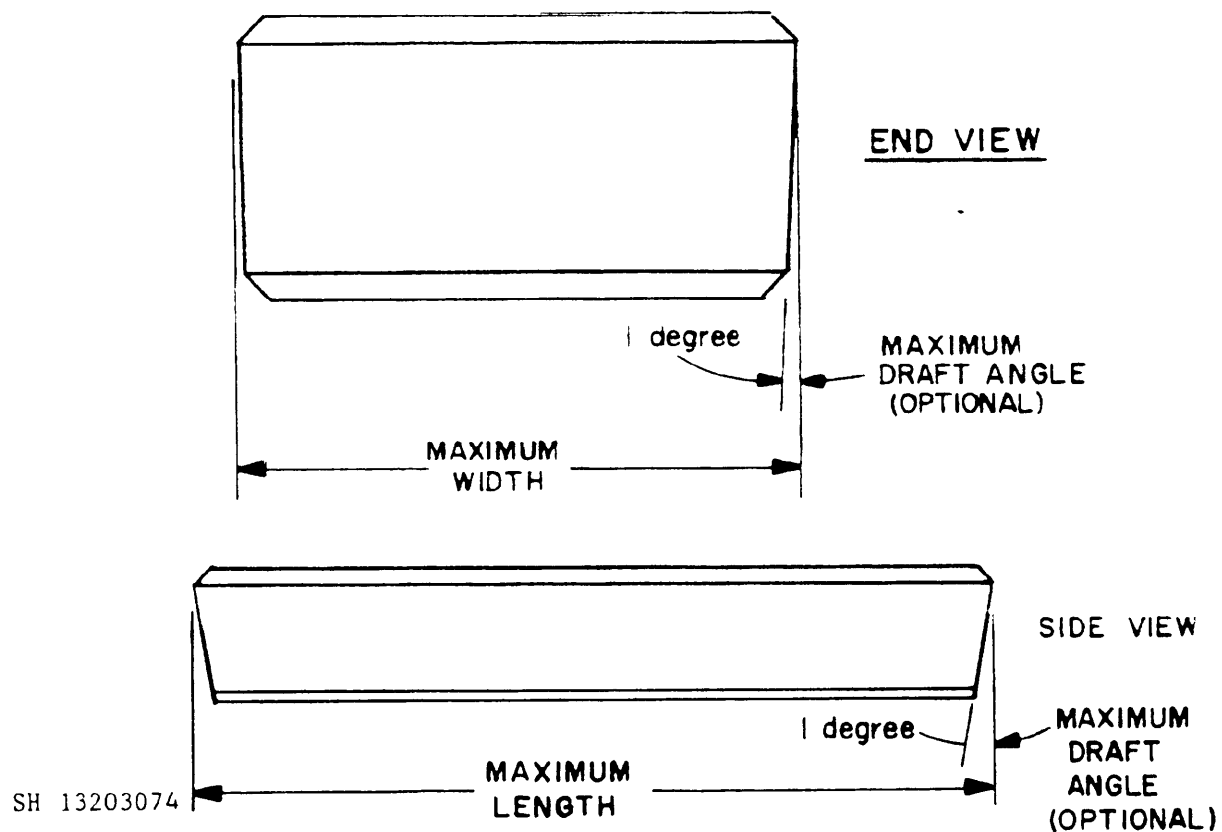
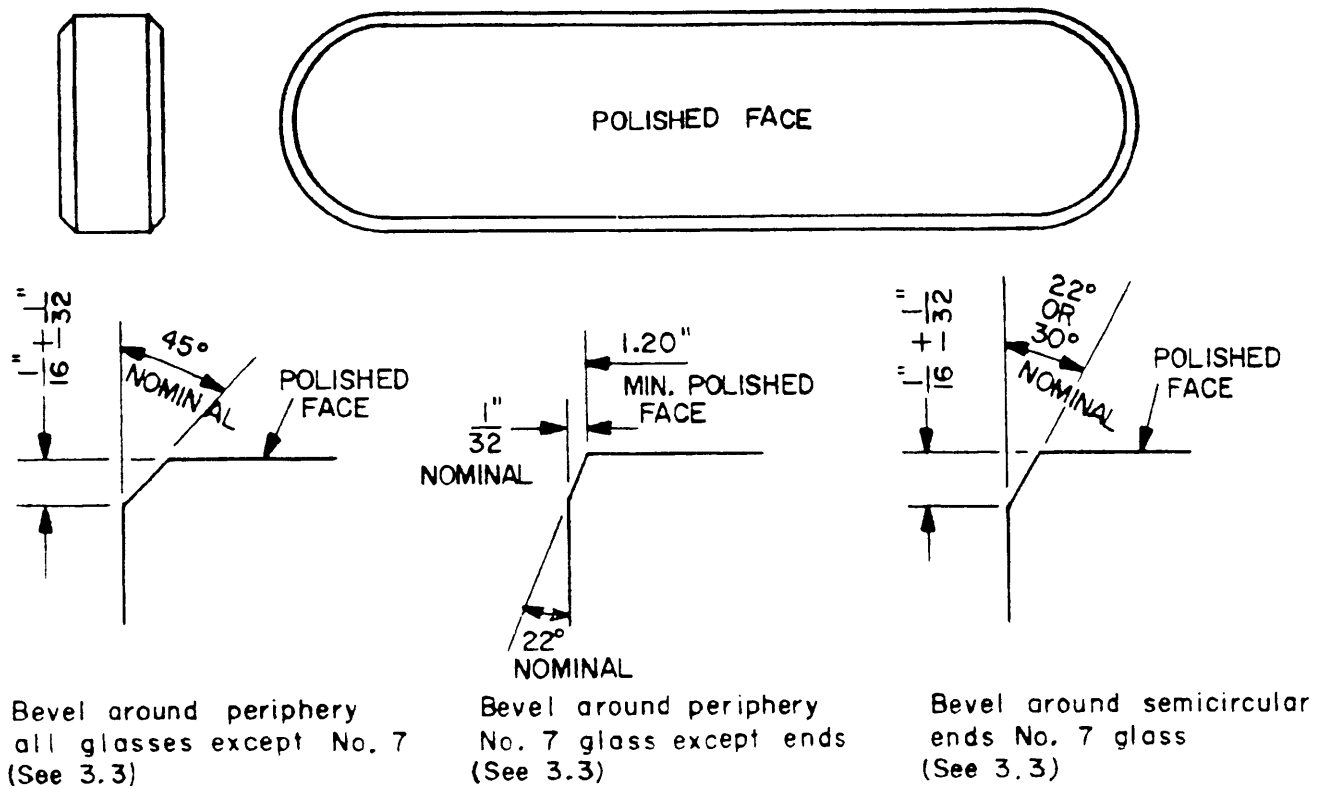


FIGURE 1. Shape and bevel of glasses.

