



Designation: **C1676—08 C1676/C1676M – 14**

Standard Specification for Microporous Thermal Insulation¹

This standard is issued under the fixed designation ~~C1676~~**C1676/C1676M**; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers the composition, physical properties, and product forms of microporous thermal insulation for use on surfaces at temperatures from ~~80~~**80** $^{\circ}\text{C}$ (~~176~~**176** $^{\circ}\text{F}$) [~~176~~**176** $^{\circ}\text{F}$] up to ~~450~~**450** $^{\circ}\text{C}$ (~~2102~~**2102** $^{\circ}\text{F}$), [2102 $^{\circ}\text{F}$], unless otherwise agreed upon by the manufacturer and purchaser.

1.2 This specification only covers microporous thermal insulation comprising compacted powder, fibers and opacifiers.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. ~~The inch-pound equivalents of SI units, given in parentheses, are given for information only and are only approximate standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.~~

1.4 *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:*²

C165 Test Method for Measuring Compressive Properties of 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

C201 Test Method for Thermal Conductivity of Refractories

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

C303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation

C335 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

C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

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

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

C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions

C1104/C1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation

E84 Test Method for Surface Burning Characteristics of Building Materials

3. Terminology

3.1 *Definitions*—For definitions used in this specification, see Terminology **C168**.

3.2 *Definitions of Terms Specific to This Standard:*

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.

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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.

3.2.1 *flexible microporous insulation, n—insulation* that is capable of conforming to a non planar surface being insulated without damage over a specified temperature range.

3.2.2 *rigid microporous insulation, n—insulation* that will be damaged when forced to conform to a non-planar surface being insulated.

4. Classification

4.1 Microporous thermal insulation covered by this specification shall be classified into three types as shown in **Table 1**. Type classification is based on the physical form in which the insulation is manufactured.

4.2 Microporous thermal insulation covered by this specification shall be classified into four grades as shown in **Table 2**. Grade classification is based on the maximum recommended use temperature of the insulation.

4.3 Grade 2B microporous insulation is hydrophobic and has been chemically treated to make the material water-repellant.

4.3.1 Grade 2B, hydrophobic insulation, will retain its water repellency up to 250 °C (482 °F). At higher temperatures, the treatment will degrade at a rate which depends on the temperature applied. The user shall contact the manufacturer for specific information on the lifetime of the treatment at higher temperatures than 250 °C (482 °F).

4.3.2 Grade 2B, hydrophobic insulation, which has been heated to the point where the hydrophobic treatment is destroyed, performs as Grade 2 insulation with a use temperature of 1000 °C (1832 °F).

5. Ordering Information

5.1 The type, grade and dimensions shall be specified by the purchaser.

5.2 The purchaser shall specify inspection of the material, where required.

5.3 When a certification, test report, or both, are required, it shall be specified by the purchaser.

5.4 The purchaser and supplier shall agree whether the insulation shall be supplied plain or with facings to facilitate ease of handling, to minimize dust generation, or to resist the ingress of water. If faced, the purchaser and supplier shall agree on the type and requirements. (**Warning**—The purchaser is advised that the maximum use temperature of facings, adhesives, and thread is usually lower than the maximum use temperature of the insulation. The purchaser and supplier shall agree whether the facings need to maintain their integrity on heating or whether they are sacrificial).

6. Materials and Manufacture

6.1 *Composition*—Microporous insulation shall be comprised of compacted inorganic metal oxide powders of surface area greater than 90 m²/g (3,052 [3,052 sq yd/oz], powdered inorganic infra-red opacifiers and man-made or natural fibers or filaments. Asbestos shall not be used as an ingredient or component of the product.

TABLE 1 Types of Microporous Insulation

Type	Definition
Type I — Boards	Boards are rigid pieces of microporous insulation of rectangular shape and cross-section in which the thickness is uniform and substantially smaller than the other dimensions. The density of boards is in the range 200 to 450 kg/m ³ (12.5 to 28.1 lb/ft ³). They are supplied either unfaced or faced. Facing materials often have maximum service temperatures lower than that of the insulation and degrade without affecting the insulation properties in service.
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Type II — Quilted Panels	Quilted panels are flexible panels completely encased in woven glass cloth and stitched completely through parallel or crosswise in distances from 25 to 100 mm (1 to 4 in.) in order to give flexibility in one or two dimensions. Thread types used include glass, aramid, or stainless steel. The density of quilted panels is in the range 190 to 300 kg/m ³ (11.9 to 18.7 lb/ft ³). The glass cloth is provided for handling purposes only and embrittles or melts at temperatures below the maximum usage temperature of the insulation without affecting the insulation properties in service.
Type II — Quilted Panels	Quilted panels are flexible panels completely encased in woven glass cloth and stitched completely through parallel or crosswise in distances from 25 to 100 mm [1 to 4 in.] in order to give flexibility in one or two dimensions. Thread types used include glass, aramid, or stainless steel. The density of quilted panels is in the range 190 to 300 kg/m ³ [11.9 to 18.7 lb/ft ³]. The glass cloth is provided for handling purposes only and embrittles or melts at temperatures below the maximum usage temperature of the insulation without affecting the insulation properties in service.
Type III — Molded Pipe Sections	Molded Pipe sections are half-shells or segments of microporous insulation faced with woven glass cloth and high-temperature adhesive for the insulation of cylindrical objects such as pipes. The density of pipe sections is in the range 300 to 400 kg/m ³ (18.7 to 25.0 lb/ft ³). The glass cloth is provided for handling purposes only and embrittles or melts at temperatures below the maximum usage temperature of the insulation without affecting the insulation properties in service.
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TABLE 2 Grades of Microporous Insulation

