INCH-POUND
MIL-G-24696B(SH)
AMENDMENT 1
18 February 1998

MILITARY SPECIFICATION

GASKET, SHEET, NON-ASBESTOS

This amendment forms a part of MIL-G-24696B(SH), dated 25 May 1995, and is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

PAGE 5

Add as new paragraphs:

"3.11.2.3 Water exposure (appendix J only). The gasket material shall provide a seal on two standard piping flange assemblies for 100 hours at 1800 lb/in^2 gauge and be maintained at a temperature of 300°F (149°C) during thermal cycles. A minimum cool down time between cycles is 8 hours. Appearance of water or wetting at the fluid boundary formed by the gasket is cause for either rejection of the gasket or retorquing of the flange bolts (see 4.5.9.1).

3.11.2.3.1 Blow-out test. Gasket materials shall be tested according to the blow-out test in appendix J, at 450°F and shall maintain integrity to a limit of 4500 lb/in^2 gauge."

PAGE 6

3.11.4, line 5: Delete "150" and substitute "600".

PAGE 12

4.5.9.1, line 3: Delete "appendices C and E" and substitute "appendices C, E, and J".

Delete 4.5.9.1.1 and substitute:

"4.5.9.1.1 Flange assemblies for steam and water. Both raised-face and flat-faced flanges shall be used in test assemblies. The requirements and configurations for each are described below."

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Add as new paragraphs:

"4.5.9.1.1.1 Raised-faced flange assemblies for steam and water. Four standard flange assemblies are required as test fixtures. The flange assembly described in appendices B and C and shown on figure 1 shall be as follows:

(a) 1-inch carbon steel flange in accordance with ANSI B16.5 class 300.
(b) 8-inch carbon steel flange in accordance with ANSI B16.5 class 300.

The flange assemblies described in appendices B and C shall have face surface finish roughness averages between 150 and 500 microinches.

The flange assemblies described in appendix J shall be as follows:

(a) 8-inch steel flange in accordance with ANSI B16.5 class 2500.
(b) 2-inch steel flange in accordance with ANSI B16.5 class 2500.

The flange assemblies described in appendix J shall have face surface finish roughness average of 125 microinches. Raised face flanges used as test assemblies shall have surfaces serrated with a concentric or phonograph pattern in accordance with ANSI B16.5.

4.5.9.1.1.2 Flat-faced flange assembly for steam and water. The flat-faced flange assembly for steam and water tests shall be as described in appendices D and E."

Add as new paragraph:

"4.5.9.3.2 Flat-faced flange for hydraulic oil. The flat-faced flange assembly for hydraulic oil tests shall be as described in appendix I."

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4.5.9.4.1, line 2: Delete "three" and substitute "five". Line 3: Delete "(appendices D and E)" and substitute "(appendices D, E, and J)".

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6.1, Intended use., lines 2 and 3: Delete “425°F (218°C), and” and substitute “366°F (186°C),”. Line 4: between “(149°C)” and “.” add “and for high pressure water pump casing gaskets up to 1800 lb/in^2 gauge, 300°F (149°C).”

6.2, Acquisition requirements., (d), between “and” and “MIL-G-24696/1A” insert “the associated PIN number of”.

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FIGURE 1, table: Delete and substitute:

Appendix	Flange data (all flanges are ANSI B16.5)				Gasket specimen dimension (inches)		
	Flange size (inches)	Flange face	Class	Assembly vol. 1/ (liters)	Id	Od	Thickness
B, C	1	Raised	300	2.54	1.31	2.88	1/32
B, C	8	Raised	300	20.32	8.62	12.12	1/8
D, E, H	3	Flat	150	4.5	3.50	5.38	1/16
F	1	Raised	150	2.3	1.31	2.88	1/32
F	3	Raised	150	4.5	3.50	5.38	1/16
G	1	Raised	600	2.3	1.31	2.88	1/32
I	3	Flat	600	4.5	3.50	5.38	1/16
J	8	Raised	2500	20.32	6.8	8.8	1/16
J	2	Raised	2500	Min.	2.38	3.63	1/16

1/ Tolerance value is plus or minus 2 percent.

PAGE 28

30.1, Steps., (f), line 4: between “temperature.” and “Since” add “System pressure may fluctuate due to temperature controllers and band heater response time. Accordingly, the test loop may be modified to include an accumulator to stabilize pressure variations.”

PAGE 45 (new)

Add as new appendix:

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APPENDIX J

HIGH PRESSURE TEST

10. SCOPE

10.1 Scope. This appendix describes a high pressure test for determining the performance of gasket materials covered under this specification. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

10.2 Plan. This test procedure places gasket material in test flanges and tests for leakage under high pressure and thermal cycling. A blow-out test is performed to determine the maximum pressure the gasket material can withstand. All candidate gaskets will be subjected to both tests.