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TABLE III. Sizes (length) of glasses and type I gaskets.

Size number/code	L +0.000 -0.031 (Inches)
0	3-3/4
1	4-1/2
2	5-1/2
3	6-1/2
4	7-1/2
5	8-5/8
6	9-7/8
7	11
8	12-5/8
9	13-3/8

3.12.3.1.1 Glass faces. The front and back faces of the glasses shall be parallel within 0.004 inch.

3.12.3.1.2 Glass uniformity. Glass shall contain no scratches, be uniform in thickness, straight on the sides, free from twist or warp, and shall be free from irregularities which would cause false indication of water level meniscus. The glass shall contain no more than 12 air bubbles (inclusions) over all with a maximum bubble diameter of 0.031 inch, and shall contain no more than six air bubbles within the viewing range of the glass. Air bubbles shall not be located in any pattern as to cause false indication of water level.

3.12.3.2 Thermal shock resistance. Glass shall not crack or spall when tested as specified in 4.8.5.5.

3.12.3.2.1 Fracture resistance. Glass shall be tempered so that only an interlocking type fracture shall occur when tested as specified in 4.8.5.6.

3.12.3.3 Simulative service. Glass shall be smooth and transparent and shall show no erosion of the surfaces after being subjected to the test specified in 4.8.5.7.

#### 3.12.4 Mica shield.

3.12.4.1 Mica quality. Mica shall be visual quality classification V-4, good stained, in accordance with ASTM D 351 or better, except that air inclusions shall be of V-2 quality or better. The mica shields shall be made from natural muscovite clear white, ruby, light green or rum-colored mica. Minimum quality of the mica shall be hard, of uniform color, may contain medium waves, slight crystallographic discoloration and very slight air inclusions in not more than one-fourth of the usable area. Mica shall be completely free from air chains, buckles, ridges, herringbones, cross grains, hairline cracks, tears, sandblast, and holes.

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3.12.4.2 Mica shield shape. Unless otherwise specified (see 6.2.1), a mica shield of the shape shown on figure 1 and of the same width and length as the glass for which intended, shall be furnished for type A gauges. Mica shield thickness shall be composed of either one or two laminations. The mica shield shall vary not more than 0.001 inch in total thickness along the length. The mica shield, as a minimum, shall be 0.009 inch thick whether composed of one or two laminations. In the case of a two-piece shield, the thinner lamination shall be not less than 0.004 inch thick. Mica shield container shall indicate that the thicker lamination shall be placed next to steam and water.

3.12.4.3 Mica shield radius. The radius at the ends of the mica shield shall be accurately die cut and accurately faired into the two parallel sides. Each individual piece of the mica shield shall be free of partial films more than 0.0001 inch thick, and only one partial film shall be permitted in each piece. The complete shield shall have only light visible scratches when hand held at a distance of 6 inches to 1 foot and only very light visible scratches when viewed at a distance of 6 feet. Edge fractures resulting from cutting or splitting shall conform to the following standards:

<u>Applicable thickness of mica shield piece</u>	<u>Extension of edge fractures from edge of piece</u>
0.004 inch to 0.0075 inch	Not greater than 1/16 inch
Greater than 0.0075 inch	Not greater than 1/8 inch average of lot samples with isolated fractures not greater than 1/4 inch

3.12.5.1 Gasket material. Class I and II steam or water side gaskets shall be made from compressed sheet gasket material which forms a resilient product suitable as a seal for the pressure and temperature of the applicable water level gauge. The sheet material shall be uniform throughout as a result of thorough dispersion of the ingredients. The gasket material shall not age at room temperature and shall not cause discoloration of mica. The outer side or cover gasket shall be made up of similar compressed gasket material. Class IV sealing, outer or cover, and spacer gasket material shall be of a quality required to meet the test requirements specified in 4.8.5.9, and Drawing 6685-798-5485.

3.12.5.1.1 Compressibility. Compressibility of the class I and II gasket sheet material shall be not more than 10 percent nor less than 3 percent (see 4.8.5.10).

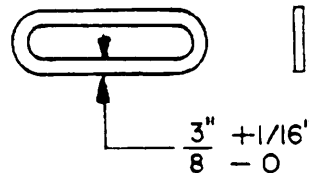
3.12.5.1.2 Recovery. Recovery of the class I and II gasket sheet material shall be not less than 55 percent (see 4.8.5.10).

3.12.5.1.3 Tensile strength. Tensile strength of the class I and II gasket sheet material shall be not less than 2000 pounds force per square inch (lbf/in<sup>2</sup>) perpendicular to the calender grain of the sheet (see 4.8.5.10.1).

3.12.5.1.4 Weight per unit area. Weight per unit area of the class I and II gasket sheet material shall be not less than 9.0 ounces per square foot when thickness is 1/16-inch (see 4.8.5.10.2).

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3.12.5.2 Gasket shape. Unless otherwise specified (see 6.2.1), class I and II shall be furnished with two gaskets, one a steam or water side gasket 1/16 inch thick, and one an outer side or cover gasket and two spacers 1/32 inch by 5/8 inch by 3 inches made of compressed sheet gasket material (see 3.12.5.1). Class I and II gaskets shall be shaped as shown on figure 2. Class IV shall be furnished with two gaskets, one a steam or water side gasket, one an outer side or cover gasket, and spacers as required to conform to gauge frame.



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FIGURE 2. Shape of gasket.

3.12.5.3 Outside dimension and bearing surface of gasket. The outside dimensions of class I and II gaskets shall be the same as those of the glass for which intended. The bearing surface of the gaskets shall be of uniform width and shall be not less than 3/8 inch and not more than 7/16 inch. The bearing surface and dimensions of class IV gaskets shall be in accordance with Drawing 6665-796-3465.

