

INCH-POUND

MIL-PRF-2818D

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SUPERSEDING

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9 April 1992

PERFORMANCE SPECIFICATION

INSULATION BLANKET, THERMAL

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for a metal mesh reinforced thermal insulation blanket.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 cited in the solicitation or contract.

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navsea.navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1623 - Fire Performance Requirements and Approved Specifications for Interior Finish Materials and Furnishings (Naval Shipboard Use).

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 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 of these documents are those cited in the solicitation or contract.

BUREAU OF MEDICINE AND SURGERY (BUMED)

BUMED INST 6270.8 - Procedures for Obtaining Health Hazard Assessments Pertaining to Operational Use of a Hazardous Material.

(Copies of this document are available online at <https://bumed.med.navy.mil> or from Bureau of Medicine and Surgery, Department of the Navy, 2300 E Street, NW, Washington, DC 20372-5300.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

S9510-AB-ATM-010 Rev 2 of 30 July 1992 - Nuclear Powered Submarine Atmosphere Control Manual.

(Copies of this document are available from the Naval Sea Systems Command, Code SEA 05Z9, 1333 Isaac Hull Avenue, SE, Stop 5133, Washington Navy Yard DC 20376-5133.)

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 these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

- C 167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations. (DoD adopted)
- C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus. (DoD adopted)
- C 411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation. (DoD adopted)
- C 447 - Standard Practice for Estimating the Maximum Use Temperature of Thermal Insulations.
- C 592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type). (DoD adopted)
- C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing. (DoD adopted)
- C 892 - Standard Specification for High-Temperature Fiber Blanket Thermal Insulation.

(Copies of these documents are available from www.astm.org or ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

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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, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Material. The thermal insulation blanket material when specified (see 6.2), shall be secured between metallic supporting members. The insulation material shall contain neither asbestos nor ceramic (refractory) fiber.

3.3 Physical requirements. The insulation material shall conform to the physical requirements specified in Table I.

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

TABLE I. Physical requirements.

Characteristic	Requirement	Test Method
Non-fibrous material (shot content) percent by weight, max.	20	4.5.1
Alkalinity percent, max.	0.6	4.5.2
Corrosiveness to steel, copper, and aluminum	No corrosion greater than that observed with sterile cotton	4.5.3
Binder content, percent, max.	1.5	4.5.4
Density lb/ft ³ (without supporting metal facings)	8-12	4.5.5
Thermal conductivity (K) Max. Btu in/hr. sq. ft. degree Fahrenheit at a mean temperature of		4.5.6
200°F	0.31	
400°F	0.44	
600°F	0.60	
Moisture absorption, percent, max.	1.25	4.5.7

3.4 Dimensions. The length, width and thickness of the insulation blanket shall be as specified (see 6.2). The tolerances shall be plus 1/4 inch and minus 1/8 inch for thickness, plus or minus 1/2 inch for length and plus or minus 1/4 inch for width.

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3.5 Supporting members. The supporting members shall consist of stainless steel wire mesh on both sides of the insulations or wire mesh on one side and metal lath on the other side or without supporting members, as specified (see 6.2 and 6.9)

3.6 Resistance to vibration. The insulation blanket shall not, after heating/vibration, lose more than 15.0 percent in mass, nor sag an average of more than 3 inches (see 4.5.8). There shall be no detrimental affect to the overall physical characteristics of the blanket when comparing to a control specimen. For example, bolts cutting through the insulation material which cause large quantities of fiber or insulation blanket pieces to drop off the test stand holder during or after the test is unacceptable.

3.7 Fire resistance. The insulation material without supporting members shall meet the requirements of MIL-STD-1623 (see 4.5.9).

3.8 Maximum exothermic temperature rise. The insulation blanket mid-point temperature shall not exceed the hot surface temperature by more than 100°F when tested in accordance with ASTM C 411 and the hot surface performance section of ASTM C 447 at the insulation's maximum use temperature and at the manufacturer's maximum recommended thickness for that temperature. The 100°F criterion applies during heat-up as well as steady state conditions (see 4.5.10).

3.9 Toxicity. When evaluated in accordance with 4.5.11, the insulation blanket material shall have no adverse effect on the health of personnel when used for its intended purpose and shall not cause any environmental problems during waste disposal (see 4.5.11 and 6.6).

