

**INCH-POUND**  
MIL-PRF-2819G  
17 November 2004  
SUPERSEDING  
MIL-PRF-2819F  
7 October 1975

## PERFORMANCE SPECIFICATION

### INSULATION BLOCK, 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 thermal insulation block for use on machinery and equipment at surface temperatures up to the limits for the classes specified.

1.2 Classification. Thermal block insulation is of the following classes, as specified (see 6.2).

Class 2 - Temperatures up to 1,200 degrees Fahrenheit (°F)

Class 3 - Temperatures up to 1,500°F.

#### 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.

#### DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-2861 - Cement, Insulation, High Temperature.

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](mailto: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 <http://assist.daps.dla.mil>.

## DEPARTMENT OF DEFENSE STANDARDS

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

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or [dodssp.daps.dla.mil](http://dodssp.daps.dla.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 165 - Standard Method for Measuring Compressive Properties of 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 203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation. (DoD adopted)
- C 303 - Standard Test Method for Dimensions and Density of Preformed Block and Broad-Type Thermal Insulation. (DoD adopted)
- C 356 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat. (DoD adopted)
- C 411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation. (DoD adopted)
- C 421 - Standard Test Method for Tumbling Friability of Preformed Block-Type Thermal Insulation. (DoD adopted)
- C 449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement. (DoD adopted)

(Copies of these documents are available from [www.astm.org](http://www.astm.org) or ASTM International, 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, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 Qualification. The insulation block 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 Material. The insulation block shall be composed of asbestos-free, heat-resisting compounds suitable for the temperature conditions and the purpose intended (see 6.1 and 6.9)

3.2.1 Prohibited fibers. Neither asbestos nor ceramic (refractory) fibers nor materials containing any of these fibers shall be used in the insulation.

#### 3.3 Dimensions and tolerances.

3.3.1 Dimensions. Insulation shall be furnished in block form in 18-inch length by 3-inch width or 36-inch length by 6- or 12-inch width as specified (see 4.4.2 and 6.2). Blocks shall be furnished in thicknesses of 1, 1-1/2, 2, 2-1/2, 3, 3-1/2, 4, 4-1/2 or 5 inches as specified (see 4.4.2 and 6.2).

3.3.2 Tolerances. A tolerance of plus or minus 1/8 inch in length and plus or minus 1/16 inch in width and thicknesses will be permitted (see 4.4.2).

3.4 Physical requirements. The insulation block shall conform to the physical requirements specified in Table I.

TABLE I. Physical requirements.

Properties	Class 2	Class 3
Density, lb/ft <sup>3</sup> , maximum	15.0	15.0
Compressive strength, at not more than 5 percent deformation, minimum lb/in <sup>2</sup>	60.0	60.0
Weight loss by tumbling, loss in weight, percent maximum:		
After first 10 minutes	20.0	20.0
After second 10 minutes	40.0	40.0
Flexural strength, lb/in <sup>2</sup>	1/	1/
Change under soaking heat (6 hours at 1200°F for class 2 and 1500°F for class 3) linear shrinkage	See 4.4.8	See 4.4.8
Linear shrinkage, percent, maximum	2.0	2.0
Thermal conductivity, Btu-in/hr ft <sup>2</sup> °F maximum, at a mean temperature of:		
200°F	0.42	0.42
300°F	0.45	0.47
400°F	0.50	0.52
500°F	0.60	0.57
600°F	0.65	0.63
700°F	0.70	0.69
800°F	----	0.76
900°F	----	0.87

1/ Three times density (pounds per cubic foot)(lb/ft<sup>3</sup>) of the sample tested.

3.5 Simulative Performance. Thermal block insulation shall not warp, crack or show other visible changes upon completion of the test specified in 4.4.10. Minor surface cracks that do not propagate more than 1/4-inch internally from the hot face surface of the insulation shall be disregarded.

3.6 Fire resistance and smoke density. The insulation material shall conform to fire resistance and smoke density requirements in accordance with MIL-STD-1623 (see 4.4.11).

3.7 Compatibility. The insulation shall be compatible with thermal cement conforming to ASTM C 449 and with high temperature thermal insulating cement conforming to MIL-C-2861. Without the application of a primer, the cements shall readily adhere to the insulation segments and form a smooth, protective surface. Drying time for each cement after application shall be not greater than 2 hours (see 4.4.12).

3.8 Appearance and workmanship. The insulation shall be free of defects in appearance and workmanship (see 4.4.3).

3.9 Toxicity. When evaluated in accordance with 4.4.13, the insulation 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 4.4.13 and 6.7).

3.10 Off-gassing. The insulation material shall meet the requirements in the Nuclear Powered Submarine Atmosphere Control Manual, NAVSEA Technical Manual S9510-AB-ATM-010 Rev 2 of 30 July 1992, for a usage category of Limited (see 4.4.14 and 6.8).

3.11 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.

#### 4. VERIFICATION

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

- a. Qualification 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 Qualification inspection. Qualification inspection shall consist of the examination and tests listed in Table II. Qualification tests shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command.

TABLE II. Qualification inspection.

