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INCH-POUND
MIL-DTL-32585
8 August 2017
SUPERSEDING
(See 6.4)

DETAIL SPECIFICATION

INSULATION, THERMAL AND ACOUSTIC, FIBROUS GLASS

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 and acoustic fibrous glass insulation (see 6.6.1) for use on bulkheads, overheads, ventilation ducting, machinery, equipment, and piping on surface ships and submarines.

1.2 Classification. Insulation is of the following types, forms, and facings, as specified (see 6.2).

1.2.1 Types. The types of insulation are as follows:

a. Type I – Thermal

b. Type II – Acoustic

1.2.2 Forms. The forms of insulation are as follows:

a. Form 1 – Board

b. Form 2 – Blanket with binder (up to 400 °F)

c. Form 3 – Blanket without binder (up to 1,200 °F)

d. Form 4 – Preformed pipe (up to 370 °F)

1.2.3 Facings. The facings of insulation are as follows:

a. Facing A – Unfaced

b. Facing B – Faced with fibrous glass cloth conforming to MIL-C-20079, type I, class 2

c. Facing C – Faced with fibrous glass cloth conforming to MIL-C-20079, type I, class 2 perforated with nominal 3/16-inch diameter holes on ½-inch centers

d. Facing D – Faced with ½-mil thick polyester film reinforced with four-yarns-per-inch by three-yarns-per-inch fibrous glass scrim conforming to MIL-Y-1140 and adhered to the polyester film with a fire-retardant thermosetting adhesive conforming to the fire requirements of MIL-A-3316

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, 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. 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 SPECIFICATIONS

MIL-Y-1140	-	Yarn, Cord, Sleeving, Cloth and Tape-Glass
MIL-A-3316	-	Adhesives, Fire-Resistant, Thermal Insulation
MIL-C-20079	-	Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
MIL-PRF-24596	-	Coating Compounds, Nonflaming, Fire-Resistant
MIL-DTL-24607	-	Enamel, Interior, Nonflaming (Dry), Chlorinated Alkyd Resin, Semigloss

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)

(Copies of these documents 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.)

T9070-AL-DPC-020/077-2	-	NAVSEA Hazardous Material Avoidance Process

(Copies of T9070-AL-DPC-020/077-2 are available online via Technical Data Management Information System (TDMIS) at https://mercury.tdmis navy.mil/ by searching for the document number without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. This document is available for ordering (hard copy) via the Naval Logistics Library at https://nll navsup navy.mil. For questions regarding the NLL, contact the NLL Customer Service at nllhelpdesk@navy mil, (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

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.

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ASTM INTERNATIONAL

ASTM C165	-	Standard Test Method for Measuring Compressive Properties of Thermal Insulations
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 C203	-	Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C302	-	Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation
ASTM C335/C335M	-	Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
ASTM C411	-	Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
ASTM C423	-	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C518	-	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C585	-	Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
ASTM C665	-	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C1617	-	Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
ASTM D578/D578M	-	Standard Specification for Glass Fiber Strands
ASTM D903	-	Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1448	-	Standard Test Method for Micronaire Reading of Cotton Fibers
ASTM D3773/D3773M	-	Standard Test Methods for Length of Woven Fabric
ASTM D3774	-	Standard Test Method for Width of Textile Fabric
ASTM D5034	-	Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM E70	-	Standard Test Method for pH of Aqueous Solutions with the Glass Electrode
ASTM E84	-	Standard Test Method for Surface Burning Characteristics of Building Materials

(Copies of these documents are available online at www.astm.org.)

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1182	-	Reaction to Fire Tests for Products – Non-Combustibility Test
ISO/TR 9705-2	-	Reaction-to-Fire Tests – Full-Scale Room Tests for Surface Products – Part 2: Technical Background and Guidance
ISO/IEC 17025	-	General Requirements for the Competence of Testing and Calibration Laboratories

(Copies of these documents are available online at www.iso.org.)

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T 803	-	Puncture Test of Container Board

(Copies of this document are available online at www.tappi.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 and 6.3), a sample shall be subjected to first article inspection in accordance with 4.1 and 4.4.

3.2 Materials. Materials shall be as specified in 3.2.1 through 3.2.2.

3.2.1 Toxicity and prohibited materials.

3.2.1.1 Toxicity. When evaluated in accordance with 4.4.27, the fibrous glass insulation shall pose no serious or high risk to the health of personnel or the environment when used for its intended purpose (see 4.4.27 and 6.7).

3.2.1.2 Prohibited materials. The fibrous glass insulation shall not contain any chemicals categorized as "prohibited" in accordance with T9070-AL-DPC-020/077-2.

3.2.1.2.1 Asbestos and ceramic (refractory) fibers. Neither asbestos nor ceramic (refractory) fibers nor materials containing either of these fibers shall be used in the fibrous glass insulation.

3.2.1.2.2 Mercury and polychlorinated biphenyls. Insulation materials shall be free of mercury and polychlorinated biphenyls.

3.2.2 Type I and type II. The type I and type II material shall be glass, processed from a molten state to a fibrous form.

3.2.2.1 Type I, form 1, facing A. Type I, form 1, facing A material shall be glass, processed from a molten state into fibrous form, bonded with a binder and compressed or otherwise formed into a board. Type I, form 1, facing A shall be the replacement for MIL-I-742, type II unfaced board (see 6.1.a and 6.4).

3.2.2.2 Type I, form 1, facing B. Type I, form 1, facing B material shall be glass, processed from a molten state into fibrous form, bonded with a binder and compressed or otherwise formed into a board and faced with fibrous glass cloth conforming to MIL-C-20079, type I, class 2. Type I, form 1, facing A shall be used as the core for type I, form 1, facing B. Type I, form 1, facing B (fibrous glass cloth conforming to MIL-C-20079, type I, class 2) shall be the replacement for MIL-I-742, type I fibrous glass cloth faced thermal board (see table VIII).

3.2.2.3 Type I, form 2, facing A. Type I, form 2, facing A material shall be glass, processed from a molten state into a fibrous form, bonded with a binder to form a flexible blanket. Type I, form 2, facing A shall be the replacement for MIL-I-22023, type I thermal blanket (see 6.1.b and table VIII).

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3.2.2.4 Type I, form 3. Type I, form 3 material shall be 100 percent glass without binder and without shot, processed from a molten state into a fibrous form, which is mechanically entangled to form a flexible blanket. Type I, form 3 shall be the replacement for MIL-I-16411 (see 6.1.c and table VIII).

3.2.2.5 Type I, form 4. Type I, form 4 material shall be glass, processed from a molten state into a fibrous form, bonded with a binder and formed into a pipe shape. Type I, form 4 shall be the replacement for MIL-PRF-22344 (see 6.1.d and table VIII).

3.2.2.6 Type II, form 1, facing C. Type II, form 1, facing C material shall be glass, processed from a molten state into a fibrous form, bonded with a binder and compressed or otherwise formed into a board. Type II, form 1 shall be a laminate consisting of a fibrous glass backing board (type II, form 1), a high density fibrous glass layer impregnated with a binder and compressed or otherwise formed into a waffle configuration, and a perforated fibrous glass cloth facing as specified in 3.2.2.6.1 through 3.2.2.6.1.3.1. Type II, form 1 faced with perforated fibrous glass cloth shall be the replacement for MIL-A-23054 (see 6.1.e and table VIII).