3.10 Off-gassing. The insulation blanket shall meet the requirements in the Nuclear Powered Submarine Atmosphere Control Manual, NAVSEA Technical Manual S9510-AB-ATM-010 Rev 2, for a usage category of Limited (see 4.5.12 and 6.7).

4. VERIFICATION

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

- a. First article inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.1.1 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the test conditions specified herein.

4.2 First article inspection. First article inspection shall consist of the tests specified in Table II (see 6.3). Unless otherwise specified (see 6.2), if more than one thickness of insulation blanket is acquired at any one time, one blanket of each thickness shall constitute the first article sample.

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TABLE II. First article inspection.

Inspection	Requirement	Test method
Non-fibrous material (shot content)	3.3	4.5.1
Alkalinity	3.3	4.5.2
Corrosiveness to steel, copper, and aluminum	3.3	4.5.3
Binder content	3.3	4.5.4
Dimensions	3.4	4.5.5
Density	3.3	4.5.5
Thermal conductivity	3.3	4.5.6
Moisture absorption	3.3	4.5.7
Resistance to vibration	3.6	4.5.8
Fire resistance ^{1/}	3.7	4.5.9
Maximum exothermic temperature rise	3.8	4.5.10
Toxicity	3.9	4.5.11
Off-gassing ^{1/}	3.10	4.5.12

^{1/} Shall be performed when specified (see 6.2).

4.3 Conformance inspection. Conformance inspection shall be in accordance with Table III. The fire resistance, thermal conductivity, resistance to vibration and maximum exothermic temperature rise conformance tests only need to be conducted for one of the following reasons:

- a. If within 1 year prior to the last test approval date the material has not been tested and found in compliance with section 3 and Table I (as applicable) or
- b. If the material being offered for delivery is not manufactured the same in all respects as that previously tested.

TABLE III. Conformance inspection.

Inspection	Requirement	Test method
Non-fibrous material (shot content)	3.3	4.5.1
Binder content	3.3	4.5.4
Dimension	3.4	4.5.5
Density	3.3	4.5.5
Thermal conductivity ^{1/}	3.3	4.5.6
Resistance to vibration ^{1/}	3.6	4.5.8
Fire resistance ^{1/}	3.7	4.5.9
Maximum exothermic temperature rise ^{1/}	3.8	4.5.10

^{1/} Shall be performed when specified (see 6.2).

4.3.1 Testing of the end item. When required by contract or purchase order (see 6.2), conformance testing specified in 4.5 shall be conducted in accordance with Table IV.

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TABLE IV. Sampling for examination and test.

Lot size	Sample size	Accept	Reject ^{1/2/3/}
2 - 15	2	0	1
16 - 25	3	0	1
26 - 90	5	0	1
91 - 150	6	0	1
151 - 280	7	0	1
281 - 500	9	0	1
501 - 1200	11	0	1
1201 - 3200	13	0	1
3201 - over	15	0	1

^{1/} All defective items must be replaced with acceptable items prior to lot acceptance.

^{2/} Inspect sample size until reject criteria is reached. If reject criteria is reached, reject entire lot.

^{3/} Reject lots may be screened and resubmitted for inspection and test.

4.3.2 Noncompliance. If any of the material tested fails to meet the requirements of Table III, the contractor shall notify the contracting activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered by the inspection activity to be subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action has been taken, inspections shall be repeated on additional units (all tests and examinations, or the test which the original unit failed at the option of the contracting activity). Final acceptance and shipment shall be withheld until inspections have shown that the corrective action was successful. In the event of failure after re-inspection, information concerning the failure shall be furnished to the cognizant inspection activity and the contracting activity.

4.3.3 Certification. The material shall meet the requirements for fire resistance, thermal conductivity, resistance to vibration and maximum exothermic temperature rise. A certificate of compliance is not acceptable in place of a first article test for resistance to vibration, thermal conductivity, and maximum exothermic temperature rise but may be acceptable for the fire resistance test (see 6.3).

4.4 Examination. When required by contractor or purchase order (see 6.2), blankets selected in accordance with the sampling guidance provided in 4.3.1 shall be surface examined and measured to determine conformance to the requirements of this specification which do not require tests. Defects shall be as described in Table V. Any blanket selected for examination which contains one or more visual or dimensional defects shall not be offered for delivery.

TABLE V. Defects.

