

INCH-POUND

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SUPERSEDING

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## 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 covers metal-wire mesh reinforced thermal insulation blankets.

### 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 that they must meet all specified requirements of documents cited in sections 3 and 4 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.

#### DEPARTMENT OF DEFENSE STANDARDS

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

(Copies of this document are available online at <http://quicksearch.dla.mil/>.)

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.

#### NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9510-AB-ATM-010 - Nuclear Powered Submarine Atmosphere Control Manual

(Copies of the chapter titled "Material Control Program" are available by email request to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil).)

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@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 <https://assist.dla.mil>.

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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

ASTM C167	-	Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
ASTM C177	-	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C411	-	Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
ASTM C447	-	Standard Practice for Estimating the Maximum Use Temperature of Thermal Insulations
ASTM C592	-	Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C665	-	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C892	-	Standard Specification for High-Temperature Fiber Blanket Thermal Insulation
ASTM C1139	-	Standard Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board for Military Applications

(Copies of these documents are available online at [www.astm.org](http://www.astm.org).)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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. When specified (see 6.2), the thermal insulation blanket material 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, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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.

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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 <sup>3</sup> (without supporting metal facings)	8 - 12	4.5.5
Thermal conductivity, max. Btu in/hr sq. ft. degrees Fahrenheit at a mean temperature of 200 °F 400 °F 600 °F	0.31 0.44 0.60	4.5.6
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 ¼ inch and minus ⅛ inch for thickness, ±½ inch for length, and ±¼ inch for width.

3.5 Supporting members. The supporting members shall consist of stainless steel metal-wire mesh on both sides of the insulations, metal-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 effect 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 for insulating blankets in 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 C411 and the hot surface performance section of ASTM C447 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 Workmanship. The insulation blanket shall be free of defects such as jagged ends of metal-wire mesh, tie wire, or expanded metal; tie wires not properly spaced; tie wires not securely attached; metal-wire mesh not properly spaced; broken expanded metal; and supporting members not specified.

3.10 Toxicity. When evaluated in accordance with 4.5.11 (the Health Hazard Assessment [HHA]), the insulation blanket shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.5.11 and 6.6).

3.11 Off-gassing. The insulation blanket shall be evaluated for off-gassing in accordance with the requirements of 4.5.12. Based on the circumstances of use and the chemical nature of the subject of document, the Navy will determine whether off gas testing is required or if an administrative assessment is acceptable. In order to be considered acceptable for use in submarines, the subject of document shall be assigned to either the "Permitted" or "Limited" category (see 4.5.12 and 6.7).

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## 4. VERIFICATION

4.1 Classification of inspections. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the test conditions specified herein. The inspection requirements specified herein are classified as follows:

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

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.

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	3.7	4.5.9
Maximum exothermic temperature rise	3.8	4.5.10
Toxicity	3.10	4.5.11
Off-gassing <sup>1/</sup>	3.11	4.5.12
NOTE: <sup>1/</sup> Shall be performed when specified (see 6.2).		

4.3 Conformance inspection. Conformance inspection shall be in accordance with [table III](#) and the examination of 4.4.

4.3.1 Exception. The thermal conductivity, resistance to vibration, fire resistance, 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.

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TABLE III. Conformance inspection.

<b>Inspection</b>	<b>Requirement</b>	<b>Test Method</b>
Non-fibrous material (shot content)	3.3	4.5.1
Binder content	3.3	4.5.4
Dimensions	3.4	4.5.5
Density	3.3	4.5.5
Thermal conductivity <sup>1/</sup>	3.3	4.5.6
Resistance to vibration <sup>1/</sup>	3.6	4.5.8
Fire resistance	3.7	4.5.9
Maximum exothermic temperature rise <sup>1/</sup>	3.8	4.5.10
NOTE: <sup>1/</sup> Shall be performed when specified (see 6.2).		

4.3.2 Testing of the end item. When specified (see 6.2), conformance testing specified in 4.5 shall be conducted in accordance with [table IV](#).

TABLE IV. Sampling for examination and test.

<b>Lot Size</b>	<b>Sample Size</b>
2 - 15	2
16 - 25	3
26 - 90	5
91 - 150	6
151 - 280	7
281 - 500	9
501 - 1,200	11
1,201 - 3,200	13
3,201 - over	15
NOTE: 1. Rejected lots may be screened and resubmitted for inspection and test.	

4.4 Examination. When specified (see 6.2), blankets selected in accordance with the sampling guidance provided in 4.3.2 shall be surface examined (see 3.5 and 3.9) and measured (see 3.4) to determine conformance to the requirements of this specification. Any blanket selected for examination that contains one or more visual or dimensional defects shall not be offered for delivery.

