

INCH-POUND

MIL-PRF-2863C(SH)

4 February 2000

SUPERSEDING

MIL-P-2863B(SHIPS)

24 April 1963

PERFORMANCE SPECIFICATION  
PACKING, PREFORMED, CONDENSER TUBE, NON-ASBESTOS

1. SCOPE

1.1 Scope. This specification establishes the requirements for preformed packing assemblies for sealing to tube-to-tubesheet joints in main and air-ejector type steam condensers.

1.2 Classification. Packing grades are as follows, and as specified (see 6.2):

Grade A - Seawater-cooled main-condenser type applications.

Grade B - Freshwater-cooled air-ejector-condenser type applications.

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

2.2.1 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are cited in the solicitation (see 6.2).

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 261 - Protection of Environment: Identification and Listing of  
Hazardous Waste

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 05Q, 2531 Jefferson Davis Highway, Arlington VA 22242-5160 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5330

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**MIL-PRF-2863C(SH)**

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of 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 documents cited in the solicitation (see 6.2).

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 512 - Test Methods for Chloride Ion in Water. (DoD adopted)
- D 516 - Test Methods for Sulfate Ion in Water.
- D 1179 - Test Methods for Fluoride Ion in Water. (DoD adopted)
- D 1246 - Test Method for Iodide and Bromide in Water. (DoD adopted)
- D 4327 - Test Method for Anions in Water by Ion Chromatography.

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

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Qualification. Packing material furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Composition. The packing material and construction shall conform to that of the sample submitted for qualification inspection. Asbestos and polychlorinated biphenyls (PCBs) shall not be used in the packing material. The manufacturer shall certify that no asbestos or PCBs were intentionally included in packing elements, components or coatings.

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

3.3 Sizes.3.3.1 Grade A packing.

3.3.1.1 Metallic rings. Sizes shall conform to those shown in table I, as specified (see 6.2).

TABLE I. Sizes for grade A metallic rings

Inside diameter (in)	Outside diameter (in)	Length (in)
0.625	0.781	0.312
0.750	0.906	0.312
0.875	1.031	0.312
1.000	1.156	0.312

**MIL-PRF-2863C(SH)**

3.3.1.2 Non-metallic rings. Sizes shall conform to those shown in table II, as specified (see 6.2).

TABLE II. Sizes for grade A non-metallic rings.

Inside diameter (in)	Outside diameter (in)	Length (in)
0.625	0.781	0.187
0.750	0.906	0.187
0.875	1.031	0.187
1.000	1.156	0.187

3.3.2 Grade B packing.

3.3.2.1 Metallic rings. Sizes shall conform to those shown in table III, as specified (see 6.2)

TABLE III. Sizes for grade B metallic rings.

Inside diameter (in)	Outside diameter (in)	Length (in)
0.625	0.781	0.187
0.625	0.781	0.250
0.625	0.781	0.375
0.625	0.781	0.406
0.625	0.781	0.437
0.750	0.906	0.250
0.750	0.906	0.375

3.3.2.2 Non-metallic rings. Sizes shall conform to those shown in table IV, as specified (see 6.2). The rings shall be sufficiently resilient to insure flowing into the threads of the stuffing box by light caulking without deformation to the tube ends.

TABLE IV. Sizes for grade B non-metallic rings.

Inside diameter (in)	Outside diameter (in)	Length (in)
0.625	0.781	0.187
0.625	0.781	0.250
0.750	0.906	0.187

3.3.3 Tolerances. A tolerance of minus 0, plus 0.007 inch will be permitted on the inside diameter. A tolerance of plus or minus 0.03 inch will be permitted for outside diameter and length. The inside diameter, outside diameter and length shall be measured to the nearest 0.01 inch.

3.4 Weight. The weight per 1000 rings shall be within 20% of the weight of the sample submitted for qualification. Individual rings weighed during inspection shall be weighed to the nearest 0.0002 pounds (0.1g).