3.12.5.4 Simulative service. When tested as specified in 4.8.5.9, the gaskets shall permit no leakage.

3.12.6 Rotation. For purposes of positioning during installation, the gauge frame shall be rotatable through 360 degrees.

3.12.7 Frame clamping. Individual means of clamping the body and covers shall be used, compensating for slight buckling or other imperfections throughout the body and cover depth. This shall include individual clamps or fingers, spring cone washers, and shouldered cap screws. Spring cone washers shall be at least equal to 17-7 pH corrosion-resisting steel.

3.12.8 Chain guides. Shut-off valves on gauges shall be equipped with sprocket wheels to act as chain guides; provision shall be made to protect the chain guides and to preclude slippage of the chain from the wheel. In addition, for class IV service, chain stops shall be provided as specified in 3.12.9.2.

3.12.9 Gauge fittings.

3.12.9.1 Nipples and connector. The connecting tubes shall be welded into the frame (see 3.10.1). The frame shall be removed from the connectors or valves without removal of the fittings from the boiler to which the gauge is attached. Connectors shall have a minimum of two-hole flanges. The end stem or the end connectors shall be slotted so that the frame may be disengaged from the valves or end connectors without springing the expansion loop. The

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length of the tubular connecting pieces shall suit the distance between centers of the top and bottom fittings as installed on the boiler. Union fittings shall not be permitted. Dimensions shall be in accordance with Drawing 5000-S5100-841604.

3.12.9.2 Shut-off valves. One chain pull of 3 feet shall allow sufficient valve opening for spontaneous gauge action. Top valve shall also include expansion loop to allow movement not to exceed plus or minus 1/8 inch in the valve frame relationship. Shut-off valves shall use single threads. Nominal size shall be 1/2 inch. Failure or leakage of the gauge of 200 pounds per hour or less of saturated steam shall cause the bottom automatic check valve to close. Arrangement of the ball check valves in the gauge assembly shall preclude seating of the balls under pitch and roll conditions up to 60 degrees. The closed bottom check valve shall seal without ball extrusion, seat deformation or leakage of more than 100 cm<sup>3</sup> per hour.

3.12.9.2.1 Valves shall be of the flanged bonnet construction and shall incorporate the following features:

- (a) Bonnet alignment shall be obtained by body guiding, that is, a close tolerance fit between the bonnet and valve body. The bonnet shall not be aligned by means of the bonnet studs.
- (b) Flanged face shall assure proper compression of the flanged gasket when the body and bonnet flanges are drawn up metal-to-metal.

3.12.9.2.2 Outside screw and yoke construction shall be used. Valves shall have a positive backseat.

3.12.9.2.3 Stuffing boxes shall be of ample depth for at least six turns of packing. Stuffing box glands shall be secured and adjusted by a bolting arrangement which by adjustment shall insure tightness of the stuffing box under all operating conditions. The bearing surface between the gland follower and the gland flange shall be spherically finished.

3.12.9.2.4 The disc shall be attached to the stem with a swivel. Seats shall be integral with the body or shall consist of a tubular insert, or seat, welded to the body. Disc and seat shall be hardfaced with Stellite no. 6, Haynes alloy no. 25, or equal. Finished thickness of facing shall be not less than 3/32 inch.

3.12.9.3 Drain valves. Two globe drain valves shall be provided for attachment to the bottom shut-off valve, allowing the gauge glass to be drained with the shut-off valves open or closed. The valve connecting to the piping shall act as a throttling valve and shall be of the stop valve construction. At least one connection on valve attaching to the gauge shall be flanged; interconnection of the two valves need not be flanged.

3.12.9.4 Mounting flanges. Flanges of top and bottom shut-off valves shall be 3/4 inch size. Unless otherwise specified (see 6.2.1), flange pressure rating for type A, class I and II gauges shall be 600 lb/in<sup>2</sup>; for type A, class IV, 1500 lb/in<sup>2</sup>. Drain valve flanges shall also be 3/4 inch size.

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3.12.10 Materials. Minimum material requirements for type A shall be as follows:

- (a) Frame bodies, cover plates, and connector fittings of forged steel, cast steel, steel plate or pipe, shall be of a quality to meet the performance requirements of this specification. Preferred material for class IV gauge is corrosion-resisting steel. Method of plating of gasket-contact surfaces of carbon-steel bodies, if used, shall be by a method that results in crack-free bodies.
- (b) Bolts, studs and nuts for frame covers shall be steel in accordance with MIL-S-1222; or ASTM A 193 and ASTM A 194; cap screws in accordance with FF-S-86.
- (c) Ball checks shall be corrosion-resisting steel in accordance with ASTM A 217 or ASTM A 276, or Haynes Stellite no. 3, or equal.
- (d) Tubular connecting pieces shall be material equal to or better than that used in frame body.
- (e) Valve sprocket wheels shall be ductile iron, forged steel or cast steel.

3.12.11 Illuminators and vision hoods. Gauges shall be furnished complete with high intensity illuminators operating on 110 volts alternating current (ac). Illuminator boxes and vision hoods (if used) shall be easy to remove and to maintain and depth of box shall be held to the minimum possible. Mercury vapor type lamps shall not be permitted. Illuminators and hoods shall not be adversely affected by externally imposed vibrations through 33 hertz (Hz). Illuminators and hoods shall be shockproof (see 4.5.1.1 and 4.5.1.2). Hoods, when used, shall allow a minimum angle of 90 degrees visibility.

### 3.12.12 Shock and vibration.

3.12.12.1 Shock. Gauges shall withstand the test for grade A, type A equipment as specified in MIL-S-901. Gauges shall not be damaged or caused to malfunction by the shock loadings encountered aboard ship such as those resulting from non-contact underwater explosion when tested as specified in 4.5.1.1.

3.12.12.2 Vibration. Gauges shall withstand the type I vibration test in accordance with MIL-STD-167-1 through 33 Hz. Gauges shall not be adversely affected by externally imposed vibrations when tested as specified in 4.5.1.2.