3.2.2.6.1 Construction of type II, form 1, facing C. The construction of type II, form 1, facing C faced with perforated fibrous glass cloth shall be in accordance with 3.2.2.6.1.1 through 3.2.2.6.1.3.1.

3.2.2.6.1.1 Fibrous glass backing board. The fibrous glass backing board shall be type I, form 1, except that the board shall be furnished in nominal thicknesses of ¾ inch and 1¾ inch (see 6.2).

3.2.2.6.1.2 High density fibrous glass layer (waffle board). The high density fibrous glass layer shall have a density of not less than 10 pounds per cubic foot (lb/ft^3). The layer shall consist of glass fibers impregnated with a binder and compressed or otherwise formed into a waffle configuration having $\frac{3}{16}$-inch deep indentations tapering from a nominal ¼-inch diameter to a nominal ⅛-inch diameter on ½-inch centers. The nominal thickness of the high density fibrous glass layer shall be ¼-inch (see 6.2).

3.2.2.6.1.3 Perforated fibrous glass cloth facing. The cloth used for facing the high density fibrous glass layer shall be facing C. The cloth facing shall be impregnated with a hardening agent. The cloth facing shall be perforated with nominal $\frac{3}{16}$-inch diameter holes on ½-inch centers.

3.2.2.6.1.3.1 Fibrous glass cloth facing adhesive. The impregnated fibrous glass cloth facing shall be compatible with adhesive conforming to MIL-A-3316, type II. The adhesive strength requirements for securing the fibrous glass cloth facing to the high density fibrous glass layer shall conform to MIL-A-3316.

3.2.2.7 Type II, form 2, facing A. Type II, form 2, facing A material shall be glass, processed from a molten state into a fibrous form, bonded with a binder to form a flexible blanket. Type II, form 2, facing A shall be the replacement for MIL-I-22023, type II acoustic blanket (see 6.1.f and table VIII).

3.2.2.8 Type II, form 2, facing D. Type II, form 2 material shall be glass, processed from a molten state into a fibrous form, bonded with a binder to form a flexible blanket and faced with ½-mil thick polyester film reinforced with fibrous glass yarns scrim conforming to MIL-Y-1140 in a four-yarns-per-inch by three-yarns-per-inch construction adhered to the polyester film with a fire-retardant thermosetting adhesive conforming to the fire requirements of MIL-A-3316. Type II, form 2, facing D faced with ½-mil thick polyester film reinforced with fibrous glass yarns scrim conforming to MIL-Y-1140 in a four-yarns-per-inch by three-yarns-per-inch construction adhered to the polyester film with a fire-retardant thermosetting adhesive conforming to the fire requirements of MIL-A-3316, shall be the replacement for MIL-I-22023, type III faced, thermal and acoustic blanket (see 6.1.g and table VIII).

3.3 Fiber diameter.

3.3.1 Type I and type II, form 1, facing A and B; and type I, form 1 backing board of type II, form 1, facing C. The average fiber diameter of type I and type II, form 1, facing A and B; and type I, form 1 backing board used in the construction of type II, form 1, facing C shall not exceed 0.00030 inch when tested in accordance with 4.4.1.1.

3.3.2 Type I and type II, form 2, facing A and D. The average fiber diameter of type I and type II, form 2, facing A and D shall not exceed 0.00038 inch when tested in accordance with 4.4.1.1.

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3.3.3 Type I, form 3. The average fiber diameter of type I, form 3 shall not exceed 0.00036 inch and at least 90 percent of the fibers shall be less than 0.00040 inch diameter when tested in accordance with 4.4.1.2.

3.3.4 Type I, form 4. The average fiber diameter of type I, form 4 shall not exceed 0.00040 inch when tested in accordance with 4.4.1.1.

3.4 Fiber length of type I, form 3. The average fiber length of type I, form 3 shall be 1 inch or greater when tested in accordance with 4.4.2.

3.5 Shot content of type I and type II, form 2. The shot content of type I and type II, form 2 shall not exceed 1.5 percent by mass when tested in accordance with 4.4.3.

3.6 Binder content of type I and type II, form 2. The binder content of type I and type II, form 2 shall not exceed 30 percent by weight when tested in accordance with 4.4.4.

3.7 Density.

3.7.1 Density of type I and type II, form 2, facing A. The type I and type II, form 2, facing A shall conform to densities of 0.75 lb/ft^3, 1.0 lb/ft^3, 1.5 lb/ft^3, 2.0 lb/ft^3, and 3.0 lb/ft^3 ±10 percent as required, when tested in accordance with 4.4.5.1 and as specified in 6.2.

3.7.2 Density of type I and type II, form 2, facing D. The density of type I and type II, form 2, facing D shall be 2.8 lb/ft^3 ±10 percent when tested in accordance with 4.4.5.1 and as specified in 6.2.

3.7.3 Density of high density fibrous glass layer of type II, form 1. The density of the high density fibrous glass layer of type II, form 1 shall be not less than 10 lb/ft^3 when tested in accordance with 4.4.5.2 and as specified in 6.2.

3.7.4 Density of type I, form 4. The density of type I, form 4 shall be a nominal 5 lb/ft^3 with a tolerance of ±2 lb/ft^3 when tested in accordance with 4.4.5.3 and as specified in 6.2.

3.8 Weight. The weight of type I, form 1, facing A and B; and type I, form 3 fibrous glass insulation shall be as specified in table I when tested in accordance with 4.4.6 and as specified in 6.2.

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TABLE I. Weight.

Nominal thickness (inch)	Nominal weight, pounds per square foot (lb/ft^2)		
	Type I, form 1, facing A 1/, 2/	Type I, form 1, facing B 2/, 3/	Type I, form 3 4/
½	---	---	0.38
¾	0.18	0.28	0.77
1	0.23	0.34	0.94
2	0.46 5/	0.57 5/	---
2	0.49 6/	0.64 6/	---

NOTES:

1/ A tolerance of ±20 percent weight for an individual board.

2/ A tolerance of ±10 percent for the average weight of a lot.

3/ A tolerance of +10 or -20 percent weight for an individual board.

4/ A tolerance of ±10 percent weight for the ordered thickness.

5/ Board manufactured without lamination.

6/ Board manufactured by lamination. Weight includes adhesive used in laminating.

3.9 Dimensions and tolerances for thickness, width, and length of all types and forms. Unless otherwise specified (see 6.2), the insulation dimensions and tolerances for thickness, width, and length shall be as specified in table II. Unless otherwise specified (see 6.2), tolerances shall be tested in accordance with 4.4.7.

3.10 Pipe size of type I, form 4. Type I, form 4 insulation shall fit standard pipe and tube sizes, from ¼- to 36-inch nominal pipe size (nps) and as specified (see 6.2). The longitudinal seam shall close to within ⅛ inch along the entire length of the section. The inner diameter (ID) of the insulation shall not exceed the outside diameter of the pipe by ¼ inch for nps up to 4½ inch or by 5 percent on sizes over 4½ inch nps, as specified in table II and 4.4.8.

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TABLE II. Thickness, width, and length.