Inspection	Requirement	Test method
Material	3.2, 3.2.1	Certification and visual
Dimensions	3.3.1, 3.3.2	4.4.2
Density	3.4	4.4.4
Thermal conductivity	3.4	4.4.9
Weight loss by tumbling	3.4	4.4.6
Flexural strength	3.4	4.4.7
Changes under soaking heat (6 hours at 1200°F for class 2 and 1500°F for class 3) linear shrinkage	3.4	4.4.8
Compressive strength at 5 percent deformation (min) (lbs/in <sup>2</sup> )	3.4	4.4.5
Simulative performance	3.5	4.4.10
Fire resistance and smoke density	3.6	4.4.11
Compatibility	3.7	4.4.12
Appearance and workmanship	3.8	4.4.3
Toxicity	3.9	4.4.13
Off-gassing	3.10	4.4.14

4.2.1 Sampling for qualification tests. For each class of thermal block insulation, three samples shall be tested for the tests specified in 4.4.2, 4.4.3, 4.4.4, 4.4.5, and 4.4.6, and 4.4.7 and two samples shall be tested for the tests specified in 4.4.8, 4.4.10, and 4.4.11. One sample shall be tested for the tests specified in 4.4.9, 4.4.12, 4.4.13 and 4.4.14. The average test results shall be within the limits specified in Table I and the individual test results shall not exceed these limits by more than 10 percent.

4.3 Conformance inspection. Conformance inspection shall consist of the examinations and test as specified in Table III (see 6.9).

TABLE III. Conformance inspection.

Inspection	Requirement	Test method
Material	3.2, 3.2.1	Certification and visual
Dimensions	3.3.1, 3.3.2	4.4.2
Density	3.4	4.4.4
Compressive strength	3.4	4.4.5
Weight loss by tumbling	3.4	4.4.6
Flexural strength	3.4	4.4.7
Changes under soaking heat (6 hours at 1200°F for class 2 and 1500°F for class 3) linear shrinkage	3.4	4.4.8
Appearance and workmanship	3.8	4.4.3

4.3.1 Lot. For purposes of inspection sampling, a lot is defined as all block insulation the same class, thickness and size produced in the same facility, under essentially the same conditions and from the same materials.

4.3.2 Sampling for conformance inspection. As a minimum, the contractor shall select a sample quantity of insulation sections from each lot as specified in Table IV and subject the sample sections to the examinations and tests as specified in Table III (see 6.6).

TABLE IV. Sampling for conformance inspection.

Lot size	Sample size
2 to 25	3
26 to 50	5
51 to 90	6
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1200	15
1201 to 3200	18
3201 to 10000	22
10001 and over	29

#### 4.4 Test methods.

4.4.1 Conditioning of samples. Test specimens shall be conditioned by drying to constant weight in an oven at a temperature of 215°F to 250°F preceding a test.

4.4.2 Dimensions. Length, width and thickness shall be measured in accordance with ASTM C 303. (see 3.3.1).

4.4.3 Appearance and workmanship. The insulation block shall be examined to determine that none of the following defects exist (see 3.8):

- a. Cracked or broken blocks.
- b. Edges not plane.
- c. Excessive voids.
- d. Warping.
- e. Form not as required.

4.4.4 Density. The density shall be determined in accordance with ASTM C 303.

4.4.5 Compressive strength. The compressive strength shall be determined in accordance with ASTM C 165.

4.4.6 Weight loss by tumbling. Weight loss by tumbling shall be determined in accordance with ASTM C 421.

4.4.7 Flexural strength. The flexural strength shall be determined in accordance with ASTM C 203.

4.4.8 Physical changes under soaking heat (linear shrinkage). Specimens shall be measured, placed in an electrically heated oven, and subjected to the maximum temperature for the respective class for 6 hours . The

specimens shall be removed from the oven and tested in accordance with ASTM C356 to determine linear shrinkage. Class 2 shall be exposed to 1200°F. Class 3 shall be exposed to 1500°F.

4.4.9 Thermal conductivity. Conductivity shall be determined in accordance with ASTM C 177.

4.4.10 Simulative performance. Simulative performances shall be determined in accordance with ASTM C 411. Class 2 shall be conducted at 1200°F and Class 3 at 1500°F test temperatures respectively.

4.4.11 Fire resistance and smoke density. Specimens shall be tested in accordance with MIL-STD-1623.

4.4.12 Compatibility. A 6- by 6-inch block, 1-1/2 inches thick, shall be uniformly surface coated, while at room temperature, with approximately a 1/8-inch layer of finishing cement in accordance with ASTM C 449. Drying time under ambient air temperature conditions shall be determined. This test shall be repeated with a second block using cement in accordance with MIL-C-2861. The drying time for this cement shall also be determined.

4.4.13 Toxicity. The insulation 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 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 6.7.

4.4.14 Off-gassing. The insulation material 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 6.8).

## 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 covered by this specification is intended for use for thermal insulation of machinery and equipment operating to 1200°F surface temperature for class 2 and to 1500°F for class 3. Class 3 is recommended for use in boilers.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Class required (see 1.2).
- c. Thickness, width, and length required (see 3.3.1).
- d. Inspection conditions if other than specified (see 4.1.1).
- e. Packaging requirements (see 5.1 and 6.9).

- f. Material safety data sheets, when required (see 6.4).
- g. Toxicity conformance (see 3.9 and 6.7)
- h. Off-gassing conformance (see 3.10 and 6.8).

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 QPL No. 2819 whether or not such products have actually been so listed by that date. The attention of the 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160.

6.4 Material safety data sheets. When required, 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 Commercial sizes. Commercial sizes and thicknesses of block insulation covered by this specification are industry standards. Other sizes and thicknesses may be obtained upon request.

6.6 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.

6.7 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 20376-5160.

6.8 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.

6.9 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 the quality conformance inspection.



6.10 Subject term (key word) listing.

Conductivity, thermal  
Resistance, fire

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  
Air Force - 99

Preparing activity:  
Navy - SH  
(Project 5640-0013)

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