### 3.12.13 Pressure.

3.12.13.1 Class I. Class I gauges shall accommodate a designed pressure to 700 lb/in<sup>2</sup> (600 lb/in<sup>2</sup> nominal). These gauges shall be for installation on boilers up to and including 700 lb/in<sup>2</sup> design pressure.

3.12.13.2 Class II. Class II gauges shall be for designed pressure to 1050 lb/in<sup>2</sup> (900 lb/in<sup>2</sup> nominal). These gauges shall be for installation on boilers between 700 and 1050 lb/in<sup>2</sup> design pressure.



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3.12.13.3 Class IV. Class IV gauges shall be for designed pressure to 2550 lb/in<sup>2</sup> (2500 lb/in<sup>2</sup> nominal). These gauges shall be for installation on 1200 lb/in<sup>2</sup> boilers.

3.12.14 Life. Boiler-water gauge assemblies, except for glass set inserts, shall have a life of 40,000 hours of operation at saturated steam pressures corresponding to applicable boiler design pressure. Glass set inserts shall have a minimum life of 5000 hours operation at saturated steam pressures corresponding to applicable boiler design pressure. Bulbs for illuminators shall operate for a minimum of 2500 hours service.

### 3.13 Type B.

3.13.1 Configuration. The type B gauges shall be furnished with reflex glasses. Sizes and visibility range of gauge glass shall be as specified (see 6.2.1). Shut-off valve with sprocket wheels and chain shall be furnished (see 3.10.2).

3.13.1.1 Reflex glass. The reflex glass shall be made of a heat-resisting glass for use with steam up to 300 lb/in<sup>2</sup> pressure. The steam or water face of the glass shall have molded or cast prismatic serrations extending the full length of the inner or exposed surface of the glass. There shall be ample margin on the inner surface to receive the gasket. The glass shall be 1-5/16 plus 3/64, minus 1/64 inches wide and 11/16 plus 0, minus 1/32 inch thick. Length shall be in accordance with size shown in table II as specified (see 6.2.1). Both ends shall be rounded to a semicircle of a radius equal to one-half of the width. The front and back faces of the glass shall be parallel within 0.010 inch.

3.13.1.2 Gaskets. Two gaskets 1/16 inch thick made of compressed sheet gasket material for 300 lb/in<sup>2</sup> steam or water pressure shall be furnished with each glass. The outside dimensions of the gaskets shall be the same as those of the glass for which they are intended. The bearing surface of the gasket shall have a uniform width of not more than 3/8 inch and not less than 5/16 inch.

3.13.2 Frame. The frame of the gauges shall have 3/4 inch outside diameter tubular connecting pieces. The connecting pieces or tube assembly shall be inserted into the top and bottom valve connections through union fittings. Gauge shall be removed from the valves without removal of the fittings from the boiler. Commercial standard threaded union fittings shall be permitted.

3.13.3 Clamping device. The frame shall be clamped to the cover by U-bolts, the U-bolts extending through the cover and retained by nuts. Means shall be included in the frame or cover to retain the U-bolts in position when the cover is removed.

3.13.4 Valves. Type B gauge valves shall be constructed for 300 lb/in<sup>2</sup>.

3.13.5 Mounting flanges. Flange pressure rating for type B shall be 300 lb/in<sup>2</sup>.

3.13.6 Shock. Gauges shall conform to the type C shock requirement of MIL-S-901 (see 4.5.1.1).

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3.13.7 Vibration. Gauges shall conform to the type I vibration requirement of MIL-STD-167-1 through 25 Hz (see 4.5.1.2).

3.13.8 Materials. Materials for type B gauges shall be as follows:

(a) Frames, covers, tube assemblies and fittings:

- (1) Ductile iron in accordance with grade 60-45-10 of ASTM A 536.
- (2) Forged steel in accordance with ASTM A 105.
- (3) Cast steel in accordance with grade WCB of ASTM A 216 or ASTM A 352.
- (4) Steel pipe in accordance with ASTM A 106.

(b) Tubular connecting pieces:

- (1) Brass.
- (2) Corrosion-resisting steel in accordance with ASTM A 276.
- (3) Nickel-copper-alloy in accordance with ASTM B 163 or ASTM B 165.
- (4) Steel pipe in accordance with ASTM A 106.

(c) Valve sprocket wheels shall be made of ductile iron, cast steel or forged steel.

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

3.15 Designation and marking.

3.15.1 Water level marker. A marker shall be furnished with each gauge labeled "Designed Water Level". The marker shall be complete with simple means of mounting on gauge frame. Markers shall not be required with replacement frames.

3.15.2 Identification plates. Identification plates and other designating markings shall be furnished. Plates shall be installed on and furnished as part of the boiler-water gauge for which they are intended. They shall be attached to a part of the water gauge which shall not ordinarily be removed during the normal service life, and shall be located in a readily accessible position where they can be read at all times without danger to personnel. Data marked on identification plates shall include the following:

- (a) Manufacturer's name, design rating, Federal stock number, manufacturer's contract number, and date of manufacture.
- (b) Blank space for inspector's official stamping.

3.16 Tools. For type A gauges, a kit of tools shall be furnished for each fireroom of the ship for which the gauges are furnished. This kit shall be furnished in a pocketed roll-up kit or in a metal box. One each of all special tools required for assembly or for normal maintenance, repair, and

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adjustment of the gauges shall be furnished. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Services Management Area (DCASMA)).

3.17 Cleaning. Material shall be cleaned so that all surfaces shall be free of corrosion, oil, grease and all other foreign residues. Cleaning shall be accomplished in any manner which will accomplish thorough cleaning without damage to the gauges or gauge parts.

3.18 Workmanship. Gauges shall be uniform, clean, smooth, free of grooves, indentations, cracks, or blisters or any imperfection that might impair serviceability.

#### 4. QUALITY ASSURANCE PROVISIONS

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

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

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

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examinations and tests as specified in 4.5 and 4.7.1.

4.3.1 First article test report. When specified in the contract or order, a first article test report shall be prepared (see 6.2.2).

4.3.1.1 Sample for first article inspection. A sample gauge shall be examined and tested as specified in 4.3 (see 6.3). Replacement glass sets for type A shall be examined and tested as specified in 4.8.5.