Insulation	Thickness (inches)		Width (inches)		Length (feet)	
	Dimension	Tolerance	Dimension	Tolerance	Dimension	Tolerance
Type I, form 1, facing A	¾ 1 2	±⅛	24	±¼	3 and 4	±¼
Type I, form 1, facing B	¾ 1 2	±⅛	24	±¼	3 and 4	±¼
Type I and type II, form 2, facing A	1 1.5 2 2.5 3 3.5 4 5 6	±⅛	24, 30, 36, 48, and 72	±¼	3, 4, 50, and 100	±½
Type II, form 2, facing D	¾ 1 1½ 2	±⅛	24	±¼	3, 4, 50, 100, and 200	±½
Type I, form 3	½ ¾ 1	±⅛	60	+1½	75 45 45	+1½
Type II, form 1, facing C	1 2	±⅛	24	±¼	3	±¼
Type I, form 4 [1/]	½ 1 1½ 2 2½ 3 3½ 4	±⅛	---	---	3 to 6	±3⁄16

NOTE:

[1/] Insulation shall be furnished to fit standard pipe and tube sizes as specified (see 6.2). The inner diameter of the insulation shall not exceed the outside diameter of the pipe by ¼ inch for nps up to 4½ inches or by 5 percent on sizes over 4½ inches nps. The longitudinal seam shall close to within ⅛ inch along the entire length of the section (see 4.4.8).

3.11 Thermal conductivity. Thermal conductivity shall be no greater than the values specified in table III when tested in accordance with 4.4.9.

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TABLE III. Thermal conductivity (1-inch thickness).

Insulation	Density (lb/ft^3)	Thermal conductivity at mean temperature (Btu-in/hr-ft^2-°F) [1/]							
		25 °F	50 °F	75 °F	100 °F	200 °F	300 °F	500 °F	700 °F
Type I, form 1, facing A	---	---	---	0.23	---	---	---	---	---
Type I, form 1, facing B	---	---	---	0.23	---	---	---	---	---
Type I, form 2, facing A	0.75 1.0 1.5 2.0 3.0	0.26 0.24 0.23 0.22 0.21	0.28 0.26 0.24 0.23 0.22	0.30 0.28 0.26 0.24 0.23	0.32 0.30 0.28 0.25 0.24	0.43 0.39 0.35 0.31 0.30	---	---	---
Type II, form 2, facing D	---	---	---	0.23	---	---	---	---	---
Type I, form 3	---	---	---	0.29	---	---	0.40	0.50	0.65
Type I, form 4	---	0.23	0.24	0.25	0.26	0.31	---	---	---

NOTE:
[1/] British thermal units per inch per hour per square foot per degrees Fahrenheit (Btu-in/hr-ft2-°F).

3.12 Alkalinity.

3.12.1 Alkalinity of type I, form 1, facing A and B; type I and type II, form 2; and type II, form 2, facing D. The alkalinity of type I, form 1, facing A and B; type I and type II, form 2; and type II, form 2, facing D shall not exceed 0.60 percent when tested in accordance with 4.4.10.1.

3.12.2 Alkalinity of type I, form 3. The alkalinity of type I, form 3 shall not exceed 0.20 percent when tested in accordance with 4.4.10.2.

3.12.3 Alkalinity of type I, form 4. The alkalinity of type I, form 4 shall not exceed 0.60 percent when tested in accordance with 4.4.10.3.

3.13 pH of type I, form 1, facing A and B; type I and type II, form 2; type II, form 2, facing D; and type I, form 4. The pH of type I, form 1, facing A and B; type I and type II, form 2; type II, form 2, facing D; and type I, form 4 fibrous glass insulation shall not exceed 12 when tested in accordance with 4.4.11.

3.14 Corrosiveness to carbon steel. When tested in accordance with ASTM C665 as specified in 4.4.12, carbon steel plates in contact with the fibrous glass insulation shall show no corrosion greater than comparative carbon steel plates in contact with sterile cotton. Alternatively, when tested in accordance with ASTM C1617 as specified in 4.4.12, the mass loss corrosion rate of unfaced insulation extract on carbon steel shall not exceed that of a 5-ppm chloride solution.

3.15 Fusing temperature of type I, form 3. The fusing temperature of type I, form 3 fibers shall be not less than 1,300 °F when tested in accordance with 4.4.13.

3.16 Tensile strength of type I, form 3. The tensile strength of type I, form 3 before and after heating to 1,200 °F shall be not less than 5.0 pounds per square inch (lb/in^2) when tested in accordance with 4.4.14.

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3.17 Compression and recovery.

3.17.1 Compression and recovery of type I, form 1, facing A and B. The unit load required to compress type I, form 1, facing A and B to 40 percent of its original thickness shall average not less than 250 pounds per square foot (lb/ft^2) when tested in accordance with 4.4.15.1. Upon completion of the test, type I, form 1, facing A and B, after a 5-minute interval, shall return to at least 90 percent of its original thickness when tested in accordance with 4.4.15.1.

3.17.2 Compression and recovery of type II, form 2, facing D. The unit load required to compress type II, form 2, facing D to 40 percent of its original thickness shall average not less than 255 lb/ft^2 when tested in accordance with 4.4.15.2. Upon completion of the test, type II, form 2, facing D, after a 5-minute interval, shall return to at least 70 percent of its original thickness when tested in accordance with 4.4.15.2.

3.18 Flexibility of type II, form 2, facing A. Type II, form 2, facing A shall show no visible rupture or cracking on the outside surface and shall spring back to the original shape and dimensions when tested in accordance with 4.4.16.

3.19 Vibration resistance of type II, form 2. Type II, form 2 shall exhibit no sagging or settling and there shall be not more than a 0.50 percent mass loss of the material when tested in accordance with 4.4.17.

3.20 Puncture resistance of type I, form 1, facing B. The puncture resistance of type I, form 1, facing B shall be not less than 800 ounce-inches per inch of tear when tested in accordance with 4.4.18.

3.21 Kerfing of type I, form 1, facing A and B; and type II, form 2, facing D. Type I, form 1, facing A and B; and type II, form 2, facing D shall be capable of being kerfed with a 90-degree V-groove, producing smooth-cut surfaces, and shall be capable of being folded at the V-groove to facilitate bending at the fold to form a neat square corner when tested in accordance with 4.4.19.

3.22 Facing alignment of type I, form 1, facing B; type II, form 1, facing C; and type II, form 2, facing D. The facing B on type I, form 1; the facing C on type II, form 1; and the facing D on type II, form 2 shall cover the entire surface of the board or blanket and shall not recede further than ⅛ inch from any edge and shall not extend over the edge of the board or blanket by more than ⅛ inch when tested in accordance with 4.4.20. When specified (see 6.2), special order faced board or blanket facing shall extend over the edge of the board or blanket by more than ⅛ inch.

3.23 Yarn separation in facing of type I, form 1, facing B; and type II, form 1, facing C. The yarns in facing B on type I, form 1 and facing C on type II, form 1, across which a cut is made, shall not be separated from the board face over a distance of more than ⅛ inch when the board is cut or sawed when tested in accordance with 4.4.21.

3.24 Adhesive bond strength of MIL-C-20079, type II fibrous glass tape to type I, form 1, facing B; type II, form 2, facing D; and type II, form 1, facing C. The adhesive bond strength of fibrous glass tape conforming to MIL-C-20079, type II, class 1 adhered to facing B on type I, form 1, to facing D on type II, form 2, and to facing C on type II, form 1 with adhesive conforming to MIL-A-3316, class 1 shall be equal to or greater than 3 pounds when tested in accordance with 4.4.22.