Grade	Grade Temperature of use, °C (°F), max
1	900 (1652)
2A	1000 (1832)
2B ^A	250 (482)
3	1150 (2102)

TABLE 2 Grades of Microporous Insulation

Grade	Grade Temperature of use, °C [°F], max
1	900 [1652]
2A	1000 [1832]
2B ^A	250 [482]
3	1150 [2102]

^ASee 4.3 for a definition of the difference between Grades 2A and 2B.

6.2 Typical facings are as follows:

- 6.2.1 Glass cloth, wrapped around or adhered to the surface of the microporous insulation with an alkali silicate based adhesive;
- 6.2.2 For other facings, if available, contact the manufacturer.

7. Physical Properties

7.1 The microporous insulation shall conform to the physical requirements described in Tables 3-5, other than for maximum density which is provided for information only. Consult the manufacturer for specific design recommendations for all material types, grades, and classes.

7.2 The user is advised that some applications require knowledge of the thermal conductivity of the insulation material at mean temperatures above those shown. Consult the manufacturer for data at mean temperatures exceeding those listed.

7.3 The physical requirements are based on the properties of samples dried and conditioned, or both, as specified in the referenced test methods. Microporous insulation, other than grade 2 hydrophobic, tends to absorb moisture to varying degrees depending on exposure conditions. It can absorb up to 4 times its dry weight if placed in direct contact with water through improper storage or application. Proper packaging and storage is required as defined in 15.1.

TABLE 3 Type I Boards

Properties	Grade 1	Grade 2	Grade 2 hydrophobic	Grade 3
Maximum usage temperature °C (°F) ^A	900 (1652)	1000 (1832)	1000 (1832)	1150 (2102)
Maximum usage temperature °C [°F] ^A	900 [1652]	1000 [1832]	1000 [1832]	1150 [2102]
Apparent thermal conductivity W/m·K (Btu-in./h·ft ² ·°F), max				
At mean temperature °C (°F)				
Apparent thermal conductivity W/m·K [Btu-in./h·ft ² ·°F], max				
At mean temperature °C [°F]				
100 (212)	0.027 (0.187)	0.027 (0.187)	0.027 (0.187)	0.033 (0.229)
200 (392)	0.029 (0.201)	0.029 (0.201)	0.029 (0.201)	0.035 (0.236)
300 (572)	0.031 (0.215)	0.031 (0.215)	0.031 (0.215)	0.037 (0.257)
400 (752)	0.034 (0.236)	0.034 (0.236)	0.034 (0.236)	0.040 (0.270)
500 (932)	0.038 (0.263)	0.038 (0.263)	0.038 (0.263)	0.044 (0.284)
600 (1112)	0.042 (0.294)	0.042 (0.294)	0.042 (0.294)	0.047 (0.326)
800 (1472)	0.054 (0.371)	0.054 (0.371)	0.054 (0.371)	0.053 (0.367)
100 [212]	0.027 [0.187]	0.027 [0.187]	0.027 [0.187]	0.033 [0.229]
200 [392]	0.029 [0.201]	0.029 [0.201]	0.029 [0.201]	0.035 [0.236]
300 [572]	0.031 [0.215]	0.031 [0.215]	0.031 [0.215]	0.037 [0.257]
400 [752]	0.034 [0.236]	0.034 [0.236]	0.034 [0.236]	0.040 [0.270]
500 [932]	0.038 [0.263]	0.038 [0.263]	0.038 [0.263]	0.044 [0.284]
600 [1112]	0.042 [0.294]	0.042 [0.294]	0.042 [0.294]	0.047 [0.326]
800 [1472]	0.054 [0.371]	0.054 [0.371]	0.054 [0.371]	0.053 [0.367]
Linear shrinkage, %, in the length and width dimensions at maximum usage temperature, max	2	2	2	2
Linear shrinkage, %, in the thickness dimension at maximum usage temperature, max	10	10	10	10
Water vapor sorption, max, % by weight	10	10	5	10
Water vapor sorption, max, % by weight	17	17	5	10
Compressive strength, min at 10% deformation kPa, (psi)	140 (20.3)	140 (20.3)	100 (14.5)	100 (14.5)
Compressive strength, min at 10% deformation kPa, [psi]	140 [20.3]	140 [20.3]	100 [14.5]	100 [14.5]
Surface Burning Characteristics:				
Flame spread index, max	0	0	0	0
Smoke developed index, max	10	10	10	10
Corrosiveness	Passed	Passed	Passed	Passed

^ASee Warning statement in 5.4.