Jagged ends of mesh wire, tie wire, or expanded metal.
Length not as specified (3.4).
Width not as specified (3.4).
Thickness not as specified (3.4).
Spacing of tie wires not as specified (3.5).
Tie wires not securely attached.
Mesh wires not properly spaced.
Expanded metal broken.
Supporting members not specified.

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4.5 Test methods.

4.5.1 Non-fibrous material (shot content). The non-fibrous material (shot) content shall be tested as specified in ASTM C 892, Annex 2.

4.5.2 Alkalinity. The alkalinity test shall be performed as follows: Weigh a 5 + 0.01 gram representative sample of the insulation material, and introduce into a 500 milliliter (mL) Pyrex Erlenmeyer flask. Wet with 5 mL of 95 percent ethyl alcohol and add 400 mL of distilled water. Reflux for 4 hours plus or minus 5 minutes. At the end of this period, disconnect the condenser and filter at once through a no. 41 Whatman paper, or its equivalent, supported in a Buechner funnel and connected to a suction source. Wash the flask and residual material three times with 25 mL portions of hot distilled water. Titrate the combined filtrate and wash solution immediately with 0.02N H₂SO₄ using 6 to 8 drops of a 1 percent solution of phenol red indicator to the disappearance of the pink color. Run a blank determination on the same amount of distilled water and alcohol and substitute the titration value in the formula below:

$$\text{Percentage alkalinity as Na}_2\text{O} = \frac{(A-B)N \times 0.031 \times 100}{W}$$

Where:

A - mL H₂SO₄ required to titrate total sample

B - mL H₂SO₄ required to titrate blank

N - Normality of the H₂SO₄

W - Weight of the samples in grams

A representative sample may be prepared by taking borings with a large cork borer through the cross section of the insulation.

4.5.3 Corrosiveness to steel, copper, and aluminum. The insulation shall be tested in accordance with the corrosiveness method of ASTM C 665.

4.5.4 Binder content. The binder content of each sample tested shall be determined by heating not less than 1/2 square foot of insulation material separated into small pieces to approximately 800 degrees Fahrenheit (F°) for 3 hours in an oven vented in such a manner as to ensure complete circulation of the atmosphere of the entire oven chamber, preferably by fan or other forced circulation methods. The weight before and after heating shall be taken under atmospheric conditions of the same relative humidity.

4.5.5 Dimensions and density. The dimensions and density of the insulation shall be determined in accordance with the method specified in ASTM C 167.

4.5.6 Thermal conductivity. Thermal conductivity shall be determined in accordance with the method specified in ASTM C 177.

4.5.7 Moisture absorption. A 3-1/2 by 3-1/2 by 3 inch specimen of the insulation material component shall be weighed and then subjected to an atmosphere of 90 + 3 percent humidity at 120 + 3°F for 6 hours. The specimen shall be weighted immediately upon removal from the test chamber and the percent moisture absorbed shall be determined.

4.5.8 Resistance to vibration. Vibration resistance shall be conducted in accordance with the test method in the Supplementary Requirements Section of ASTM C 592.

4.5.9 Fire resistance. Fire resistance shall be conducted in accordance with the test method in MIL-STD-1623.

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4.5.10 Maximum exothermic temperature rise. Maximum exothermic temperature rise shall be tested in accordance with ASTM C 411 and the hot surface performance section of ASTM C 447 at the insulation's maximum use temperature and at the manufacturer's maximum recommended thickness for that temperature. The test surface shall be at the intended surface temperature when the test begins.

4.5.11 Toxicity. The insulation blanket material shall be evaluated by the Navy Environmental Health Center (NAVENVIRHLTHCEN) using the administrative Health Hazard Assessment (HHA). A flowchart for this process can be found as enclosure (1) of BUMEDINST 6270.8. The HHA is a review of the insulation blanket material based on information submitted by the manufacturer, to assess health hazards associated with the handling, application, use and removal of the product. Sufficient data to permit a HHA of the product shall be provided by the manufacturer/distributor to the NAVENVIRHLTHCEN. To obtain current technical information requirements specified by the NAVENVIRHLTHCEN, see 6.6.