3.25 Paintability of type I, form 1, facing B; and type II, form 2, facing D. The facing B on type I, form 1 and facing D on type II, form 2 shall be compatible with and hold one coat of paint conforming to MIL-DTL-24607 when tested in accordance with 4.4.23. The paint shall dry to a uniform smooth coat, which shall have a flat to semi-gloss appearance when viewed under ordinary conditions of illumination. The paint shall exhibit no signs of bleeding, discoloration, cracking, or crazing. There shall be no shiners or flashes.

3.26 Sound absorption coefficients of type II, form 1, facing C; and type II, form 2, facing A and D. The sound absorption coefficients of type II, form 1, facing C; and type II, form 2, facing A and D shall be equal to or greater than those values shown in table IV when tested in accordance with 4.4.24.

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TABLE IV. Minimum sound absorption coefficients.

Insulation	Thickness (inches)	Frequency (hertz)						
		125	250	500	1,000	2,000	4,000	NRC
Type II, form 1, facing C	1	0.07	0.25	0.70	0.90	0.75	0.70	---
	2	0.25	0.70	0.90	0.85	0.75	0.75	---
Type II, form 2, facing A	0.5	0.04	0.10	0.20	0.40	0.55	0.55	0.31
	1	0.06	0.20	0.45	0.65	0.65	0.65	0.49
	2	0.15	0.40	0.75	0.75	0.75	0.70	0.66
	3	0.20	0.60	0.90	0.80	0.80	0.75	0.77
	4	0.25	0.65	0.95	0.85	0.85	0.80	0.82
Type II, form 2, facing D	2	0.43	0.96	1.00	0.70	0.51	0.35	0.80

3.27 Hot surface performance of type I, form 4 (temperatures up to 370 °F). Type I, form 4 shall be appropriate for use at temperatures up to and including 370 °F when tested in accordance with 4.4.25. When tested at the temperature for which it is rated, type I, form 4 insulation shall show no evidence of flaming, glowing, smoldering, or smoking. There shall be no degradation, such as cracking or delamination of the insulation. The insulation thickness along the top of the pipe shall decrease by not more than 10 percent. Minor loss of binder or discoloration of binder shall be acceptable.

3.28 Fire performance. Each type, form, grade, and temperature rating of fibrous glass insulation shall meet the fire performance requirements specified in this section when tested in accordance with 4.4.26.

3.28.1 Non-combustibility of type I, form 1, facing A; type I, form 1, facing A used as the core for type I, form 1, facing B; and type I, form 3. Type I, form 1, facing A; type I, form 1, facing A used as the core for type I, form 1, facing B; and type I, form 3 shall pass all requirements for non-combustibility when tested in accordance with 4.4.26.1. Facing materials and their adhesives are not required to be non-combustible. To meet the requirements of non-combustibility, all of the following criteria shall be satisfied:

a. The average furnace thermocouple temperature rise shall not exceed 54 °F.

b. The average surface thermocouple temperature rise shall not exceed 54 °F.

c. The mean duration of sustained flaming shall not exceed 10 seconds.

d. The average mass loss shall not exceed 50 percent.

3.28.2 Flame spread and smoke developed. Flame spread and smoke developed shall be no greater than the values specified in table V when tested in accordance with 4.4.26.2.

TABLE V. Flame spread and smoke developed.

Insulation	Flame spread index	Smoke developed index
Type I, form 1, facing B	25 maximum	15 maximum
Type I, form 2, facing A	25 maximum	50 maximum
Type II, form 2, facing A	25 maximum	50 maximum
Type II, form 2, facing D	25 maximum	50 maximum
Type II, form 1, facing C	30 maximum	100 maximum
Type I, form 4	25 maximum	50 maximum

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3.28.3 Flame resistance. Type II, form 2, facing A and type II, form 2, facing D material shall meet the following full-scale room test performance requirements when tested in accordance with 4.4.26.3:

a. Net peak heat release rate over any 30-second period less than 500 kilowatts (kW).

b. Net average heat release rate for test less than 100 kW.

c. Flame spread shall not reach 1.6 feet above the floor excluding the area 4 feet from the corner with the ignition source.

d. No flaming droplets or flaming material at any location, which fall from the test specimen during the fire test, shall continue flaming after reaching the test platform or floor.

e. Peak smoke production rate less than 89.4 square feet per second (ft^2/s) over any 60-second period of test.

f. Test average smoke production rate less than 15.1 ft^2/s.

3.29 Off-gassing. The fibrous glass insulation material shall be evaluated for off-gassing in accordance with the requirements of 4.4.28. Based on the circumstances of use and the chemical nature of the fibrous glass insulation material, 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 fibrous glass insulation shall be assigned to either the "Permitted" or "Limited" category (see 4.4.28, 6.2, and 6.8).

3.30 Workmanship. The fibrous glass insulation shall be uniform in quality and condition. The material shall be clean and free from foreign material, dirt, and contaminates. It shall be free of any cuts, tears, delamination of fiber layers, or repaired sections. When faced, the faced surface shall be smooth, free of wrinkles, and shall exhibit no surface waviness or delamination from the fibrous glass insulation (see 4.4.29).

3.31 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.

3.32 Marking. Form 1 shall be marked with manufacturer's designation, date of manufacture, and thickness. Form 2 shall be marked with manufacturer's designation, date of manufacture, density, and thickness. Form 3 shall be marked with manufacturer's designation, date of manufacture, and thickness. Form 4 shall be marked with manufacturer's designation, pipe size, and thickness.

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).

4.2 First article inspection. First article inspection shall consist of the tests specified in table VI and 4.4.

4.3 Conformance inspection. Conformance inspection shall be conducted for each lot produced as specified in 4.3.1 and 4.3.2.

4.3.1 Lot. For purposes of sampling and conformance inspection, a lot for examination and testing shall consist of fibrous glass insulation of the same type, form, facing, temperature rating, size, and thickness produced in one plant under the same conditions and manufactured within the same 24-hour time period. The unit of product shall consist of sufficient board, blanket, or preformed pipe, to perform the conformance tests, as applicable. A random sample of material shall be selected from each lot in accordance with table VII. Plants following an ISO-approved quality assurance program may use product data obtained during the manufacturing of the product during this 24-hour time period to show compliance with fiber diameter, binder content, density or weight, thickness, width, length, and pipe (ID) instead of performing post testing for this lot of material.

4.3.2 Conformance tests. Samples selected in accordance with 4.3.1 shall conform to the requirements when subjected to the tests specified in table VI.

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TABLE VI. First article and conformance inspection.

Characteristic	Requirement	Verification	First article	Conformance
Fiber diameter				
Type I and type II, form 1, facing A and B; and type I, form 1 backing board used in the construction of type II, form 1	3.3.1	4.4.1.1	X	X
Type I and type II, form 2, facing A and D	3.3.2	4.4.1.1	X	X
Type I, form 3	3.3.3	4.4.1.2	X	X
Type I, form 4	3.3.4	4.4.1.1	X	X
Fiber length				
Type I, form 3	3.4	4.4.2	X	
Shot content				
Type I and type II, form 2	3.5	4.4.3	X	
Binder content				
Type I and type II, form 2	3.6	4.4.4	X	X
Density				
Type I and type II, form 2, facing A	3.7.1	4.4.5.1	X	X
Type I and type II, form 2, facing D	3.7.2	4.4.5.1	X	X
High density fibrous glass layer of type II, form 1	3.7.3	4.4.5.2	X	X
Type I, form 4	3.7.4	4.4.5.3	X	X
Weight				
Type I, form 1, facing A and B; and type I, form 3	3.8	4.4.6	X	X
Dimensions				
Thickness				
Type I, form 1, facing A and B; type I and type II, form 2, facing A; type II, form 2, facing D; type II, form 1, facing C	3.9	4.4.7.1	X	X
Type I, form 3	3.9	4.4.7.2	X	X
Type I, form 4	3.9	4.4.7.3	X	X

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TABLE VI. First article and conformance inspection – Continued.