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4.3.1.2 Type A gauges. One unit of each class shall be tested at a laboratory having boiler test stand, operating boiler, and shock and vibration testing equipment. Laboratory tests shall include tests specified in 4.5.1.1 through 4.5.1.7.

4.3.1.3 Type B gauge. One type B gauge shall be subjected to first article inspection. First article inspection shall consist of the tests and examinations specified in 4.7.1 and 4.8.

4.3.1.4 In addition to any test stand testing performed by the laboratory, the type A gauge shall be tested by installation on a boiler of the applicable pressure rating for the class being tested. Testing shall include the following:

- (a) Ability of shut-off valves to close within the allowable leakage (see 4.5.1.3 through 4.5.1.5).
- (b) Ability of ball-check to seat automatically within leakage specified (see 4.5.1.6).
- (c) Effectiveness of gauge in indicating boiler-drum water level (see 3.3).
- (d) Gauge operation on operating boiler (see 4.5.1.7).
- (e) Shock and vibration testing of gauge, valves, illuminators and hood, if used (see 4.5.1.1 and 4.5.1.2).

4.3.1.5 Type A glass sets. First article inspection of type A glass sets shall consist of the tests as specified in 4.3.1.2 and in 4.8.5.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests as specified in 4.7 and 4.8.

#### 4.5 First article tests.

##### 4.5.1 Type A gauge.

4.5.1.1 Shock. Type A gauge, complete with valves, illuminators, and vision hoods, if used, shall be subjected to the grade A, type A tests in accordance with MIL-S-901 (see 3.12.12.1). The assembly shall be pressurized and supported in the same manner as it shall be in service. Unless otherwise specified (see 6.2.1), shock test shall not be required for type B gauges.

4.5.1.2 Vibration. Type A gauges complete with valves, illuminators, and vision hoods, if used, shall be tested through 33 Hz in accordance with type I of MIL-STD-167-1 (see 3.12.12.2). The equipment shall be pressurized and supported in the same manner as it shall be in service. Unless otherwise specified (see 6.2.1), vibration test shall not be required for type B gauges.

4.5.1.3 Shut-off and drain valve operation. The valves shall be opened and closed 100 times with saturated steam at design pressure on the inlet side and with the discharge connection arranged to permit flow under conditions simulating the maximum flows through the gauge assembly. The opening and closing shall be made with the valve hot and in cycles; that is, starting with

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the valve open and thoroughly warmed, it shall be closed with a recorded torque, observed for tightness, then re-opened with a recorded torque and the procedure repeated. Packing shall be tight enough to prevent leakage.

4.5.1.4 Shut-off and drain valve securing. Five securing trials shall be made to determine if the valve remains tight during and after cooling, having closed tight with 15 foot-pounds torque while hot. Saturated steam at design pressure shall be applied to the inlet side of the valve. The necessity for taking up on the valve stem to maintain specified seat tightness shall be noted. More than a 5 foot-pound increase in torque required to maintain seat tightness and to re-open shall be cause for rejection.

4.5.1.5 Shut-off and drain valve warming. Five warming trials shall be made to determine the torque required to open the valve after it has been closed tightly when cold.

4.5.1.6 Ball-check steam operation. The ball-check valve shall be closed by the action of escaping saturated steam at design pressure and shall be opened by the force of gravity. The valve shall close at a flow rate of between 200 and 300 pounds per hour of saturated steam at design pressure (see 3.12.9.2). The actual flow rate which the valve closes shall be recorded.

4.5.1.7 Assembled gauge operation (type A). Minimum requirements of operation test shall be as follows. Minimum operation of the gauge shall be 1000 hours:

- (a) Warm gauge at 250 degrees Fahrenheit (°F) per hour to design temperature and pressure with water level maintained at the mid-point of the visible range.
- (b) Every 8 to 12 hours cool gauge to ambient temperature at rate of 250°F per hour; then warm gauge at 250°F per hour to design temperature and pressure.
- (c) Every 50 cycles drop pressure from design pressure to 300 lb/in<sup>2</sup> in 30 seconds maximum and return to design pressure.
- (d) Every 20 operation hours maximum while at design pressure, blow down the gauge assembly through the drain valves.
- (e) Every 200 hours, cool to ambient; isolate and drain gauge, and allow to dry to 48 hours.
- (f) Repeat steps (a) through (e) four additional times.
- (g) Any additional operational procedures deemed necessary shall be demonstrated once in each 200-hour period.
- (h) Boiler and test stand testing shall include 50 warmups and cool downs (see (a) and (b)), 50 pressure changes (see (c)), and 50 blowdowns (see (d)).

Tests (b) and (c) shall be separated by a 6-hour interval.

#### 4.6 Sampling for quality conformance inspection.

4.6.1 Lot. All items of the same type, configuration, class and length (see 1.2) presented for delivery at one time shall be considered a lot.

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4.6.2 Sampling for visual and dimensional examination. A random sample of items shall be selected from each lot for examination of visual and dimensional characteristics in accordance with MIL-STD-105 at inspection level III. These sample items shall be examined as specified in 4.7. The acceptable quality level (AQL) shall be 1.0 percent defective.

4.6.3 Sampling for tests. A random sample of items shall be selected from each lot in accordance with MIL-STD-105 at inspection level III for the tests specified in 4.8. The AQL shall be 1.0 percent defective.

#### 4.7 Quality conformance inspection.

4.7.1 Visual and dimension examination. Each of the sample items selected as specified in 4.6.2 shall be visually and dimensionally examined to verify compliance with all requirements of this specification not involving tests, and for conformance to Drawing 5000-S5100-841604.

4.7.2 Magnetic particle inspection (type A gauges only). Pressure containing alloy forgings shall be 100 percent magnetic particle inspected in accordance with MIL-STD-271. Carbon steel forgings are not to be magnetic particle inspected.