3.5 Resilience of metal rings.

3.5.1 Grade A. The resiliency shall be such that the change in height (compression) of a stack of six rings shall not be less than 0.10 inch or more than 0.20 inch (see 4.4.1).

3.5.2 Grade B. The resiliency shall be such that the change in height (compression) of a stack of six rings shall not be less than 0.02 inch or more than 0.05 inch (see 4.4.1).

**MIL-PRF-2863C(SH)****3.6 Detrimental materials for grade B packing.**

**3.6.1 Halogen concentration.** The sum of high-temperature water-leachable halogens shall not exceed 250 ppm,

or

the total halogen concentration, excluding fluoride, shall not exceed 250 ppm, and the packing manufacturer shall certify in writing that 'the only intentionally added halide-bearing ingredient is polytetrafluoroethylene.' (see 4.4.2).

**3.6.2 Sulfur concentration.** Total sulfur concentration shall not exceed 700 ppm or water-leachable sulfur shall not exceed 250 ppm (see 4.4.2).

**3.6.3 Cadmium concentration.** Total cadmium concentration shall not exceed 250 ppm (see 4.4.2).

**3.6.4 Lead concentration.** Total lead concentration shall not exceed 250 ppm (see 4.4.2).

**3.6.5 Mercury.** During manufacturing, fabrication, handling and packaging, the packing shall not come into contact with mercury or mercury compounds. The manufacturer shall certify that mercury or mercury compounds did not come into contact with the packing or packing elements, components or coatings during manufacture.

**3.7 Simulated performance.** There shall be no leakage through the packing when tested in accordance with 4.4.3. The packing rings shall be sufficiently compressible or malleable so that they may be freely caulked into the tube sheet drilling and seal the pressure without impeding the movement of the tube or cause deformation of the tube.

**3.8 Workmanship.** The workmanship shall meet all requirements of this specification. The rings shall be free from voids, cracks, seams, blisters, tears, burrs and foreign matter that may affect the use of the finished product. The ends of metallic rings shall be finished smooth (see 4.4.4).

**3.9 Toxicity.** The condenser packing shall have no adverse effect on the health of personnel when used for its intended purpose (see 6.6).

**3.10 Disposal.** The manufacturer shall certify that condenser packing shall not contain any hazardous material or exhibit any hazardous characteristic as defined under 40 CFR 261 (Code of Federal Regulations). The manufacturer shall make every effort to adhere to this requirement. If no product which meets this requirement can be identified, (i.e., if condenser packing does contain a hazardous material), the manufacturer shall provide information detailing proper disposal of the packing.

**4. VERIFICATION**

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

- a) Qualification inspection (see 4.2).
- b) Conformance inspection (see 4.3).

**MIL-PRF-2863C(SH)**

4.2 Qualification inspection. Qualification inspection shall consist of the tests specified in table V.

TABLE V. Qualification inspection.

Inspection	Requirement	Test methods
Sizes	3.3	4.4.5
Weight	3.4	4.4.5
Resilience	3.5	4.4.1
Detrimental materials	3.6	4.4.2
Simulated performance	3.7	4.4.3
Visual examination	3.8	4.4.4

4.3 Conformance inspection. Conformance inspection shall consist of the tests specified in table VI.

TABLE VI. Conformance inspection.

Inspection	Requirement	Test Methods
Sizes	3.3	4.4.5
Weight	3.4	4.4.5
Resilience	3.5	4.4.1
Visual Examination	3.8	4.4.4

#### 4.3.1 Sampling for conformance.

4.3.1.1 Lot for purposes of sampling, examination and tests. A lot shall consist of all finished packing of one size, produced in one facility, using the same production processes and materials and being offered for delivery at one time.