4.5.12 Off-gassing. The insulation blanket shall be tested in accordance with the Nuclear Powered Submarine Atmosphere Control Manual, NAVSEA Technical Manual S9510-AB-ATM-010 Rev 2, by a Government approved testing facility. The results shall be submitted to the Government for evaluation and approval for use (see 3.10 and 6.7).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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. The insulation blanket covered by this specification is intended for use for insulation of hot surfaces of machinery, boilers and equipment at temperatures up to 1200°F.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. When a first article sample is required (see 3.1).
- c. When material should be secured between metallic supporting members (see 3.2 and 3.5).
- d. Length, width, and thickness required (see 3.4).
- e. Whether metal-mesh on both sides, metal-mesh on one side and expanded metal lath on the other side or whether no supporting members are required (see 3.5).
- f. Inspection conditions, if other than as specified (see 4.1.1 and 4.3).
- g. First article inspection, if other than as specified (see 4.2).
- h. Lot size, if other than as specified (see 4.3.1 and 4.4).
- i. Whether thermal conductivity, resistance to vibration, fire resistance and maximum exothermic temperature rise tests should be performed (see Tables II and III as applicable).
- j. When conformance examination and testing are required (see 4.4 and 4.5).
- k. Packaging requirements (see 5.1).
- l. Is Material safety data sheet required? (see 6.4).
- m. Toxicity conformance (see 3.9 and 6.6).

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n. Is off-gas testing required? (see 3.10 and 6.7).

6.3 Fire testing. Contractors are advised to review USCG 164.009 fire test requirements to determine whether their insulation product (manufactured in accordance with MIL-PRF-2818) automatically meets the criteria for non-combustibility without conducting prior fire tests, in which case only certification is required.

6.4 Material safety data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets 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 Lot acceptance and rejection criteria. If one or more defects are found in any sample (see 4.3.1), the entire lot should be rejected. The contractor has the option of screening 100 percent of the lot for the defective characteristic(s), or providing a new lot which should be inspected in accordance with the sampling plan herein.

6.6 Toxicity evaluation. The NAVENVIRHLTHCEN requires sufficient information to permit a HHA of the product. Any questions concerning toxicity, information required to conduct a HHA, and requests for a HHA should be addressed to the Commanding Officer, Navy Environmental Health Center, ATTN: Hazardous Materials Department, Industrial Hygiene Directorate, 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 20378-2103. Upon receipt of the HHA, a copy should be provided to Commander, Naval Sea Systems Command, ATTN: SEA 05M3, 1333 Isaac Hull Ave., SE, Stop 5133, Washington Navy Yard, DC 20376-5133.

6.7 Off-gassing. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the atmosphere and results in health hazards to personnel or deleterious effects on machinery. These controls are accomplished through the Submarine Material Control Program, which is described in the Nuclear Powered Submarine Atmosphere Control Manual, NAVSEA Technical Manual S9510-AB-ATM-010 Rev. 2. Under the Submarine Material Control Program, all materials considered for use on submarines require certification and assignment of a usage category. Under the certification process, candidate materials are selected by Navy activities or contractors, and a request for certification is submitted to Commander, Naval Sea Systems Command, ATTN: SEA 05Z9, 1333 Isaac Hull Ave., SE, Stop 5122, Washington Navy Yard DC 20376-5122. The certification request is accompanied by detailed information, including descriptions of the material. A chemical analysis is conducted, which is normally accomplished through off-gas testing. The off-gas test is required to be conducted in a Government approved laboratory designated by the preparing activity. Information pertaining to this test requirement may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05Z9, 1333 Isaac Hull Ave., SE, Stop 5160, Washington Navy Yard, DC 20376-5160. Based on the chemical analysis results, a usage category is assigned to the material defining whether, and to what extent, the material may be used on submarines.

6.8 Certification. Consideration should be given to including certificates of compliance with each shipment of insulation. Certificates should indicate successful completion of the individual tests of conformance inspection.

6.9 Supporting members. Examples of supporting member configurations are as follows:
20 gauge 1-inch 304 or 316 series stainless steel wire mesh approximately 1 inch hexagonal shaped on both sides of the insulation or wire mesh on one side and expanded metal lath (copper containing, not galvanized) having diamond shaped openings on the other side. When secured between supporting members, the supporting members is attached to each other by wires spaced 6-3/4 to 7-1/4 inches apart passing vertically through the blanket and should include rows within 2 inches from all edges of the blanket.

6.10 Subject term (key word) listing.

Boiler insulation
Machinery insulation
Metal-mesh

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6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes

Custodians:

Army - CR4
Navy - SH

Preparing activity:

Navy - SH
(Project 5640-0014)

Reviewer:

Navy - YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.