Inspection	Requirement	Verification	First article	Conformance
Width and length				
Type I, form 1, facing A and B; type I and type II, form 2, facing A; type II, form 2, facing D; and type II, form 1, facing C	3.9	4.4.7.4	X	X
Type I, form 3	3.9	4.4.7.5	X	X
Type I, form 4 (length only)	3.9	4.4.7.6	X	X
Pipe size (ID)				
Type I, form 4	3.10	4.4.8	X	X
Thermal conductivity				
Type I, form 1, facing A	3.11	4.4.9.2	X	
Type I, form 1, facing B	3.11	4.4.9.2	X	
Type I, form 2, facing A	3.11	4.4.9.2	X	
Type II, form 2, facing D	3.11	4.4.9.2	X	
Type I, form 3	3.11	4.4.9.2	X	
Type I, form 4	3.11	4.4.9.1	X	
Alkalinity				
Type I, form 1, facing A and B; type I and type II, form 2; and type II, form 2, facing D	3.12.1	4.4.10.1	X	
Type I, form 3	3.12.2	4.4.10.2	X	
Type I, form 4	3.12.3	4.4.10.3	X	
pH				
Type I, form 1, facing A and B; type I and type II, form 2; type II, form 2, facing D; and type I, form 4	3.13	4.4.11	X	
Corrosion				
All types, forms, and facings	3.14	4.4.12	X	
Fusing temperature				
Type I, form 3	3.15	4.4.13	X	
Tensile strength				
Type I, form 3	3.16	4.4.14	X	

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TABLE VI. First article and conformance inspection – Continued.

Inspection	Requirement	Verification	First article	Conformance
Compression and recovery				
Type I, form 1, facing A and B	3.17.1	4.4.15.1	X	
Type II, form, facing D	3.17.2	4.4.15.2	X	
Flexibility				
Type II, form 2, facing A and B	3.18	4.4.16	X	
Vibration resistance				
Type II, form 2	3.19	4.4.17	X	
Puncture resistance				
Type I, form 1, facing B	3.20	4.4.18	X	
Kerfing				
Type I, form 1, facing A and B; and type II, form 2, facing D	3.21	4.4.19	X	
Facing alignment				
Type I, form 1, facing B; type II, form 1, facing C; and type II, form 2, facing D	3.22	4.4.20	X	
Yarn separation in facing				
Type I, form 1, facing B; and type II, form 1, facing C	3.23	4.4.21	X	
Adhesive bond strength of MIL-C-20079, type II fibrous glass tape				
Type I, form 1, facing B; type II, form 2, facing D; and type II, form 1, facing C	3.24	4.4.22	X	
Paintability				
Type I, form 1, facing B and type II, form 2, facing D	3.25	4.4.23	X	
Sound absorption coefficients				
Type II, form 1, facing C; and type II, form 2, facing A and D	3.26	4.4.24	X	
Hot surface performance				
Type I, form 4 (370 °F)	3.27	4.4.25	X	

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TABLE VI. First article and conformance inspection – Continued.

Inspection	Requirement	Verification	First article	Conformance
Non-combustibility				
Type I, form 1, facing A and type I, form 1, facing A used as the core for type I, form 1, facing B; and type I, form 3	3.28.1	4.4.26.1	X	
Flame spread and smoke				
Type I, form 1, facing B; type I, form 2, facing A; type II, form 2, facing A; type II, form 2, facing D; type II, form 1, facing C; and type I, form 4	3.28.2	4.4.26.2	X	
Flame resistance				
Type II, form 2, facing A and facing D	3.28.3	4.4.26.3	X	
Toxicity				
All types, forms, and facings	3.2.1	4.4.27	X	
Off-gassing (submarine use only) (Navy shall determine if required or if administrative assessment is acceptable)				
All types, forms, and facings	3.29	4.4.28	X	
Workmanship				
All types, forms, and facings	3.30	4.4.29	X	

TABLE VII. Sampling for lot examination and testing.

Lot size (board, blanket, preformed pipe)	Sample size
2 to 25	1
26 to 50	2
51 to 90	4
91 to 150	6
151 to 280	10
281 to 500	11
501 to 1,200	15
1,201 to 3,200	18
3,201 to 10,000	22
10,001 to 35,000	29

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4.4 Test methods.

4.4.1 Fiber diameter.

4.4.1.1 Type I and type II, form 1, facing A and B; type I, form 1 backing board of type II, form 1; type I and type II, form 2; type I and type II, form 2, facing D; and type I, form 4. Fiber diameter shall be measured with the micronaire instrument in accordance with ASTM D1448, with the addition that the micronaire instrument shall be calibrated for the purpose of testing fibrous glass (see 3.3.1, 3.3.2, and 3.3.4).

4.4.1.2 Type I, form 3. Fiber diameter shall be determined in accordance with ASTM D578/D578M (see 3.3.3).

4.4.2 Fiber length of type I, form 3. The fiber length shall be measured with any measuring device graduated in at least 1/16-inch increments. A minimum of seven measurements shall be made on each sample. Two checks for fiber length shall be made on the raw fiber before processing into the blanket and two checks shall be made after processing into the blanket (see 3.4).

4.4.3 Shot content of type I and type II, form 2. The shot content of each sample weighing 0.353 ounces (oz) (10 grams [g]) shall be determined by finely separating or breaking up the blanket by means of a piece of soft rubber against a coarse screen directly onto a nest of two U. S. Standard sieves, Nos. 30 and 50, and a receiving pan. A soft brush may be used to facilitate sieving. Long fibers shall be removed by hand or gentle blowing if their horizontal orientation prevents them from passing through the sieves. Sieves shall be shaken by machine or by hand until essentially all of the fiber has been removed from the two sieves. The fine splinters and dust shall be aspirated. The remainder of the material clinging to the Nos. 30 and 50 sieves shall be combined, weighed, divided by the sample mass, and multiplied by 100 to give the shot content in percent. At all stages of this test, any loss of shot shall invalidate the test results (see 3.5).

4.4.4 Binder content of type I and type II, form 2. The binder content shall be determined by heating a 6 in^2 sample (minimum) of blanket separated into small sieves to 1,000 °F for 1 hour in an air circulating oven to ensure complete circulation of the atmosphere of the entire oven chamber. The mass shall be measured before and after heating under atmospheric conditions of the same relative humidity. The mass loss shall be calculated in percent by weight (see 3.6).

4.4.5 Density.

4.4.5.1 Density of type I and type II, form 2, facing A and D. The density shall be determined by the method specified in ASTM C167 (see 3.7.1 and 3.7.2).

4.4.5.2 Density of high density fibrous glass layer of type II, form 1. The density of the waffle board fibrous glass layer shall be tested at the location of manufacture prior to fabrication into final type I, form 1. Density shall be determined by dividing sample mass by sample volume. Sample mass shall be measured to the nearest 0.0353 ounce (1 gram) and sample volume shall be measured to the nearest 0.06 cubic inch (in^3) (1 cubic centimeter [c^3]) of water displaced by one board (see 3.7.3).

