

INCH-POUND

MIL-PRF-2819H

2 April 2013

SUPERSEDING

MIL-PRF-2819G

17 November 2004

## 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 covers 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 °F

Class 3 - Temperatures up to 1,700 °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

## 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://quicksearch.dla.mil/> or <https://assist.dla.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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2.2.2 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, Chapter “Material Control Program”

(Copies of the chapter titled “Material Control Program” are available from Commander, Naval Sea Systems Command, ATTN: SEA 05Z4, 1333 Isaac Hull Ave. SE Stop 5122, Washington Navy Yard, DC 20376-5122.)

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 C165 - Standard Test Method for Measuring Compressive Properties of 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 C203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- ASTM C303 - Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
- ASTM C356 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
- ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
- ASTM C421 - Standard Test Method for Tumbling Friability of Preformed Block-Type and Preformed Pipe-Covering-Type Thermal Insulation
- ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
- ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by means of the Heat Flow Meter Apparatus

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at [www.astm.org](http://www.astm.org).)

International Organization for Standardization (ISO)

ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories

(Copies of this document are available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56 CH-1211 Geneva 20, Switzerland or online at [www.iso.org](http://www.iso.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 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).

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3.2 Material. The insulation block shall be composed of asbestos-free, heat-resisting compounds suitable for the temperature conditions and 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, 1½, 2, 2½, 3, 3½, 4, 4½, or 5 inches, as specified (see 4.4.2 and 6.2).

3.3.2 Tolerances. A tolerance of  $\pm\frac{1}{8}$  inch in length and  $\pm\frac{1}{16}$  inch in width and thicknesses shall 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	22.0
Compressive strength, at not more than 5% 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>	<sup>1/</sup>	<sup>1/</sup>
Change under soaking heat (24 hours at 1,200 °F for Class 2 and 1,700 °F for Class 3) linear shrinkage, percent maximum	2.0 (see 4.4.8)	2.0 (see 4.4.8)
Thermal conductivity, BTU-in/hr ft <sup>2</sup> °F maximum, at a mean temperature of:		
200 °F	0.42	0.54
300 °F	0.45	0.58
400 °F	0.50	0.61
500 °F	0.60	0.64
600 °F	0.65	0.67
700 °F	0.70	0.70
800 °F	----	0.73
900 °F	----	0.75
1,000 °F	----	0.77
NOTE: <sup>1/</sup> 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 0.25 inch internally from the hot face surface of the insulation shall be disregarded.

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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 in accordance with ASTM C449 and with high temperature thermal insulating cement in accordance with MIL-C-2861. Without the application of a primer, the cements shall readily adhere to the insulation blocks and form a smooth, protective surface. Drying time for each cement after application shall not be 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 Health Hazard Assessment (HHA)], the insulation material shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.4.13 and 6.6).

3.10 Off-gassing. The insulation material shall be tested for off-gassing in accordance with the requirements of 4.4.14. The Navy will review the results and assign a usage category. The required usage category is "Permitted" or "Limited" (see 4.4.14 and 6.7).

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 inspections. 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.

4.1.2 Fire testing provisions. All fire tests specified in this document shall be conducted by an independent testing laboratory that is accredited to ISO/IEC 17025. Accreditation shall be obtained from a recognized accreditation body such as American Association for Laboratory Accreditation (A2LA) or International Code Council's International Accreditation Services (IAS). The scope of accreditation shall include the specific flammability and fire tests required for qualification. All other fire test provisions shall be as specified (see 6.2 and 6.8).

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 acceptable to the Naval Sea Systems Command (NAVSEA). Government representatives may witness qualification inspections.

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TABLE II. Qualification inspection.

<b>Inspection</b>	<b>Requirement</b>	<b>Test method</b>
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 at 5% deformation (min) (lbs/in <sup>2</sup> )	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 (24 hours at 1,200 °F for Class 2 and 1,700 °F for Class 3) linear shrinkage	3.4	4.4.8
Thermal conductivity	3.4	4.4.9
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 subjected to the tests specified in 4.4.2 through 4.4.7, and two samples shall be subjected to the tests specified in 4.4.8, 4.4.10, and 4.4.11. One sample shall be subjected to the tests specified in 4.4.9 and 4.4.12 through 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 ten percent.

4.3 Conformance inspection. Conformance inspection shall be as specified in [table III](#) (see 6.9).

TABLE III. Conformance inspection.

<b>Inspection</b>	<b>Requirement</b>	<b>Test method</b>
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 (24 hours at 1,200 °F for Class 2 and 1,700 °F for Class 3) linear shrinkage	3.4	4.4.8
Appearance and workmanship	3.8	4.4.3

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4.3.1 Lot. For purposes of sampling and conformance inspection, a lot shall consist of all block insulation of the same class produced under similar conditions and ready for inspection or shipment at one time. The lot size shall be the number of thermal insulation blocks in a lot.

