Designation: C 547 – 95

Standard Specification for Mineral Fiber Pipe Insulation[1]

This standard is issued under the fixed designation C 547; 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 Department of Defense.

1. Scope

1.1 This specification covers mineral fiber insulation produced to form hollow cylinders for standard pipe and tubing sizes. The mineral fiber pipe insulation may be molded or precision v-grooved, with one or more walls split longitudinally for use on pipe temperatures up to 1200°F (650°C).

1.2 For satisfactory performance, properly installed protective vapor retarders or barriers should be used 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 C 921 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 the standard. The values given in parentheses are for information only.

1.5 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations[2]

C 168 Terminology Relating to Thermal Insulating Materials[2]

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[2]

C 302 Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation[2]

C 335 Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation[2]

C 356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat[2]

C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots[2]

C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation[2]

C 585 Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)[2]

C 612 Specification for Mineral Fiber Block and Board Thermal Insulation[2]

C 795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel[2]

C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation[2]

C 1045 Practice for Calculating Thermal Transmission Properties from Steady-State Heat Flux Measurements[2]

C 1058 Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation[2]

C 1104/C1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation[2]

E 84 Test Method for Surface Burning Characteristics of Building Materials[3]

3. Terminology

3.1 The definitions in Terminology C 168 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

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[1] This specification is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulations.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 04.07.

according to maximum use temperature as follows:

4.1.1 *Type I*—Molded, for use to 850°F (454°C).

4.1.2 *Type II*—Molded, for use to 1200°F (650°C).

4.1.3 *Type III*—Precision v-groove, for use to 1200°F (650°C).

4.2 Binder decomposition at elevated temperature may be a limiting factor in certain applications. Consult the manufacturer regarding special 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. Some products may also contain adhesive.

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

NOTE 1—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.

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 Thickness loss (sag) due to hot pipe exposure shall not be greater than 5 %.

6.2.2 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.

TABLE 1 Requirements of Mineral Fiber Pipe Insulation

Property	Type I	Type II	Type III
Use temperature, max, °F (°C)	850 (454)	1200 (650)	1200 (650)
Sag resistance, max, % thickness change	5	5	5
Density, minimum, lb/ft^3 (kg/m^3)	3 (48)	6 (96)	6 (96)
Linear shrinkage (length), max, % change after change after soaking heat at maximum use temperature	2	2	2
Water vapor sorption, max, % by weight	5	5	5
Surface burning characteristics, max			
Flame spread index	25	25	25
Smoke developed index	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)
200 (93)	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)
400 (204)	0.51 (0.073)	0.45 (0.065)	0.45 (0.065)
500 (280)	0.64 (0.092)	0.54 (0.078)	0.54 (0.078)
600 (316)		0.65 (0.094)	0.65 (0.094)
700 (371)		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.

6.3 *Non-fibrous (Shot) Content*:

6.3.1 The non-fibrous content of a rock- or slag-based product shall not exceed 30 % by weight.

6.3.2 The density of glass-based insulations of any type defined by this specification shall not exceed the minimum in Table 1.

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) in ½-in. increments for most pipe and tubing sizes.

7.3 Individual dimensions for inner diameter and wall thickness shall conform to Practice C 585.

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 C 585, 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 Criteria C 390.

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 C 302.

11.1.2 *Linear Shrinkage*—Test Method C 356.

11.1.3 *Thermal Conductivity*—Test Method C 335.

11.1.3.1 Thermal performance shall be characterized on material having a thickness of at least 1½ in. (38 mm).

11.1.3.2 Calculations shall be guided by Practice C 1045. Determination shall be made at four or more mean temperatures. Two of the test mean temperatures shall be within 50°F (28°C) of the highest and lowest mean temperatures specified in Table 1 for the appropriate insulation type. The other two determinations shall be made at temperatures spaced within the specified mean temperature range. The results of these tests shall be extended, through reasonable curve fitting techniques, to establish the apparent thermal conductivity at the specified mean temperatures.