10.2.1 High pressure performance test. This test determines whether a 1/16-inch thick gasket material will satisfactorily maintain a seal over a 100 hour test period, while being subjected to thermal and pressure cycles. Water under elevated pressure and temperature (1800 lb/in^2, 300°F) is applied to a test assembly and monitored for leakage over the test period.

10.2.2 Blow-out test. This test determines the maximum pressure that may be applied to a gasket material that has been clamped between two flange plates. Pressure within the test assembly is increased until the gasket material is physically forced away from the flange sealing surfaces. Since pressure and temperature are both factors which contribute to gasket limitations, the blow-out test is conducted as temperatures and pressures above the maximum operating temperatures and pressures. This test is for high pressure pump gaskets that must perform at 1800 lb/in^2 gauge and 300°F, with a reasonable safety margin. The blow-out tests use 1/16 inch thick gasket material which is considered to be a worst-case thickness. The temperature shall be maintained at 450°F and the pressure will be increased incrementally until blow-out occurs or 5000 lb/in^2 gauge is achieved.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

FEDERAL
A-A-59004 - Anti-Galling Compound; Thread Lubricant, Seizing Resistant and CAOH Containing.

(Unless otherwise indicated, copies of the above specifications, standards, and hanbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

20.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the document cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI B1.1 - Screw Threads.

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)
ASTM A 193 - Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service, Standard Specification for.
ASTM A 194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, Standard Specification for.

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

30. FLANGE BOLT, PRE-LOAD CALIBRATION TEST

Fasteners used in the high pressure performance test (2-inch diameter) and the blow-out test (1-inch diameter) require the following calibration prior to installation in the test fixture. This procedure uses calibrated load cells and measured bolt torque values to minimize the variability of flange bolt pre-load conditions. It is intended to be performed once prior to performance and/or blow out testing. Bolt, nut, and washer hardware are arranged and marked in fastener sets that are calibrated to determine the bolt torque required for a specified bolt load.

(a) Use ASTM A 193 grade B7 or B 16 bolts and ASTM A 194 grade 2H-4 or 7 nuts in these procedures. Bolts shall be threaded in accordance with ANSI B1.1, class 2A with 8-pitch thread series. Threads for nuts shall be in accordance with B1.1, 8-UN series, class 2B fit. These fasteners shall be free from nicks, burrs, and general wear. Use hardened steel washers. Hardware shall be uncoated steel. The bolts should be purchased from the same manufacturer's lot. The nuts should also be purchased from a homogeneous lot.
(b) Pair up each nut with a bolt and label each nut and bolt in a pair with the same numeral. Maintain this pairing throughout the tests. Do not over stress fasteners at any time during testing. Use care in the handling and storage of fasteners to avoid damage.

Bolt calibration parameters.

Bolt diameter	Target torque	Target bolt load
1 inch	45 ft-lb	3,648 lb
2 inches	316 ft-lb	12,800 lb

(c) Install the bolt, washers, and nut fastener assembly to be verified in the test fixture as shown on figure 6. Lubricate the bolt threads, the bearing faces of the nuts, and the bearing faces of the washers with material in accordance with A-A-59004. Do not lubricate the bearing face of the bolt head. Label the hardware assembly. The hardware used during the verification test shall remain as an assembly for the blow-out or performance tests.

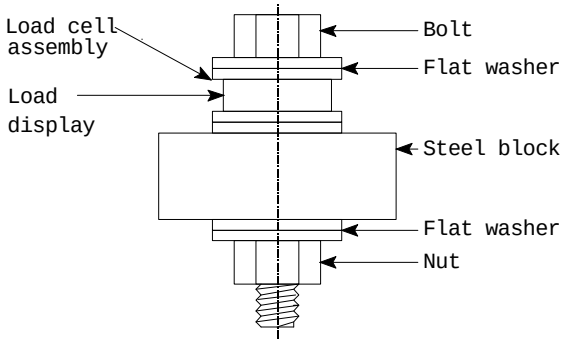

FIGURE 6. Calibration fixture.

(d) Restrain the bolt head from rotation and tighten the nut to the target torque (316 ft-lb or 45 ft-lb).
(e) Loosen the hardware assembly. Wipe off excess lube and relubricate.
(f) Repeat steps (d) and (e) two more times for a total of three torque applications. During the third cycle adjust bolt torque until the load cell indicates the target load (12,800 ± 5% lb or 3,648 ± 5% lb). Record this torque value for use when this specific fastener assembly is used in the gasket test fixture.
(g) Repeat steps (b) through (f) for each bolt, washers, and nut fastener assembly to be used for the test program recording the bolt torque value for each fastener assembly.
(h) If new hardware is required after this initial calibration procedure the new fastener assemblies must be calibrated by repeating steps (b) through (g).