4.4.5.3 Density of type I, form 4. The density shall be determined in accordance with the method specified in ASTM C302 (see 3.7.4).

4.4.6 Weight of type I, form 1, facing A and B; and type I, form 3. Weight shall be determined by the method specified in ASTM C167 (see 3.8 and table I).

4.4.7 Dimensions and tolerances for thickness, width, and length.

4.4.7.1 Thickness of type I, form 1, facing A and B; type I and type II, form 2, facing A; type II, form 2, facing D; and type II, form 1, facing C. Thickness shall be measured with a measuring device graduated in at least 1/32-inch increments and determined in accordance with the method specified in ASTM C167 (see 3.9 and table II).

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4.4.7.2 Thickness of type I, form 3. Thickness shall be determined by the method specified in ASTM C167, except that the test specimen shall be ruled off into approximately 20 equal square areas, and the thickness measurement taken at the center of ten areas, no two of which shall have a common side. In determining the thickness, the test specimen shall be placed on a hard, flat surface and the penetrating pin of the depth gauge shall be forced downward through the specimen, perpendicular to the flat surface. If necessary to prevent compression of the specimen by the depth gauge pin, the specimen shall first be pierced. When the point of the pin touches the flat surface, the sliding disk shall be lowered to the point of contact with the top surface of the specimen. The gauge shall be withdrawn, and the distance from the point of the pin to the sliding disk shall be measured to the nearest 1/32 inch. The average of the ten thickness measurements shall be taken as the thickness of the test specimen (see 3.9 and table II).

4.4.7.3 Thickness of type I, form 4. Thickness shall be measured with a measuring device graduated in at least 1/32-inch increments and shall be determined in accordance with the method specified in ASTM C302 (see 3.9 and table II).

4.4.7.4 Width and length of type I, form 1, facing A and B; type I and type II, form 2, facing A; type II, form 2, facing D; and type II, form 1, facing C. Width and length shall be determined with any measuring device graduated in 1/16-inch increments (see 3.9 and table II).

4.4.7.5 Width and length of type I, form 3. Width and length shall be determined in accordance with the method specified in ASTM D3774 and ASTM D3773/D3773M, respectively (see 3.9 and table II).

4.4.7.6 Length of type I, form 4. Length shall be determined with a measuring device graduated in at least 1/16-inch increments and shall be determined in accordance with the method specified in ASTM C302 (see 3.9 and table II).

4.4.8 Pipe size of type I, form 4. The ID of the pipe insulation shall be determined in accordance with the method specified in ASTM C585 (see 3.10 and table II).

4.4.9 Thermal conductivity.

4.4.9.1 Thermal conductivity of type I, form 4. Thermal conductivity shall be determined in accordance with ASTM C335/C335M. Determinations shall be made at three mean temperatures of 100 °F, 150 °F, and 200 °F. Results of these tests shall be extended, through reasonable curve fit or numerical techniques, to establish the thermal conductivity at the levels specified in 3.11 and table III.

4.4.9.2 Thermal conductivity of all other insulation. Thermal conductivity shall be determined in accordance with ASTM C177 or ASTM C518. In case of dispute, ASTM C177 shall be the referee test method (see 3.11 and table III).

4.4.10 Alkalinity.

4.4.10.1 Alkalinity of type I, form 1, facing A and B; type I and type II, form 2; and type II, form 2, facing D. Alkalinity shall be determined in accordance with the method specified in ASTM E70 (see 3.12.1).

4.4.10.2 Alkalinity of type I, form 3. Alkalinity shall be determined in accordance with the method specified in ASTM E70 (see 3.12.2).

4.4.10.3 Alkalinity of type I, form 4. Alkalinity shall be determined in accordance with method specified in ASTM E70. A representative sample shall be prepared by taking borings using a large cork borer through the cross-section of the pipe insulation (see 3.12.3).

4.4.11 pH of type I, form 1, facing A and B; type I and type II, form 2; type II, form 2, facing D; and type I, form 4. pH shall be determined in accordance with the method specified in ASTM E70 (see 3.13).

4.4.12 Corrosiveness to carbon steel. Corrosiveness to carbon steel shall be determined in accordance with the method specified in ASTM C665 for sterile cotton test or ASTM C1617 for 5-ppm chloride solution test (3.14).

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4.4.13 Fusing temperature of type I, form 3. To determine fusing temperature, a 0.0353-ounce (1-gram) sample of glass fiber shall be weighed and placed into a crucible, which shall be placed in a muffle furnace at room temperature. Heating elements shall be turned on at the start of the test and adjusted so that the specified temperature of 1,300 °F is reached within 45±10 minutes. When this temperature is reached, the crucible shall be immediately removed from the furnace, allowed to cool, and examined visually for fusion. Fusion shall be considered to have taken place if any part of the sample has melted and formed a homogeneous mass (see 3.15).

4.4.14 Tensile strength of type I, form 3. Tensile strength shall be determined in accordance with the grab method specified in ASTM D5034, with the following modifications:

a. Test specimens shall be 12 by 14 inches in size.

b. The specimens shall be clamped at the top and bottom sections by ½-inch pipe covered with ¼-inch thick sponge rubber to prevent cutting and slipping of the specimens.

c. The clamped specimens, having a test area of 1 ft^2, shall be attached to the grips of the testing machine, which shall separate at a rate of 2±0.2 inches per minute until rupture occurs.

d. Tensile strength determinations shall be made on specimens before and after being subjected to soaking heat at 1,200 °F for 6 hours.

e. The tensile strength shall be expressed in lb/in^2 of cross-sectional area (see 3.16).

4.4.15 Compression and recovery.

4.4.15.1 Compression and recovery of type I, form 1, facing A and B. A test specimen, 12 by 12 inches, shall be cut from a full-sized board. It shall be placed between the pressure plates of a compression testing machine, accurate to ±1 percent of the scale. A dial micrometer graduated to 0.001 inch shall be rigidly attached to the machine so as to measure the separation between the plates. The specimen shall be slowly compressed to 40 percent of its original thickness. The specimen shall be compressed again to 40 percent of its original thickness. The load at this point shall be recorded. The load shall be removed and after 5 minutes, the thickness of the specimen shall be determined and compared with the original thickness (see 3.17.1).

4.4.15.2 Compression and recovery of type II, form 2, facing D. The compression and recovery test shall be performed in accordance with ASTM C165 (see 3.17.2).

4.4.16 Flexibility of type II, form 2, facing A and B. Flexibility shall be determined in accordance with ASTM C203 (see 3.18).

4.4.17 Vibration resistance of type II, form 2.

4.4.17.1 Test procedure. A test specimen 12 in^2 shall be subjected to the endurance test for type I of MIL-STD-167-1, except that the total period of the test shall be at least 100 hours at a frequency of 12 hertz with an amplitude of vibration at 0.13 inch + 0.006 inch only. In preparation for the test, the test specimen shall be blown clean of all loose or cut surface particles and weighed to the nearest 0.00353 ounce (0.1 gram). After weighing, the test specimen shall be placed in a tight fitting five-sided sheet metal box covered with a No. 16 mesh wire screen tightly stretched and firmly attached to the box over the open side. The specimen shall be in intimate contact with the screen and five sides of the box. The method of attachment shall be in accordance with MIL-STD-167-1, allowing the test specimen to have the exposed face down and in a horizontal position. A pan shall be installed below the test specimen to catch all material/particles that fall from the test specimen during the test. The test shall be conducted with the specimen in the horizontal position only. The vibration excitation shall be in the horizontal position only.

