Designation: C547 – 22a

Standard Specification for Mineral Fiber Pipe Insulation[1]

This standard is issued under the fixed designation C547; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers mineral fiber insulation produced to form hollow cylinders for standard pipe and tubing sizes. Use mineral fiber pipe insulation that has been either molded or precision v-grooved, with one or more walls split longitudinally for use on pipe temperatures up to 1400°F (760°C).

1.2 For satisfactory performance, use properly installed protective vapor retarders or barriers on sub-ambient temperature applications to reduce movement of moisture through or around the insulation to the colder surface. Failure to use a vapor barrier can lead to insulation and system damage. Refer to Practice C921 to aid material selection.

1.3 Flexible mineral fiber wrap products such as perpendicular-oriented fiber insulation rolls, non-precision or manually scored block or board, or flexible boards or blankets used as pipe insulation, are not covered by this specification.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 For Naval Sea Systems Command (NAVSEA) acceptance, materials must also comply with Supplemental Requirements. See Annex A1 of this standard.

1.6 The following safety hazards caveat applies to the test methods portion, Section 11, only: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations

C168 Terminology Relating to Thermal Insulation

C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

C302 Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation

C335/C335M Test Method for Steady-State Heat Transfer Properties of Pipe Insulation

C356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat

C390 Practice for Sampling and Acceptance of Thermal Insulation Lots

C411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations

C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing

C665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

C680 Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs

C795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulations.

Current edition approved Sept. 1, 2022. Published October 2022. Originally approved in 1964. Last previous edition approved in 2022 as C547 – 22. DOI: 10.1520/C0547-22A.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

C921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation (Withdrawn 2021)[3]
C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
C1058/C1058M Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation
C1104/C1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
C1335 Test Method for Measuring Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation
C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
E84 Test Method for Surface Burning Characteristics of Building Materials

2.2 *Other Standards:*
UL 723 Tests for Surface Burning of Building Materials[4]
CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies[5]

3. Terminology

3.1 The definitions in Terminology C168 shall apply to the terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *molded*—refers to products preformed via a molding process to yield full-round cylindrical pipe insulation sections.

3.2.2 *precision v-groove*—refers to products fabricated from machined board via a precision cutting process. Machined segments are adhered to a backing to form a full-round cylindrical pipe insulation section. Due to the precision of the process, the product has no gaps when installed.

4. Classification

4.1 Products covered by this specification are classified according to maximum use temperature as follows:

4.1.1 *Type I*—Molded, for use to 850°F (454°C).
Grade A—Requires no heat-up schedule
Grade B—Heat-up schedule is required

4.1.2 *Type II*—Molded, for use to 1200°F (650°C).
Grade A—Requires no heat-up schedule
Grade B—Heat-up schedule is required

4.1.3 *Type III*—Precision v-groove, for use to 1200°F (650°C).
Grade A—Requires no heat-up schedule
Grade B—Heat-up schedule is required

4.1.4 *Type IV*—Molded, for use to 1000°F (538°C).
Grade A—Requires no heat-up schedule
Grade B—Heat-up schedule is required

4.1.5 *Type V*—Molded, for use to 1400°F (760°C)
Grade A—Requires no heat-up schedule
Grade B—Heat-up schedule is required

NOTE 1—**Warning:** Grade B may not be suitable for applications requiring hot installation capability at the maximum temperature indicated. Products having a Grade B designation are designed to be used with a heat-up schedule. Failure to use a heat-up schedule with Grade B products may lead to an exothermic reaction. This is dependent on thickness and temperature. Consult the manufacturer or manufacturer's literature for special heat rate considerations.

4.2 It is possible that binder decomposition at elevated temperature will be a limiting factor in certain applications. Consult the manufacturer regarding special heat rate considerations.

5. Materials and Manufacturer

5.1 *Composition*—The mineral fiber insulation for pipes shall be manufactured from mineral substance such as rock, slag, or glass, processed from a molten state into fibrous form with binder. Asbestos shall not be used as an ingredient or component part. It is possible that some products will also contain adhesive.

5.2 *Jackets (Facings)*—The user of this specification has the option to specify that the insulation be jacketed.

NOTE 2—The user is advised that the maximum use temperature of factory-applied facings and adhesives may be lower than the maximum use temperature of the insulation. The specifier shall ensure that sufficient insulation thickness is installed so none of these accessory items (facings and adhesives) are exposed to temperatures above their maximum use temperature. The products covered by this standard are predominantly inorganic in nature. Organic facings, adhesives and binders are also used in the construction of these products. The resulting composite therefore could have increased combustibility.

6. Physical Requirements

6.1 The product shall conform to the following requirements in addition to those specified in Table 1.

6.2 *Hot Surface Performance:*

6.2.1 The product shall not crack, warp, flame, or glow during hot surface exposure. No evidence of melting or fiber degradation shall be evident upon post test inspection.

6.2.2 For Grade A products, the insulation's internal temperature rise (exotherm) shall not exceed the pipe surface temperature by more than 200°F (111°C) for each measurement location as required by Practice C447. If the setpoint temperature is lower than the average pipe surface temperature, the exotherm is derived by the difference between the maximum measured temperature and the pipe surface set point temperature.