4.3.2 Sampling for conformance inspection. As a minimum, a sample quantity of insulation blocks shall be selected from each lot as specified in [table IV](#), except as specified below, and the sample blocks shall be subjected to the examinations and tests specified in [table III](#) (see 4.4.15). Sample size for the linear shrinkage and weight loss by tumbling tests shall be in accordance with [table IV](#) except for lot sizes greater than 50, in which case the sample size shall be three for each lot. Conformance tests and examinations are required for all production lots of material.

TABLE IV. Sampling for conformance inspection.

Lot size	Sample size
2 to 25	1
26 to 50	2
51 to 90	4
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1200	15
1,201 to 3,200	18
3,201 to 10,000	22
10,001 and over	29

4.3.3 Formulation changes. Any changes in formulation, ingredients, manufacturing processes, or manufacturing locations shall be approved by NAVSEA.

4.3.4 Certificate of compliance. When specified (see 6.2), a certificate of compliance shall be prepared.

#### 4.4 Test methods.

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

4.4.2 Dimensions. Length, width, and thickness shall be measured in accordance with ASTM C303 (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 C303.

4.4.5 Compressive strength. The compressive strength shall be determined in accordance with ASTM C165.

4.4.6 Weight loss by tumbling. Weight loss by tumbling shall be determined in accordance with ASTM C421.

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4.4.7 Flexural strength. The flexural strength shall be determined in accordance with ASTM C203.

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 24 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 1,200 °F. Class 3 shall be exposed to 1,700 °F.

4.4.9 Thermal conductivity. Thermal conductivity shall be determined in accordance with ASTM C177 or ASTM C518. In case of a dispute, ASTM C177 shall be the referee test method.

4.4.10 Simulative performance. Simulative performance shall be determined in accordance with ASTM C411. Class 2 shall be conducted at 1,200 °F and Class 3 at 1,700 °F test temperatures.

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, 1½ inches thick, shall be uniformly surface coated, while at room temperature, with approximately a ⅛-inch layer of finishing cement in accordance with ASTM C449. 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. An HHA shall be conducted to ensure conformance to 3.9, as specified (see 6.2). The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the insulation material using the administrative HHA data provided by the manufacturer/distributor to the NMCPHC.

4.4.14 Off-gassing. The insulation material shall be tested for off-gassing at a Government approved testing facility in accordance with S9510-AB-ATM-010 chapter titled “Material Control Program” (see 3.10 and 6.7).

4.4.15 Lot acceptance and rejection criteria. If one or more defects are found in any sample (see 4.3.2), the entire lot shall be rejected. One hundred percent of the lot can be screened for the defective characteristic(s), or a new lot shall be provided which shall be inspected in accordance with the inspections herein.

## 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 shipboard machinery and equipment operating to a 1,200 °F surface temperature for Class 2 and to a 1,700 °F for Class 3. Class 3 is recommended for use on boilers.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Class required (see 1.2).
- c. Thickness, width, and length required (see 3.3.1).
- d. Toxicity conformance (see 3.9, 4.4.13, and 6.6).
- e. Off-gassing conformance (see 3.10, 4.4.14, and 6.7).
- f. Inspection conditions, if other than specified (see 4.1.1).
- g. Additional fire testing provisions (see 4.1.2 and 6.8).

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- h. When a certificate of compliance is required (see 4.3.4 and 6.9).
- i. Packaging requirements (see 5.1 and 6.9).
- j. Material safety data sheets, when required (see 6.4).
- k. Carton identification markings (see 6.10).

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 2819 (QPL-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 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil). An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

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 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 Toxicity evaluation. The Navy and Marine Corps Public Health Center (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.

6.7 Off-gassing. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the atmosphere and can result 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, 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 the Naval Sea Systems Command, 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 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 the Naval Sea Systems Command, 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 Additional fire testing provisions. NAVSEA reserves the right to witness the tests, and/or perform any of the tests set forth herein where such testing is deemed necessary to assure compliance to prescribed requirements of the qualification tests.

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 conformance inspection.

6.10 Carton identification markings. Unless otherwise specified (see 6.2), each carton should be marked with the following information:

- a. "Asbestos free."
- b. Specification number and class.
- c. Maximum temperature limit.



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- d. Manufacturer's name.
- e. Manufacturer's product identification.

Markings should be legible, permanent, and not less than  $\frac{3}{8}$  inch in height. A minimum of two complete markings may be required per carton.

6.11 Subject term (key word) listing.

Conductivity, thermal

Resistance, fire

6.12 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 5640-2011-001)

Review Activity:  
DLA – IS

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 <http://assist.dla.mil>.