40. HIGH PRESSURE PERFORMANCE TEST

The following steps shall be performed for the high pressure performance test:

40.1 Test apparatus. The test fixture shall consist of two eight-inch ANSI class 2500, raised face pipe flanges with an eight-inch diameter pipe extending between the flanges in sufficient length to meet the volumetric requirements. The flanges shall be in accordance with ASME/ANSI B16.5. The test assembly volume shall be at least 1 liter for every 10 mm of pipe diameter (155 cubic inches for each 1 inch of pipe diameter). The volume of

the 8-inch test assembly shall be at least 20.32 liter (1240 cubic inches). The test fixture shall have heaters (thermostatically controlled) to maintain the temperature at 300 ± 10°F. Flanges are to have a contact surface 1 inch wide, modified to accommodate a 6.8 inch ID and 8.8 inch OD gasket, and with a face surface finish roughness average of 125 microinches.

40.2 Test procedure.

(a) Clean flange surfaces of the eight-inch flanges.
(b) Prepare gasket materials by cutting to ID and OD, 6.8 x 8.8 inches, respectively.
(c) Place gasket materials on stationary flange assemblies.
(d) Place movable flange assemblies in place, ensuring that the gasket materials remain centered.
(e) Use paired bolts and nuts described in section 30, appendix J that have been calibrated in accordance with that procedure. Use SAE grade 5 washers made from plain, uncoated hardened steel.
(f) Lubricate the bolt threads, the bearing faces of the nuts, and the bearing faces of the washers with material in accordance with A-A-59004. Do not lubricate the bearing face of the bolt head.
(g) Use two washers against the moving fastener (the nut), to reduce friction.
(h) Hand tighten nuts.
(i) Restrain the bolt head from rotation and tighten nuts in the sequence shown on figure 7. Use a four step tightening sequence. Apply 25 percent of the final torque value on each nut during each step. The final torque value is determined by section 30 (g), appendix J, the bolt calibration procedure. Wait a minimum of two minutes between each tightening step.

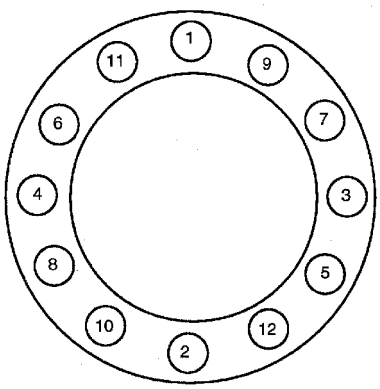

FIGURE 7. Bolt tightening sequence.

(j) Wait a minimum of five minutes after the final step of the tightening sequence, and perform a series of check passes. During each check pass, apply the final torque (from section 30 (g), appendix J). Begin the check pass sequence with position 1, shown on figure 7. Proceed to the adjacent fastener in a clockwise pattern around to position 1, which shall be checked a second time to minimize the effects of stress redistribution among fasteners. Wait a minimum of two minutes, and repeat the check pass described above. Wait a minimum of two minutes, and again repeat the check pass described above. Repeat the check pass process until no bolt-nut movement is noted. Record the number of check passes.

(k) Fill test assembly with fresh water and pressurize to 100 lb/in^2 gauge. Check gasket joints for leakage and adjust bolt torque to stop leakage if necessary. Increase pressure in 300 lb/in^2 gauge increments to 1000 lb/in^2 gauge, checking for and stopping leakage if observed. At 1000 lb/in^2 gauge, place insulating boxes in place and energize heaters. Regulate pressure and temperature until 1800 lb/in^2 gauge and 300°F is obtained. System pressure may fluctuate due to temperature controllers and band heater response time. Accordingly, the test loop may be modified to include an accumulator to stabilize pressure variations. If there is no leakage at 1000 lb/in^2 gauge, leakage is not expected at higher pressure and temperatures. If leakage does occur, adjustments in bolt torque (not to exceed torque values from section 30 (g), appendix J, the bolt calibration procedure), may be performed up to the end of the second thermal cycle. If leakage cannot be stopped, the test should be terminated and the gasket material disqualified from further testing.

(l) The first 30-hour test period begins when the pressure is stabilized at 1800 $\pm$ 50 lb/in^2 gauge, and temperature is at 300 $\pm$ 10°F. At the end of the 30-hour test period, secure the heaters and allow the test fixture to cool for eight hours.

(m) At the end of the eight-hour period, energize the heaters and again establish 1800 lb/in^2 gauge and 300°F. Adjustments to bolt torque (not to exceed torque values from section 30 (g), appendix J, the bolt calibration procedure), to control leakage may be performed if required. Continue the pressure and temperature test for 30 additional hours. At the end of the 30-hour test period secure the heaters and allow the test fixture to cool for eight hours. After the cooling cycle, energize the heaters and continue the pressure and temperature test for 40 hours. No adjustments to bolt torque shall be performed after the second heating cycle. Pressure adjustments to the test fixture should not be required after the second heating period except for minor changes due to atmospheric conditions.