NOTE 3—In some situations where an exothermic reaction is observed, the apparatus is heated above the test set point temperature by the exothermic reaction. This provision is to ensure that the amount the apparatus is heated above the set point temperature is not added to the pass/fail threshold.

6.3 *Non-fibrous (Shot) Content:*

6.3.1 The non-fibrous content of a rock- or slag-based product shall not exceed 25 % by weight.

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.
[5] Available from Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario MIR3A9.

TABLE 1 Requirements of Mineral Fiber Pipe Insulation (Grades A & B)

Property	Type I (Grades A andB)	Type II (Grades A and B)	Type III (Grades A and B)	Type IV (Grades A and B)	Type V (Grades A and B
Use temperature, max, °F (°C)	850 (454)	1200 (650)	1200 (650)	1000 (538)	1400 (760)
Sag resistance, max, % thickness change	5	5	5	5	5
Linear shrinkage (length), max, % change after change after soaking heat at maximum use temperature	2	2	2	2	2
Water vapor sorption, max, % by weight	5	5	5	5	5
Surface burning characteristics, max					
Flame spread index	25	25	25	25	25
Smoke developed index	50	50	50	50	50
Apparent thermal conductivity, max, Btu.in./h,ft^2, °F(W/m.K) Mean temperature[A] °F (°C)					
100 (38)	0.25 (0.036)	0.25 (0.036)	0.25 (0.036)	0.25 (0.036)	0.25 (0.036)
200 (93)	0.31 (0.045)	0.31 (0.045)	0.31 (0.045)	0.31 (0.045)	0.31 (0.045)
300 (149)	0.40 (0.058)	0.37 (0.053)	0.37 (0.053)	0.37 (0.053)	0.37 (0.053)
400 (204)	0.51 (0.074)	0.45 (0.065)	0.45 (0.065)	0.45 (0.065)	0.45 (0.065)
500 (260)	0.64 (0.092)	0.54 (0.078)	0.54 (0.078)	0.54 (0.078)	0.54 (0.078)
600 (316)		0.65 (0.094)	0.65 (0.094)	0.65 (0.094)	0.65 (0.094)
700 (371)		0.77 (0.111)	0.77 (0.111)	0.77 (0.111)	0.77 (0.111)

[A] The user is advised that retrofit applications (where new insulation is being applied over existing) could require knowing the thermal conductivity of the existing layer at mean temperatures above those shown. Consult a manufacturer for data at mean temperatures exceeding those listed.

6.4 For Naval Sea Systems Command (NAVSEA) acceptance, materials must also comply with Supplemental Requirements. See Annex A1 of this standard.

6.5 *Corrosiveness to Steel*—When tested and evaluated in accordance with 11.1.10, the corrosion resulting from insulation in contact with steel plates shall be judged to be no greater than for comparative plates in contact with sterile cotton. Test the composite insulation material (with facing and adhesive) when a facing is factory adhered by the manufacturer or fabricator. (**Warning—**There are adhesives that can cause corrosion to steel when they are in contact with water or water vapor and the steel. Currently there is not a test method available to satisfy all potential causes of corrosion).

6.5.1 The use of Practice C1617 is an acceptable alternative to the test procedure in 11.1.10, with the mass loss corrosion rate of the steel test sample exposed to the unfaced or faced insulation extract not to exceed that of the 5 ppm chloride solution.

7. Standard Shapes, Sizes, and Dimensions

7.1 The basic shape of mineral fiber pipe insulation forms a right annular cylinder, which is radially slit on at least one side of the cylinder axis. It is furnished in sections or segments designed to fit standard sizes of pipe and tubing.

7.2 Typical available thicknesses range from nominal ½-in. (13 mm) to nominal 6-in. (152 mm), single or double layer, in ½-in. increments for most pipe and tubing sizes.

7.3 Individual dimensions for inner diameter and wall thickness shall conform to Practice C585.

7.4 Standard section or segment length shall be 3 ft (0.91m) or as agreed upon between the buyer and seller.

8. Dimensional Tolerances

8.1 Length equals ±⅛-in. (3 mm).

8.2 When installed on a nominal pipe or tubing size as defined in Practice C585, the insulation shall fit snugly and have tight longitudinal and circumferential joints.

8.3 The inner and outer bore of the insulation shall be concentric to the outer surface. The deviation from concentricity shall not exceed 3⁄16 in. (5 mm).

9. Workmanship

9.1 The insulation shall not have defects that will adversely affect installation or service quality.

10. Sampling

10.1 When specified in the purchase order or contract, sampling and acceptance shall be in accordance with Practice C390.

11. Test Methods

11.1 The properties in this specification shall be determined in accordance with the following test methods, with jacketing excluded unless stated otherwise.

11.1.1 *Density and Dimensions*—Test Method C302.

11.1.2 *Linear Shrinkage*—Test Method C356.

11.1.3 *Thermal Conductivity*—Test Method C335/C335M.

11.1.3.1 Thermal performance shall be characterized on a 3-in. NPS × 2-in. pipe insulation size. Thermal performance must be assessed on actual pipe insulation sections. Product density of test specimen shall be recorded and reported per Test