4.8 Tests. Each of the samples selected as specified in 4.6.3 shall be subjected to the following tests:

<u>Test</u>	<u>Reference paragraph</u>
Hydrostatic pressure, valve shell	4.8.1.2
Hydrostatic pressure, assembled valve (for seat tightness)	4.8.1.3
Hydrostatic pressure, ball-check	4.8.2
Type A glass sets, first article and quality conformance	4.8.5
Gasket quality	4.8.5.9
Mica visual quality (type A only)	4.8.5.8
Type B glass sets, quality conformance	4.8.6
Gauge pressure:	
(a) Hydrostatic pressure, or	4.8.3
(b) Steam pressure	4.8.4

#### 4.8.1 Shut-off and drain valve hydrostatic pressure tests.

4.8.1.1 Hydrostatic tests. Each of the sample valves selected as specified in 4.6.3 shall be subjected to the tests specified in 4.8.1.2 for strength and porosity and the tests specified in 4.8.1.3 for tightness. The water temperature shall be 70 to 120°F.

4.8.1.2 Shell test. Valve bodies shall be subjected to the applicable pressures specified in table IV for a duration of 10 minutes. Any weeping, leakage, or permanent deformation shall be cause for rejection.

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TABLE IV. Test pressure for strength and porosity.

ANSI valve ratings (lb/in <sup>2</sup> )	Pressures (lb/in <sup>2</sup> )
300 (type B)	1088
600 (type A, class I and II)	2175
1500 (type A, class IV)	5400

4.8.1.3 Seat tests (tightness). Valves shall be pressurized in the direction tending to open the valve and examined for seat tightness. Test pressures shall be as specified in table V. Duration of test shall be a minimum of 3 minutes. There shall be no visible signs of leakage. Should there be any visible leakage, this test shall be continued for a sufficient length of time to accurately determine the rate of leakage. Leakage shall not exceed the amount specified in 3.10.2.2. The maximum allowable force to seat valves during this test shall be as specified in 3.10.2 and 3.10.3.

TABLE V. Test pressures for seat tightness.

ANSI valve ratings (lb/in <sup>2</sup> )	Pressures (lb/in <sup>2</sup> )
300 (type B)	720
600 (type A, classes I and II)	1440
1500 (type A, class IV)	3600

4.8.2 Hydrostatic test of ball-check. Each automatic ball-check valve selected as specified in 4.6.3 shall be tested for leakage by hydrostatic pressure. Automatic ball-check valves shall seat automatically under the action of escaping water, shall withstand a hydrostatic pressure of one and one-half times the designed pressure with leakage of not more than 100 cm<sup>3</sup> an hour, and shall open automatically upon release of pressure.

4.8.3 Gauge hydrostatic pressure test. Each gauge shall be subjected for at least 1 minute, maximum 10 minutes, with all valves except drain valve open, to a hydrostatic pressure equal to the applicable design pressure as a test of the strength and rigidity of the gauge for the pressure at which it is to be used. Any leakage or distortion shall be considered cause for rejection of the gauge being tested.

4.8.4 Gauge steam pressure test. Each gauge shall be subjected for at least 1 minute, maximum 10 minutes, with all valves except drain valve open, to the applicable design pressure. Any leakage or distortion shall be cause for rejection of the gauge being tested.

4.8.5 Type A glass sets.

4.8.5.1 First article inspection. The first article sample shall be subjected to the first article inspection shown in table VI.



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TABLE VI. First article and quality conformance inspection.

Examination and test	Requirement	Test	First article	Quality conformance
Visual and dimensional examination	3.12.3.1 and 3.12.3.1.2	4.8.5.4	X	X
Thermal shock	3.12.3.2	4.8.5.5	X	X
Fracture	3.12.3.2.1	4.8.5.6	X	X
Simulative service	3.12.3.3 and 3.12.5.4	4.8.5.7	X	
Mica quality	3.12.4.1	4.8.5.8	X	X
Gasket material:				
Compressibility	3.12.5.1.1	4.8.5.10	X	
Recovery	3.12.5.1.2	4.8.5.10	X	
Tensile strength	3.12.5.1.3	4.8.5.10.1	X	
Weight per unit area	3.12.5.1.4	4.8.5.10.2	X	

4.8.5.2 Glass set lot. For purposes of sampling, a lot shall consist of all glass sets of one size and type produced in one plant under essentially the same conditions and offered for delivery at one time. A lot shall not exceed 1000 sets.

4.8.5.3 Glass set sampling. A random sample of glass sets (glasses, gaskets, spacers, and mica shields, as applicable) shall be selected in accordance with MIL-STD-105 at inspection level III (S-3 for thermal shock, fracture and service test). AQL shall equal 1.5 percent defective. Each of the sample sets or units shall be subjected to the quality conformance inspection shown in table VI.

4.8.5.4 Visual and dimensional examination. Each of the sample glasses, gaskets, spacers and mica shields selected as specified in 4.6.2 shall be visually and dimensionally examined to verify compliance with the requirements of this specification not involving tests. Any items in the sample containing one or more visual and dimensional defects shall be rejected, and if the number of defective items in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.8.5.5 Thermal shock test. The glasses shall be placed on edge in a wire rack which has been wrapped with insulation to prevent glass-to-metal contact. The glasses shall be placed in the rack and care taken to ensure no glass-to-glass contact of the samples. The glasses shall be placed in the rack as specified herein and heated in a furnace (preheated to 500 °F) for a period of 25 minutes. The glasses shall then be quickly immersed in a cold water bath maintained at a temperature of  $40 \pm 5^\circ\text{F}$ . The glasses shall then be examined to determine conformance to 3.12.3.2.

4.8.5.6 Fracture test. Glasses shall be mounted in a water gauge frame and impacted with a pointed tool, such as a centerpunch, at the midpoint of the outer face to produce fracture. The glass shall be examined to determine conformance to 3.12.3.2.1.