4.4.17.2 Test results. At the completion of the test, the specimen shall be removed from its mounting attachments and the sheet metal box and again weighed to the nearest 0.0353 ounce (0.1 gram). The mass loss of the specimen shall be calculated and examined in accordance with 3.19. The specimen shall be examined for any sagging or settling to determine compliance with 3.19.

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4.4.18 Puncture resistance of type I, form 1, facing B. Puncture resistance shall be determined in accordance with the method specified in TAPPI T 803, except as follows: The 24- inch by 18- inch specimen shall be placed with the grade B fibrous glass cloth facing side faced down between the clamping plates. The loose sleeve shall be placed against the base of the puncture point and the pointer shall be set about 1 inch above the expected reading. The pendulum shall be raised to the horizontal position. The pendulum shall be released by pushing the latch handle to the left. The reading on the proper scale shall be noted after the pendulum has completed the swing. Two determinations shall be made in the warp direction of the fibrous glass cloth facing and two in the fill direction of the fibrous glass cloth facing on each specimen (see 3.20).

4.4.19 Kerfing of type I, form 1, facing A and B; and type II, form 2, facing D.

4.4.19.1 Position. Two sharp kerfing knives shall be positioned so that they form an angle of 90 degrees with each other and so that the tip of one knife is approximately ¼ inch in advance of the tip of the other knife. The knives shall be kept sharp.

4.4.19.1.2 Type I, form 1, facing A. For type I, form 1, facing A, the kerfing knives shall be adjusted to reach to approximately ¼ inch below the surface of the board.

4.4.19.1.3 Type I, form 1, facing B; and type II, form 2, facing D. For type I, form 1, facing B and type II, form 2, facing D, the kerfing knives shall be adjusted to reach just below the facing.

4.4.19.2 Process. Ninety-degree V-grooves shall be kerfed in the sample board. The grooves shall be examined for smoothness of surfaces. Then the board shall be folded and examined and the facing shall also be examined to determine that the corners are neat and square (see 3.21).

4.4.20 Facing alignment of type I, form 1, facing B; type II, form 1, facing C; and type II, form 2, facing D. Facing alignment shall be measured with a steel rule measuring device graduated in at least 1/16-inch increments (see 3.22). In case the B, C, or D facing does not cover the entire surface of the board or blanket, the uncovered portion of the board or blanket shall be measured with the steel rule and the measurement shall not be greater than 1/8 inch. Unless otherwise specified (see 6.2), the B, C, or D facing shall not extend over the edge of the board or blanket except for special order faced board or blanket where the facing shall extend over the edge of the board or blanket by more than 1/8 inch.

4.4.21 Yarn separation in facing of type I, form 1, facing B; and type II, form 1, facing C. Yarn separation from the board face shall be measured with a steel rule measuring device graduated in at least 1/16-inch increments (see 3.23). The board shall be cut or sawed and the distance of separation of the yarns in the B and C facing from the board shall be determined by measuring.

4.4.22 Adhesive bond strength of MIL-C-20079, type II fibrous glass tape to type I, form 1, facing B; type II, form 2, facing D; and type II, form 1, facing C. The B, C, or D facing shall be wiped clean with alcohol or soap and water on a 1-ft^2 section of insulation to remove possible contaminants, and allowed to dry thoroughly. A 12- by 6-inch area of the facing shall be coated with adhesive conforming to MIL-A-3316, class 1 to an approximate thickness of 1/32 inch, leaving a 12- by 6-inch area uncoated. After the adhesive has dried for 5 minutes, a 1-ft^2 piece of fibrous glass cloth conforming to MIL-C-20079, type I, class 2 shall be superimposed on the facing of the insulation and pressed and troweled to extrude the adhesive through the interstices of the fibrous glass cloth. The adhered half of the fibrous glass cloth shall then be given a finish coat of adhesive, which shall then be scraped off down to the cloth in order to remove excess adhesive. The adhesive shall be visually inspected for drying to touch at the end of 48 hours after application. If the adhesive is not dry, an additional 12 hours drying time shall be allowed. The B, C, or D facing of the insulation shall then be carefully sliced away from the fibrous glass insulation. The bonded assembly of the B, C, or D facing and fibrous glass cloth conforming to MIL-C-20079, type I, class 2 shall then be cut to provide five strips 2 inches wide and 12 inches long. A strip adhesion test shall be conducted in accordance with ASTM D903 (see 3.24).

4.4.23 Paintability of type I, form 1, facing B; and type II, form 2, facing D. One coat of flat primer conforming to MIL-PRF-24596 and one coat of fire-retardant paint conforming to MIL-DTL-24607 shall be applied to the B and D facing on the surface of the insulation. The paint shall be allowed to dry and then the painted surface shall be visually inspected for smoothness, uniformity in color, appearance of cracking, crazing, shiners, or flashes (see 3.25).

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4.4.24 Sound absorption coefficients of type II, form 1, facing C; and type II, form 2, facing A and D. Sound absorption coefficients shall be determined by laying the insulation on the floor of a reverberation room and testing in accordance with ASTM C423 (see 3.26).

4.4.25 Hot surface performance of type I, form 4. Hot surface performance of preformed pipe insulation shall be determined in accordance with ASTM C411. Type I, form 4 insulation shall be tested at a temperature of 370 °F and a thickness of 1 inch (see 3.27).

4.4.26 Fire performance. The insulation shall be tested as specified in 3.28 and in accordance with the following test methods.

4.4.26.1 Non-combustibility of type I, form 1, facing A; type I, form 1, facing A used as the core for type I, form 1, facing B; and type I, form 3. Non-combustibility tests shall be performed in accordance with ISO 1182 (see 3.28.1).

4.4.26.2 Flame spread and smoke developed of type I, form 1, facing B; type I, form 2, facing A; type II, form 2, facing A; type II, form 2, facing D; type II, form 1, facing C; and type I, form 4. The insulation shall be tested for flame spread and smoke developed in accordance with ASTM E84 (see 3.28.2 and table V).

4.4.26.3 Flame resistance of type II, form 2, facing A and type II, form 2, facing D. Type II, form 2, facing A and type II, form 2, facing D shall be tested in a room fire test in accordance with ISO/TR 9705-2 (see 3.28.3).

4.4.26.4 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 and is approved by the NAVSEA Technical Authority. 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 specific flammability and fire tests. All other fire test provisions shall be as specified (see 6.2, 6.3.1, and 6.9).

4.4.27 Toxicity and prohibited materials. A Health Hazard Assessment (HHA) will be conducted to ensure conformance to 3.2.1.1 and 3.2.1.2, as specified (see 6.2). The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the insulation using data provided by the manufacturer/distributor to the NMCPHC (see 3.2.1.2 and 6.7).

4.4.28 Off-gassing. The insulation shall be evaluated for off-gassing in accordance with S9510-AB-ATM-010 chapter titled "Material Control Program" (see 3.29, 6.2, and 6.8). If the Navy determines that off-gas testing is required, testing shall be conducted at a Naval Sea Systems Command (NAVSEA) approved test facility (see 3.29). 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 3.29).