4.3.1.2 Sampling for tests. At a minimum, the contractor shall randomly select a sample quantity from each lot of completed packing in accordance with table VII, and test them in accordance with paragraphs 4.4.1 through 4.4.5. If one or more defects are found in any sample, the entire lot shall be rejected. The contractor has the option of screening 100% of the lot for the defective characteristic(s) or providing a new lot that shall be inspected in accordance with the sampling plan contained herein.

TABLE VII. - Sampling for tests.

Lot size	Sample size
2 to 25	3
25 to 50	5
51 to 90	6
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1,201	15
1,201 to 3,200	18
3,201 to 10,000	22
10,001 to 35,000	29

4.3.1.3 Rejection. Samples tested as specified in 4.2 and 4.3, which fail to meet the requirements specified herein, shall be cause for rejection. If the failure occurred during qualification testing additional samples shall be taken from each subsequent lot and shall withstand the test wherein the failure occurred. The additional testing shall be discontinued after four successive lots have passed the test or tests.

**MIL-PRF-2863C(SH)****4.4 Tests.**

**4.4.1 Resilience of metal rings.** Six packing rings shall be placed on a close-fitting metal rod mounted on a supporting base. The height of the stack of six rings (designated H1) shall be measured. A weight of 70 pounds shall be placed on the top of the stack for a period of five minutes and the height (designated H2) again measured. H2 is measured prior to removal of the 70-lb weight and shall be measured within 30 seconds of the end of the five-minute period. Record the following measurements and calculation:

- 1) H1
- 2) H2
- 3)  $H1 - H2 = \text{absolute compression}$

**4.4.2 Detrimental materials for grade B packing rings.****4.4.2.1 Halogen content 500°F leach test.**

- a) Two packing material test specimens shall be taken. Each test specimen shall weigh not less than 15 grams and shall be taken from a different sample. The test specimen of packing material shall be representative of the sample cross section.
- b) The test specimens shall be cut into pieces not larger than 1/8 by 1/4 inch.
- c) Each test specimen shall be weighed, transferred to a pressure vessel (that is, Parr bomb or equivalent) covered with 200 to 300 mL of distilled or demineralized water and maintained at approximately 500°F (260°C) for a minimum of 6 hours. The leach water shall then be separated by filtration and the filter rinsed. A blank determination shall be run using similarly cleaned equipment and distilled or demineralized water from the same source.
- d) The constitution of bromide, chloride and fluoride ions in each filtrate shall be determined by the blank determination and ASTM D 1246, ASTM D 512 and ASTM D 1179 respectively or ASTM D 4327. NAVSEA approval to use equivalent analysis methods is not required but should be highlighted in the test information.
- e) The results of each test shall be calculated as net ppm of extractable halide ion by weight of the test specimen.

**4.4.2.2 Sulfur concentration.** Any standard test method, such as ASTM D 516 or ASTM D 4327, may be used to determine total sulfur concentration. The following 500°F-leach test shall be used to determine water-leachable sulfur concentration:

- a) Cut two specimens from the selected sample, weighing approximately 20 grams, record their weight to 0.1 gram and identify them as specimens A and B. This identification shall be maintained through the test.
- b) Each test specimen shall be transferred to a suitable pressure vessel (Parr reaction vessel, or equivalent), covered with enough distilled water to obtain a final volume of 500 ml and heated at  $500^{\circ} \pm 10^{\circ}\text{F}$  for a minimum of 6 hours. The leach water shall then be separated by filtration and the filter rinsed. A control filtrate shall be run using similarly cleaned equipment and distilled water from the same source.
- c) Using aliquots from the control filtrate and filtrates A and B, the concentration of sulfur ions in each filtrate shall be determined by an appropriate method of ASTM D 516 or by an equivalent method. The

**MIL-PRF-2863C(SH)**

concentration of water-leachable sulfur in the material shall be determined as follows:

Sulfur  $\mu\text{g/g}$  (ppm) = C multiplied by 500/M

where:

C = sulfur concentration of filtrate, in milligrams per liter; and

M = grams of test specimen, prepared per a) above.