(n) Record any pressure loss greater than 180 lb/in^2 gauge during the test period. Confirm that any pressure loss greater than 180 lb/in^2 gauge is the result of leakage by visual inspection. Any such pressure loss shall be cause to stop the test and will result in disqualification of the gasket material.

(o) Upon completion of the 100-hour test period, record the test fixture pressure, secure the heaters, and allow the test assembly to cool.

(p) After the assembly cools to room temperature, drain the test assembly and remove the flange bolts and movable flange assemblies. Remove the gasket materials and observe adhesion effects and condition of gasket materials.

Note: Alternate thermal cycling periods during testing may be substituted provided the following conditions are met:

(a) Total hot cycle testing must amount to 100 hours.
(b) A minimum of 3 thermal cycles must be used.
(c) Minimum cool down time between cycles is 8 hours.
(d) All other conditions described in 40.2 (l) and (m) must be followed without deviation.

50. BLOW-OUT TESTS

50.1 Test apparatus. The test fixture shall consist of standard two-inch ANSI class 2500, pipe flanges with a face surface finish roughness average of 125 microinches, and with two-inch pipe stubs (capped) extending from the flange assembly in sufficient length to attach band heaters, pressure gauges, and temperature monitors. The two-inch pipe stubs should be of minimum length since the test fixture does not have any specific volume requirements.

A nitrogen flask may be used to pressurize the test fixture. A boost pump may also be required to achieve sufficient pressure to create a blow-out depending upon the fixture volume. Insulation containers may be placed over the test fixture to attain temperature requirements. For safety purposes, a blow out shield or cylinder should be positioned around the test fixture prior to the blow out test.

50.2 Procedure.

(a) Clean surfaces of the two-inch ANSI flange.
(b) Prepare gasket material by cutting to ID and OD, 2.38 x 3.63 inches, respectively.
(c) Place gasket material on bottom flange assembly.
(d) Install the top flange assembly. Ensure that the gasket material remains centered.
(e) Use paired bolts and nuts described in section 30, appendix J, that have been calibrated in accordance with that procedure. Use SAE grade 5 washers made from plain, uncoated hardened steel.
(f) Lubricate the bolt threads, the bearing faces of the nuts, and the bearing faces of the washers with material in accordance with A-A-59004. Do not lubricate the bearing face of the bolt head.
(g) Use two washers against the moving fastener (the nut) to reduce friction.
(h) Hand tighten nuts.

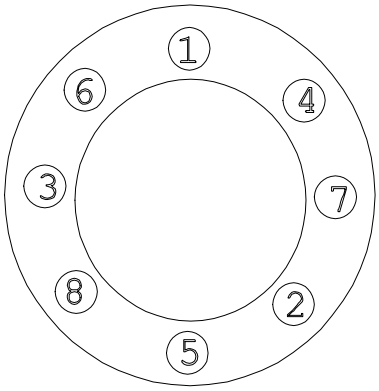

FIGURE 8. Bolt tightening sequence.

(i) Restrain the bolt head from rotation and tighten nuts in the sequence shown on figure 8. Use a four-step tightening sequence. Apply 25 percent of the final torque value on each nut during each step. The final torque value is determined by section 30 (g), appendix J, the bolt calibration procedure. Wait a minimum of two minutes between each tightening step.

(j) Wait a minimum of five minutes after the final step of the tightening sequence, and perform a series of check passes. During each check pass, apply the final torque (from section 30 (g), appendix J). Begin the check pass sequence with position 1, shown on figure 8. Proceed to the adjacent fastener in a clockwise pattern around to position 1, which shall be checked a second time to minimize the effects of stress redistribution among fasteners. Wait a minimum of two minutes, and repeat the check pass described above. Wait a minimum of two minutes, and again repeat the check pass described above. Repeat the check pass process until no bolt-nut movement is noted. Record the number of check passes.

(k) Secure band heaters to the flange assembly and place insulating boxes over the assembly.

(l) Energize band heaters and heat the assembly to 450°F. Maintain this temperature for a period of one hour.

(m) Secure band heaters, remove insulating boxes from the flange assembly. Place blow-out shield around the flange assembly.
(n) Open nitrogen supply valve and monitor assembly pressure until a blow-out occurs or until 5000 lb/in^2 gauge is reached. Do not exceed 5000 lb/in^2 gauge. If necessary, start boost pump to obtain a blow-out or to reach 5000 lb/in^2 gauge.
(o) Record temperature and blow-out pressure or maximum pressure attained."

Preparing activity:
Navy - SH
(Project 5330-1044)