4.4.29 Workmanship. The fibrous glass insulation shall be visually inspected for the presence of cuts, tears, delamination of fiber layers, markings, or repaired sections. The insulation shall also be inspected for cleanliness and dirt, foreign material, and contaminates. The insulation shall be inspected for uniformity in quality and condition. Faced insulation shall also be inspected for smoothness of facing, wrinkles, surface waviness, or delamination from the fibrous glass insulation (see 3.30).

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.

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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 fibrous glass insulation covered by this specification is intended for thermal insulation, acoustic insulation, or both for use on bulkheads, overheads, ventilation ducting, machinery, equipment, and piping for Navy ships. The classifications and uses are as follows:

a. Type I (thermal), form 1 (board), facing A (unfaced) is used for thermal hull, compartment, and ventilation duct insulation.

b. Type I (thermal), form 2 (blanket with binder), facing A (unfaced) is used for thermal bulkhead, overhead, and ventilation duct insulation.

c. Type I (thermal), form 3 (blanket without binder) is used as thermal insulation of machinery and equipment, and as a component of removable pads for valves and flanges at operating temperatures up to 1,200 °F.

d. Type I (thermal), form 4 (preformed pipe) is used on piping as thermal insulation for operating temperatures up to 370 °F.

e. Type II (acoustic), form 1 (board), facing C (faced with perforated MIL-C-20079, type I, class 2 fibrous glass cloth) is used for reduction of sound in spaces, such as machinery spaces, where there is a high level of noise. Type II (acoustic), form 1 (board) is the replacement for the backing board used in the construction of MIL-A-23054 backing board (see 3.2.2.6.1.1 and table VIII).

f. Type II (acoustic), form 2 (blanket with binder) is used for acoustic bulkhead, overhead, and ventilation duct insulation.

g. Type II (acoustic), form 2 (blanket with binder), facing D (faced with ½-mil thick polyester film reinforced with fibrous glass yarns scrim conforming to MIL-Y-1140 in a four-yarns-per-inch by three-yarns-per-inch construction adhered to polyester film with a fire-retardant thermosetting adhesive conforming to the fire requirements of MIL-A-3316) is used for thermal ventilation duct insulation, acoustic ventilation duct lining, bulkhead insulation, and on the plane surfaces of machinery spaces, shops, or other spaces where the insulation may be exposed to oil, water, grease, dirt, or high levels of humidity.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Type, form, and facing (see 1.2).

c. When first article is required (see 3.1 and 6.3).

d. Nominal thickness of type I, form 1 (see 3.2.2.6.1.1).

e. Nominal thickness of high density fibrous glass layer (waffle board) (see 3.2.2.6.1.2).

f. Density required (see 3.7).

g. Weight required (see 3.8).

h. Length, width, and thickness required (see 3.9).

i. Nominal pipe and tube sizes required (see 3.10).

j. Standard pipe and tube sizes (see table II).

k. Special facing requirements (see 3.22 and 4.4.20).

l. Requirements for an HHA (see 3.2.1 and 4.4.27).

m. When off-gas testing is required (see 3.29 and 4.4.28).

n. Additional fire testing provisions (see 4.4.26.4, 6.3.1, and 6.9).

o. Packaging requirements (see 5.1).

p. Safety data sheets, when required (see 6.5).

q. When a certificate of compliance is required (see 6.10).

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6.3 First article inspection. First article inspection should be performed when one or more of the following apply (see 6.2):

a. Upon initial offering of a material to the Government by the vendor.

b. When any change in material formulation is made from previous first article test samples.

c. When any change in manufacturing processing, processing cure, or conditions (for example; temperature or cure time) are made from previous first article test samples.

d. When the product being offered is manufactured at a plant different than that of previous first article test samples.

e. When required by the Naval Sea Systems Command.

6.3.1 Guidelines for first article inspection for fire performance. The following guidelines should be used to determine the necessity for required first article inspection for fire performance (see 6.2):

a. If within the 3-year period preceding the date of invitation for bids, the insulation has not been tested by an accredited independent testing laboratory and found in compliance with the requirements of this specification, or

b. If the material offered for delivery is not manufactured the same in all respects as that previously tested.

6.4 Supersession data. This specification supersedes MIL-A-23054A W/AMENDMENT 1 dated 25 June 1984, MIL-I-742F W/AMENDMENT 1 dated 30 April 1981, MIL-I-16411F dated 14 November 1988, MIL-I-22023D W/AMENDMENT 1 dated 21 February 1984, and MIL-PRF-22344E dated 14 October 2004 (see table VIII). Existing stock of fibrous glass insulation material manufactured to the above listed document versions are acceptable for use until depleted.

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TABLE VIII. Cross reference.

MIL-DTL-32585	Superseded specification
Type I (thermal), form 1 (board), facing A (unfaced)	MIL-I-742, type II unfaced board
Type I (thermal), form 1 (board), facing B (faced with fibrous glass cloth conforming to MIL-C-20079, type I, class 2)	MIL-I-742, type I fibrous glass cloth faced thermal board
Type I (thermal), form 2 (blanket with binder), facing A (unfaced)	MIL-I-22023, type I thermal blanket
Type I (thermal), form 3 (blanket without binder)	MIL-I-16411
Type I (thermal), form 4 (preformed pipe)	MIL-PRF-22344
Type II (acoustic), form 1 (board), facing C (faced with perforated fibrous glass cloth)	MIL-A-23054
Type II (acoustic), form 2 (blanket with binder), facing A	MIL-I-22023, type II acoustic blanket
Type II (acoustic), form 2 (blanket with binder), facing D (faced with ½-mil thick polyester film reinforced with MIL-Y-1140 fibrous glass yarns scrim in a 4-yarns-per-inch by 3-yarns-per-inch construction adhered to polyester film with a fire-retardant thermosetting adhesive conforming to the fire requirements of MIL-A-3316)	MIL-I-22023, type III faced, thermal and acoustic blanket

6.5 Safety data sheets. When specified (see 6.2), contracting officers will identify those activities requiring copies of completed Safety Data Sheets (SDS) prepared in accordance with FED-STD-313. In order to obtain the SDS, Federal Acquisition Regulation (FAR) clause 52.223-3 must be in the contract.

6.6 Definition.

6.6.1 Fibrous glass insulation. A homogeneous base of glass, processed from a molten state to a fibrous form, to produce an insulation material exhibiting uniform properties throughout its thickness or length.

6.7 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.

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6.8 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. 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. 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 Additional fire testing provisions. NAVSEA reserves the right to witness the tests, and perform any of the tests set forth herein where such testing is deemed necessary to assure compliance to prescribed requirements. NAVSEA will provide a letter upon request that indicates the approved laboratories which are accredited to ISO/IEC 17025 and which details how to obtain and maintain accreditation (see 6.2).

6.10 Certification. Consideration should be given to including certificates of compliance with each shipment of insulation. When specified (see 6.2), certificates should indicate successful completion of the individual tests.

6.11 Subject term (key word) listing.

Blanket

Board

Fire performance

Pipe

Tube

CONCLUDING MATERIAL

Custodians:
- Army – MI
- Navy – SH
- Air Force – 11
- DLA – IS

Preparing activity:
- Navy – SH
- (5640-2016-001)

Review activities:
- Army – AV
- Navy – AS
- Air Force – 03, 84

Civil agency:
- GSA – FAS

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 https://assist.dla.mil.