4.4.2.3 Cadmium and lead concentration. Any standard test method may be used to determine total cadmium and lead concentration (suggested: use oxygen combustion bomb digestions for metal analysis; analyze digestates of cadmium and lead by direct aspiration atomic absorption spectroscopy).

#### 4.4.3 Simulated performance.

4.4.3.1 Test fixture. Simulated performance tests shall be conducted in an apparatus consisting of two 1.25-inch thick brass tube sheets bolted to the flanged ends of an 11-inch length of 8-inch pipe. Each tube sheet shall contain six stuffing boxes drilled 0.75 inch deep and tapped for 0.625-inch condenser tubes. Ferrules are to be 0.625 inch long with 18 threads per inch. Copper nickel alloy tubes of 0.049-inch wall thickness shall be used in the test. Thermocouples shall be located in the center of each tube sheet and inside the pipe. In the event that sustained leakage occurs, provisions shall be made to collect leakage water from the joints for volumetric measurements.

4.4.3.1.1 Test samples. Only packing assemblies that have been tested per paragraphs 3.3, 3.4 and 3.5 of this procedure shall be used for simulated performance tests. Each packing assembly and its location in the test fixture shall be recorded. This will allow identification of a particular packing assembly's physical characteristics in the event that there is leakage.

4.4.3.1.2 Grade A. The six tubes shall be packed with four rings at each end. The four-ring installation shall consist of two metallic and two non-metallic rings. Screw ferrules shall not be used. The order of installation shall be: first a non-metallic ring installed at the bottom of the stuffing box followed by a metallic ring, then the second non-metallic ring and the second metallic ring last.

4.4.3.1.3 Grade B. The six tubes shall be packed with three rings at each end. The three-ring installation shall consist of two metal rings and one non-metallic ring. The order of installation shall be: first a metallic ring installed at the bottom of the stuffing box followed by the second metallic ring and last, the non-metallic ring installed next to the screw ferrules. Ferrules are to be 0.625 inch long with 18 threads per inch.

4.4.3.2 Conditions. The performance of the packing in maintaining watertight tube-sheet end stuffing boxes shall be determined under the following successive conditions:

- a) Water at 10 psi and 70°F for half an hour for initial tightness.
- b) Water at 50 psi, 200°F for grade A and 300 psi, 200°F for grade B maintained for 5 hours.
- c) Condenser tubes moved ten times alternately forward and backward 1/8 inch while condition b) is maintained. Tube movement is accomplished by light blows of a one-pound hammer on a guide pin inserted in the end of the tube.
- d) Condenser drained and vented for two weeks.

**MIL-PRF-2863C(SH)**

- e) Twenty cycles of thermal and pressure shocks caused by sudden changes of the circulating water from 10 psi and 70°F to 30 psi and 200°F. Tube movement is not conducted between each cycle. Prior to changing from one condition to another, the following criteria shall be met: the test fixture shall remain at a temperature/pressure condition for 1 hour or until the tube sheets stabilize at temperature for 20 minutes, whichever is longer. Record which criteria is limiting.

4.4.4 Visual examination. Packing materials shall be visually examined for the workmanship attributes specified in 3.8.

4.4.5 Tolerance and weight measurements. Tolerance measurements on the inside diameter, outside diameter and length shall be accomplished using a calibrated dial or digital caliper having a precision of at least 0.001 inch. Weight measurements shall be accomplished using a calibrated balance having a precision of at least 0.00002 pounds (0.01g).

4.5 Toxicity. To determine conformance with the requirements of 3.9, the material shall be evaluated via a Health Hazard Risk Assessment (HHRA) performed at the Navy Environmental Health Center (NEHC) (see 3.9, 6.2 and 6.6).