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4.8.5.7 Simulative service test for glass set. Glass sets (glass, mica and gaskets) shall be installed in the applicable water level gauge frame which shall be mounted on a boiler steam drum or test facility (simulating boiler conditions) and operated at a steam gauge pressure of approximately 1500 lb/in<sup>2</sup>. Class IV glass sets shall be hydrostatically tested to 2500 lb/in<sup>2</sup>. Gauge assembly shall be in accordance with instructions of the gauge manufacturer. Minimum requirements of simulative service test shall be as follows:

- (a) Assembled water level gauge shall be operated continuously for a minimum of 100 hours at design pressure.
- (b) Water level shall be maintained at the visible range centerline.
- (c) Water level gauge shall be blowdown a minimum of five times during each working day in accordance with the following procedure:
  - (1) Open water level gauge drain line stop valve.
  - (2) Shut water level gauge top cut out valve.
  - (3) Crack open water level gauge drain valve and blow down gauge, clearing of all water.
  - (4) Shut water level gauge drain valve.
  - (5) Open water level gauge top cut out valve.
  - (6) Shut water level gauge bottom cut out valve.
  - (7) Crack open water level gauge drain valve and blow down gauge for 20 seconds.
  - (8) Shut water level gauge drain valve.
  - (9) Open water level gauge bottom cut out valve. Ensure water level returns to visible range centerline.
  - (10) Shut water level gauge drain line stop valve.

4.8.5.8 Mica quality test. Visual quality tests in accordance with ASTM D 351 shall be applied to each lot, checking carefully for flaws and surface defects. Air bubbles (inclusions) and waviness rather than stains (discoloration) shall determine mica quality, unless the stains are too dark for clear visibility in the usable (vision) area of the mica shield. Samples shall be measured for compliance with minimum thickness standards of 3.12.4.2. Samples shall be checked for compliance with the film, visible scratch, edge fracture and manufacturing standards specified in 3.12.4.3.

4.8.5.9 Tests for quality of sheet gasket material for classes I and II (to be conducted on sheets prior to cutting of lot gaskets and spacers).

4.8.5.10 Compressibility and recovery. The gasket sheet material shall be tested for compressibility and recovery in accordance with procedure B or F of ASTM F 36 to determine conformance to the requirements specified in 3.12.5.1.1 and 3.12.5.1.2.

4.8.5.10.1 Tensile strength. Three specimens 1/2-inch wide by 6 inches long shall be tested. The specimens shall be cut so that the lengths are perpendicular to the calender grain of the sheet. Specimen thickness shall be determined to the nearest 0.001 inch. The specimens shall be conditioned at 212°F for 1 hour and cooled to room temperature in a desiccator before testing. A 3-inch length of specimen shall be placed between grips of the testing machine. The machine shall be operated at a rate of separation of the grips of

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12 ± 1 inches per hour. Tensile strength shall be determined by dividing the breaking force in pounds by the cross-section of the unstressed area in square inches. The average tensile strength of three specimens shall be determined.

4.8.5.10.2 Weight per unit area. Weight per unit area shall be determined on specimens of 1/16 inch nominal thickness cut to 6 by 6 inches plus or minus 1/32 inch. Each specimen shall be measured for thickness to the nearest 0.001 inch at three locations and the average determined. The specimens shall be heated at 212°F for 1 hour, cooled to room temperature in a desiccator and weighed to the nearest 0.5 gram. Weight per unit area shall be calculated in accordance with the following formula:

$$\text{Weight per unit area (ounces per square foot)} = \frac{4 \times W \times 0.0625}{28.35 \times T}$$

Where:

W = the weight of the specimen in grams.

T = the average specimen thickness in inches.

The average of three specimens shall be determined.

4.8.6 Type B glass sets. Quality conformance inspection shall be performed on the sample selected as specified in 4.8.6.1. This inspection shall include the examination of 4.8.6.2 and the tests of 4.8.6.3.

4.8.6.1 Lot and sampling. For the purpose of sampling, a lot shall consist of all glass sets of one size and type produced in one plant under essentially the same conditions and offered for delivery at one time. A lot shall not exceed 1000 sets. A random sample of glass sets (glass and gaskets) shall be selected in accordance with MIL-STD-105 at inspection level S-2. AQL shall equal 2.5 percent defective.

4.8.6.2 Examination. Each sample selected as specified in 4.8.6.1 shall be examined for compliance with the requirements of this specification. This inspection shall encompass all visual examinations and dimensional measurements.

4.8.6.3 Tests. Each sample selected in accordance with 4.8.6.1 shall be tested to determine conformance to the requirements of this specification. Tests shall be conducted as specified in 4.8.6.3.1 and 4.8.6.3.2.

4.8.6.3.1 Corrosion test. The corrosion test shall be performed as follows: Glass shall be carefully placed in gauges with proper gaskets in the front and back of the glass. Dry saturated steam shall then be allowed to pass through the gauge for a period of 48 hours at a pressure of 275 lb/in<sup>2</sup>. Glass shall show no surface disintegration.

4.8.6.3.2 Spall test. Glasses shall not spall or crack when dropped flatwise into cold water at 48 ± 1°F after heating for 15 minutes at 350 ± 5°F.

4.9 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.

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## 5. PACKAGING

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

### 5.1 General.

#### 5.1.1 Navy fire-retardant requirements.

5.1.1.1 Lumber and plywood. Unless otherwise specified (see 6.2.1), all lumber and plywood including laminated veneer material used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

- Level A and B - Type II - weather resistant.  
Category I - general use.
- Level C - Type I - non-weather resistant.  
Category I - general use.

5.1.1.2 Fiberboard. Fiberboard used in the construction of class-domestic non-weather resistant fiberboard, and cleated fiberboard boxes shall meet the flame spread index and the specific optic density requirements as specified in PPP-F-320 and amendments thereto.

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

#### 5.2.1 Level A.

5.2.1.1 Cleaning and drying. Cleaning and drying of all gauge (see 3.4) surfaces (internally and externally), glass sets, and parts shall be by a process and procedure in accordance with MIL-P-116 which shall ensure removal of corrosion, dirt, grease and other foreign material without damage to the item.

#### 5.2.1.2 Gauges.

5.2.1.2.1 Preservation. Application to chamber inner surfaces of contact type preservation compounds shall not be required. Molybdenum-disulfide coating shall be applied to seating surfaces and frame bolts or studs.

#### 5.2.1.2.2 Unit protection.

5.2.1.2.2.1 Gauges weighing less than 40 pounds. Gauge openings shall be sealed with water-resistant, pressure-sensitive tape. Gauges shall be individually packed in water-resistant folding, set-up, or metal edged paperboard or fiberboard boxes in accordance with the unit container requirements of MIL-STD-2073-1, appendix F, at the contractor's option. Box closure shall be in accordance with the applicable box specification. Gauges shall be supported, blocked, braced or cushioned to prevent damage during handling, shipment, stowage and storage.