#### 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 C892.

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4.5.2 Alkalinity. The alkalinity test shall be performed as follows: Weigh a  $5 \pm 0.01$ -gram representative sample of the insulation material and place in a 500-milliliter (mL) Pyrex Erlenmeyer flask, or equal. Wet the sample with 5 mL of 95 percent ethyl alcohol and add 400 mL of distilled water. Reflux for 4 hours  $\pm 5$  minutes. At the end of this period, disconnect the condenser and immediately filter through a no. 41 Whatman paper, or equal, 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 0.02 N sulfuric acid ( $\text{H}_2\text{SO}_4$ ), 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:

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

Where:

A – mL  $\text{H}_2\text{SO}_4$  required to titrate total sample

B – mL  $\text{H}_2\text{SO}_4$  required to titrate blank

N – Normality of the  $\text{H}_2\text{SO}_4$

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 specified in ASTM C665.

4.5.4 Binder content. The insulation shall be tested in accordance with the binder content method specified in ASTM C1139.

4.5.5 Dimensions and density. The dimensions and density of the insulation shall be determined in accordance with the method specified in ASTM C167.

4.5.6 Thermal conductivity. Thermal conductivity shall be determined in accordance with the method specified in ASTM C177.

4.5.7 Moisture absorption. A  $3\frac{1}{2}$ - by  $3\frac{1}{2}$ - by 3-inch specimen of the insulation material component shall be weighed and then subjected to an atmosphere of  $90 \pm 3$  percent humidity at  $120 \pm 3$  °F for 6 hours. The specimen shall be weighed 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 C592.

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

4.5.10 Maximum exothermic temperature rise. The maximum exothermic temperature rise shall be tested in accordance with ASTM C411 and the hot surface performance section of ASTM C447 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. An HHA will be conducted to ensure conformance to 3.10, as specified (see 6.2). The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the insulation blanket using data provided by the manufacturer/distributor to the NMCPHC (see 3.10 and 6.6).

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4.5.12 Off-gassing. The insulation blanket shall be evaluated for off-gassing in accordance with S9510-AB-ATM-010 chapter titled “Material Control Program” (see 3.11 and 6.7). If the Navy determines that off gas testing is required, testing shall be conducted at a NAVSEA approved test facility (see 3.11). The Navy will review the off gas test results and assign a usage category. Additionally, the Navy will assign a usage category if an administrative review is conducted in lieu of off gas testing (see 3.11).

## 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 insulation of hot surfaces of machinery, boilers, and equipment at temperatures up to 1,200 °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-wire mesh on both sides, metal-wire mesh on one side and expanded metal lath on the other side, or no supporting members are required (see 3.5).
- f. Requirements for an HHA (see 3.10 and 4.5.11).
- h. Inspection conditions, if other than as specified (see 4.1 and 4.3.1).
- i. First article inspection, if other than as specified (see 4.2).
- j. Whether thermal conductivity, resistance to vibration, and maximum exothermic temperature rise tests should be performed (see [tables II](#) and [III](#), as applicable).
- k. Lot size, if other than as specified (see 4.3.2 and 4.4).
- l. When conformance examination and testing are required (see 4.4 and 4.5).
- m. Packaging requirements (see 5.1).
- n. Whether Material Safety Data Sheets are required (see 6.4).

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. When specified (see 6.2), contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets (MSDSs) 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 4.3.2), 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.

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6.6 Toxicity evaluation. The NMCPHC requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation. The HHA process is described on the NMCPHC's website, <http://www.med.navy.mil/sites/nmcphc/industrial-hygiene/Pages/health-hazard-assessment.aspx>.

6.7 Material certification. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the submarine's atmosphere and can result in health hazards to personnel or deleterious effects on machinery. These controls are administered through the Submarine Material Control Program, which is described in the Nuclear Powered Submarine Atmosphere Control Manual, S9510-AB-ATM-010 chapter titled "Material Control Program." 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 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil). The certification request is accompanied by detailed information, including descriptions of the material, method of application, usage, and storage. A chemical analysis is conducted, which can be accomplished through off gas testing. If off gas testing is required, it must be conducted in a Government approved laboratory. Information pertaining to this test requirement may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil). 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 metal-wire mesh, approximately 1-inch hexagonal shaped on both sides of the insulation, or metal-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 are attached to each other by wires spaced 6¾ to 7¼ 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.

Insulation, boiler

Insulation, machinery

Metal mesh

Wire mesh

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 5640-2014-001)

Reviewer:  
Navy – YD

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