## 5. PACKAGING

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

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Grade A rings are intended for use for packing steam condenser tube header boxes in main-condenser type applications which utilize seawater coolant. Grade B rings are intended for use for packing steam air-ejector-condenser type stuffing boxes where freshwater coolant is used.

6.2 Acquisition requirements. Acquisition documents are required to specify the following:

- a) Title, number and date of this specification.
- b) Issue of DoDISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2 and 2.3).
- c) Grade required (see 1.2).
- d) Size of metallic and non-metallic rings required (see 3.3).
- e) Inspection conditions, if other than as specified (see 4.1).
- f) Number and composition of rings required (see 6.7).
- g) Packaging requirements (see 5.1).
- h) Material safety data sheet requirements (see 6.4).
- i) Part or identifying number (see 6.5).
- j) Toxicity conformance (see 4.5 and 6.6).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List No. 2863 whether or not such products have actually been so listed by that date. The attention of the

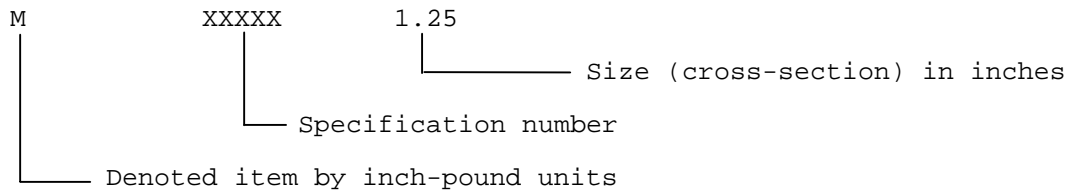


**MIL-PRF-2863C(SH)**

contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Naval Sea Systems Command, SEA 05Q, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160.

6.4 Material safety data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets (MSDS) prepared in accordance with FED-STD-313. In order to obtain the MSDS, FAR clause 52.223-3 must be in the contract.

6.5 Part or identifying number (PIN). The PIN is a definitive part number formed by selecting from the requirement options available in the specification as follows:



6.6 Toxicity evaluation. Questions concerning toxicity and requests for Health Hazard Risk Assessments (HHRA) should be addressed to Commanding Officer, Navy Environmental Health Center, 2150 Walmer Avenue, Norfolk, Virginia 23513-2617. Attention: C. I. H. / NEHC-34. NEHC requires sufficient information to permit toxicological evaluation of the product. At a minimum, the information should include approximate percentages by weight of each ingredient in the product, identification of its pyrolysis products, and any other information as may be needed to permit an accurate appraisal of toxicity problems associated with the handling, storage, application, use, removal, disposal or combustion of the product. Upon receipt of the HHRA performed by NEHC, a copy should be provided to Commander, Naval Sea Systems Command, SEA 05M, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160.

6.7 Past formulations. Grade A packing assembly has traditionally consisted of alternating non-metallic rings (vulcanized cotton fiber) and metallic (lead) rings with a total of four rings. Grade B packing assembly has traditionally consisted of two metallic (copper) rings and one non-metallic (Teflon coated fiber) ring.

6.8 Subject term (key word) listing.

Condenser tube packing

Custodian:  
Navy - SH

Preparing activity:  
Navy - SH  
(Project 5330-N169)

Review activities:  
Navy - AS  
DLA - IS

**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL****INSTRUCTIONS**

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4,5,6, and 7 and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of 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.

**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER

2. DOCUMENT DATE (YYYYMMDD)

3. DOCUMENT TITLE

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include Zip Code)*d. TELEPHONE *(Include Area Code)*

(1) Commercial

(2) DSN

*(if applicable)*7. DATE SUBMITTED  
(YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME

b. TELEPHONE *(Include Area Code)*

(1) Commercial

(2) DSN

c. ADDRESS *(Include Zip Code)*

Commander, Naval Sea Systems Command  
ATTN: SEA 05Q, 2531 Jefferson Davis Hwy  
Arlington, VA 22242-5160

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