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5.2.1.2.2.2 Gauges weighing 40 pounds and over. Gauges shall be disassembled and each frame assembly and each valve individually packed in boxes (see 5.2.1.2.2.1). Detached connecting hardware shall be placed in waterproof envelopes or bags, sealed, and included in the component box. The boxed items, making up one complete gauge, shall then be packed together as a unit in containers for the level of packing specified.

5.2.1.3 Glass sets. One glass, two gaskets (one inner and one outer gasket), two spacers (as applicable) and one mica and one mica shield (consisting of one or two pieces) shall be packed in boxes (see 5.2.1.2.2.1). Mica shields shall be placed in a plastic or kraft paper envelope or bag, reinforced by heavy cardboard on each side of mica, and inserted in the carton or box in a position between the gaskets and the glass.

5.1.2 Gaskets. When ordered separately, two gaskets (one inner and one outer gasket) shall be unit packed in a kraft paper envelope and six envelopes (12 gaskets) shall be packed in a unit container specified in 5.2.1.2.2.1.

5.1.3 Mica shield. When ordered separately, one mica shield (consisting of one or two pieces) shall be unit packaged in a kraft paper envelope or plastic bag, reinforced by heavy cardboard on each side of the mica. Twelve envelopes or bags shall be packed in a unit container specified in 5.2.1.2.2.1.

5.2.2 Level C. Preservation of gauges, glass sets, gaskets and mica shields shall be as specified for level A except that the unit containers specified in 5.2.1.2.2.1 shall be of the domestic or nonweather resistant type, class or variety as applicable.

5.2.3 Commercial. Commercial packaging (cleaning, preservation, cushioning, and the unit pack) shall be in accordance with ASTM D 3951. Unit pack quantities shall be as specified under level A.

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

5.3.1 Levels A, B, and C containers. Materials preserved as specified (see 5.2) shall be packed in shipping containers, for the level of packing specified (see 6.2.1), in accordance with the exterior shipping container tables of MIL-STD-2073-1, appendix C and herein. Unless otherwise specified (see 5.2.1), container selection shall be at the contractor's option. Glass sets shall be packed in units of one dozen or multiples thereof. Packages containing glass shall be separated by fiberboard pads, and lined top, bottom and sides with double wall corrugated fiberboard.

5.3.1.1 Caseliners, closure, and gross weight.

5.3.1.1.1 Caseliners. Unless otherwise specified (see 6.2.1), level A shipping containers shall be provided with waterproof caseliners in accordance with MIL-STD-2073-1.

5.3.1.1.2 Closure. Container closure, reinforcing, or banding shall be in accordance with the applicable container specification or appendix thereto except that weather-resistant fiberboard boxes shall be closed in accordance

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with method V and reinforced with non-metallic or tape banding and domestic fiberboard boxes shall be closed in accordance with method I using pressure sensitive tape.

5.3.1.1.3 Weight. Wood, plywood, and cleated type containers exceeding 200 pounds gross weight shall be modified by the addition of skids in accordance with MIL-STD-2073-1 and the applicable container specification or appendix thereto.

5.3.2 Commercial. Material preserved as specified (see 5.2) shall be packed for shipment in accordance with ASTM D 3951 and herein.

5.3.2.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical handling equipment during shipment, storage, and stowage.

#### 5.4 Marking.

5.4.1 Levels A, B, C, and commercial. In addition to any special marking required (see 6.2.1), interior packs and shipping containers shall be marked including barcoding in accordance with MIL-STD-2073-1, appendix F.

### 6. NOTES

6.1 Intended use. The two types of gauges including replacement glass sets are intended for direct boiler-water reading on US Naval surface ships.

6.1.1 Type A. Type A gauges are for use on main boilers and for some auxiliary boilers.

6.1.2 Type B. Type B reflex gauges are for use on auxiliary boilers.

#### 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 and class required (see 1.2).
- (c) When first article inspection is required (see 3.1).
- (d) When bolts, studs, nuts, and screws are other than specified (see 3.6).
- (e) Quantity and size of drain valves required (see 3.10.6).
- (f) Visibility range required for type A, if other than specified (see 3.12.2).
- (g) Shape and dimensions for type A, if other than specified (see 3.12.3.1).
- (h) When mica shield is not required (see 3.12.4.2).
- (i) When other than two gaskets are required for class I gauges (see 3.12.5.2).
- (j) Pressure rating of mounting flanges for type A gauges, if other than specified (3.12.9.4).



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- (k) Size and visibility range of reflex glass for type B gauges (see 3.13.1 and 3.13.1.1).
- (l) When shock test is required for type B gauges (see 4.5.1.1).
- (m) When vibration test is required for type B gauges (see 4.5.1.2).
- (n) Levels of preservation and packing required (see 5.2, 5.3, and 5.3.1).
- (o) When fire-retardant treated material is not required (see 5.1.1.1).
- (p) When waterproof caseliners are not required (see 5.3.1.1.1).
- (q) Special marking required (see 5.4.1).

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>
3.14	Drawings, engineering and associated lists	DI-E-7031	Level 3
4.3.1	First article inspection report	DI-T-4902	

(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 one unit of each class. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the



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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 Subject term (key word) listing.

Fittings  
Glass  
Liquid level  
Mica shield  
Visibility

6.7 Supersession data. This specification includes the requirements of MIL-G-18498 for class A glass sets using 1500 lb/in<sup>2</sup> glass for 600 lb/in<sup>2</sup> boilers and 2500 lb/in<sup>2</sup> glass for 1200 lb/in<sup>2</sup> boilers. Revision also incorporates requirements of DD-G-491, Glass, Liquid Sight Indicator, Flat (cancelled February 7, 1978) for class B reflex glass sets.

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.

## Custodians:

Army - ME  
Navy - AS

## Preparing activity:

Navy - SH  
(Project 6680-0203)

## Review activities:

Army - ME  
Navy - YD  
DLA - GS

## User activities:

Navy - MC

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**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.

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(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-G-16356D		2. DOCUMENT TITLE GAUGES, BOILER-WATER, DIRECT READING	
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): _____	
b. ADDRESS (Street, City, State, ZIP Code)			
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)	