11.1.3.3 Thermal performance must be assessed on actual pipe insulation sections. Data obtained on flat samples, using

Test Method C 177, shall not be used to state compliance with this specification.

11.1.3.4 The delta T comprising the test temperatures shall comply with the intent of the large delta T recommendations of Practice C 1058.

11.1.4 *Water Vapor Sorption*—Test Method C 1104/C 1104M.

11.1.5 *Surface Burning Characteristics*—Test Method E 84.

11.1.5.1 Flat specimens otherwise identical in composition to pipe insulation shall be used. This applies to plain and factory-jacketed products.

11.1.6 *Hot Surface Performance*—Test Method C 411.

11.1.6.1 A 3-in. (75-mm) nominal pipe size or larger shall be used. A test specimen shall be at least 36 in. (914 mm) in length. All types shall be tested at 6-in. (150-mm) nominal thickness.

11.1.6.2 The test pipe shall be at the Type I, Type II, or Type III temperature specified in 4.1, when the insulation is applied. Any special requirement for heat-up shall be specified by the manufacturer.

11.1.7 *Sag Resistance*:

11.1.7.1 *Scope*—This procedure is used to determine thickness loss as a result of exposure to maximum service during the hot surface performance test.

11.1.7.2 *Significance and Use*—Products having excessive thickness loss at elevated temperature could yield less than expected in-service performance.

11.1.7.3 *Procedure*—For the sag determination, measure the thickness of the test length before and after 96 h hot surface exposure. A pin gage suitable for this is described by Test Methods C 167. The measurement shall be taken at the top longitudinal center of the horizontally mounted test specimen. The pin gage shall be vertically inserted through the insulation to obtain tip contact with the hot pipe surface. The pin gage shall be read with a steel rule to the nearest 1/32-in. (1 mm). Calculate the thickness sag as follows:

$$\% \text{ change} = ((t1 - t2)/t1) \times 100 \quad (1)$$

where:

$t1$ = starting thickness, and
$t2$ = thickness after 96 h.

11.1.7.4 *Precision and Bias*—No statement is made about either the precision or bias of the sag determination test since the result merely states whether there is conformance to the criteria for success specified in Table 1.

11.1.8 *Non-fibrous Content (Shot)*—Non-fibrous content shall be determined in accordance with Specification C 612.

11.1.9 *Stress Corrosion Performance*—When requested, compliance with Specification C 795 is necessary.

12. Qualification Requirements

12.1 The following requirements shall be employed for the purpose of product qualification:

12.1.1 Density and dimensions,
12.1.2 Linear shrinkage,
12.1.3 Apparent thermal conductivity,
12.1.4 Surface burning characteristics,
12.1.5 Hot surface performance,
12.1.6 Sag resistance,
12.1.7 Water vapor sorption, and
12.1.8 Non-fibrous content (shot).

13. Inspection

13.1 When agreed upon between the purchaser and manufacturer or supplier, the inspection of material shall be made at either the point of shipment or the point of delivery. The following requirements are generally employed for the purposes of acceptance and sampling of lots, on shipments of qualified insulation:

13.1.1 Dimensional tolerances, and
13.1.2 Workmanship.

13.2 *Rejection*—Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the manufacturer or supplier promptly and in writing. The manufacturer and supplier have the right to verify rejected products.

14. Packaging and Package Marking

14.1 *Packaging*—Mineral fiber preformed pipe insulation shall be packaged in the manufacturer's standard commercial container unless otherwise agreed upon between the buyer, seller, and the manufacturer.

14.2 Unless otherwise specified, each container shall be marked with the manufacturer's name, product name, quantity, nominal dimension, manufacturer's lot or date code identification, and facing, if any, on the material in the container. When specified in the purchase order or contract, each container shall also be marked with the appropriate Specification C 547 type and maximum use temperature.

15. Keywords

15.1 mineral fiber thermal insulation; molded; physical properties; pipe insulation; precision v-groove; thermal properties