Designation: C 553 – 00~~2~~

Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications[1]

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

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.23 on Blanket and Loose Fill.

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1. Scope

1.1 This specification covers the classification, composition, physical properties, and dimensions of mineral fiber (rock, slag, or glass) blanket intended for use as thermal insulation on surfaces at temperatures below ambient or above ambient up to 1200°F (649°C). For specific applications, the actual temperature limit shall be agreed upon between the supplier and the purchaser.

1.2 The orientation of the fibers within the blanket is primarily parallel to the principal surface (face). This specification does not cover fabricated pipe and tank wrap insulation where the insulation has been cut and fabricated to provide a fiber orientation that is perpendicular to the surface (face).

1.3 For satisfactory performance, properly installed protective vapor retarders must be used in low temperature (below ambient) applications to prevent movement of water vapor through or around the insulation towards the colder surface.

1.4 This standard does not purport to provide the performance requirements of hourly-rated fire systems. Consult the manufacturer for the appropriate system.

1.5 The values stated in inch-pound units ~~are to~~ shall be regarded as the standard. The System International (SI) equivalents of inch-pound units are given in parentheses and are for information only and ~~may be~~ are approximate.

1.~~5~~6 *This standard does not purport to address all of the safety concerns 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~~ Insulation[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 ~~390 Criteria~~ 390 Practice for Sampling and Acceptance of Preformed Thermal Insulation Lots[2]

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

C 447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations[2]

C 518 Test Method for Steady-State ~~Heat Flux Measurements and~~ Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[2]

C 665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing[2]

C 680 Practice for Determination of Heat Gain or Loss and the Surface Temperatures of Insulated Pipe and Equipment Systems by the Use of a Computer Program[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 1101/C 1101M Test Method for Classifying the Flexibility or Rigidity of Mineral Fiber Blanket and Board Insulation[2]

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

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

C 1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus[2]
C 1136 Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulations[2]
C 1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials[2]
C 1335 Test Method for Measuring the Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulations[2]
E 84 Test Method for Surface Burning Characteristics of Building Materials[3]
2.2 *Other Referenced Documents:*
CAN/ULC-S102–M88 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies[4]

3. Terminology

3.1 *Definitions*—For definitions used in this specification, refer to Terminology C 168.
3.2 *Definitions of Terms Specific to This Standard:*
3.2.1 *mean temperature*—the sum of the cold surface temperature and the hot surface temperature divided by two.
3.2.2 *shot*—shot is defined, for the purposes of this document, as that material which cannot be brushed or mechanically shaken through No. 100 (150µm) sieve.

4. Classification

4.1 Mineral fiber blanket insulation covered by this specification shall be classified into seven types shown in Table 1. The classification is based upon the insulations' maximum use temperature and apparent thermal conductivity.

5. Ordering Information

5.1 The type, dimensions, maximum use temperature, and facing ~~(if required)~~ shall be specified by the purchaser. A product certification ~~may~~ (if required) shall be specified in the purchase order.

6. Materials and Manufacture

6.1 *Composition*—Mineral fiber blanket insulation shall be composed of rock, slag, or glass processed from the molten state into fibrous form bonded with an organic or inorganic binder, or both. Asbestos shall not be used as an ingredient or component part of the product.
6.2 *Facings*:
6.2.1 The purchaser shall specify whether the insulation shall be supplied plain or with facing, and if faced, shall specify the type and its requirements.
(**Warning—**The user of this specification is advised that the maximum use temperature of facing and adhesives may be lower than the maximum use temperature of the insulation. The user of this specification shall ensure that sufficient insulation thickness

[3] *Annual Book of ASTM Standards*, Vol 04.07.
[4] Available from Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, Canada M1R 3A9.

TABLE 1 Physical Property Requirements[A]

Properties	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
Maximum Use Temperature °F (°C) See Paragraph 6.2.1 - **Warning**	Up to 450 (232)	Up to 450 (232)	Up to 450 (232)	Up to 850 (454)	Up to 1000 (538)	Up to 1000 (538)	Up to 1200 (649)
Apparent Thermal Conductivity Max. Btu·in./h·ft²·°F (W/m·K) Mean Temperatures							
°F (°C)							
75 (24)	0.36 (0.052)	0.31 (0.045)	0.26 (0.038)	0.25 (0.036)	0.31 (0.045)	0.26 (0.038)	0.25 (0.036)
100 (38)	0.39 (0.056)	0.33 (0.048)	0.28 (0.040)	0.27 (0.039)	0.33 (0.048)	0.28 (0.040)	0.27 (0.039)
200 (93)	0.55 (0.079)	0.44 (0.063)	0.36 (0.052)	0.34 (0.049)	0.44 (0.063)	0.36 (0.052)	0.34 (0.049)
300 (149)	0.76 (0.110)	0.60 (0.087)	0.46 (0.066)	0.43 (0.062)	0.60 (0.087)	0.46 (0.066)	0.43 (0.062)
400 (204)				0.55 (0.079)	0.89 (0.128)	0.60 (0.087)	0.55 (0.079)
500 (260)				0.70 (0.101)	1.10 (0.159)	0.80 (0.115)	0.70 (0.101)
600 (316)					1.50 (0.216)	1.05 (0.151)	0.89 (0.128)
700 (371)							1.13 (0.163)
Water Vapor Sorption[B] % by Weight, max	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Surface Burning Characteristics							
Flame Spread Index, max	25	25	25	25	25	25	25
Smoke Developed Index, max	50	50	50	50	50	50	50

[A] Additional physical property requirements, refer to Section 7.
[B] Water sorption characteristics may change after the product is subject to elevated temperatures within normal service conditions.

is installed so that none of these accessory items (facings and adhesives) are exposed to temperatures above their maximum use temperature. Practice C 680 can be used to determine surface temperatures.)

6.2.2 The vapor retarder facings shall be in accordance with specification C 1136.

6.2.3 Typical ~~facings are~~ facing is as follows (others ~~may be~~ are available):

6.2.3.1 Aluminum foil, reinforced fiber glass scrim, and natural (brown) kraft paper laminate (facing) ~~generally~~ is known as FRK or FSK,

6.2.3.2 White kraft paper, reinforced fiber glass scrim, and aluminum foil laminate (facing) ~~generally~~ is known as ASJ (All Service Jacket),

6.2.3.3 Aluminum foil, reinforced fiber glass scrim, and plastic film (example: polyethylene) laminate (facing) ~~generally~~ is known as FSP (Foil - Scrim - Polyethylene),

6.2.3.4 Aluminum foil, and

6.2.3.5 Vinyl film.

7. Physical Property Requirements

7.1 The insulation shall be classified as flexible, when tested in accordance with 11.7.

7.2 The insulation type shall conform to the following requirements in Table 1: maximum use temperature, apparent thermal conductivity, water vapor sorption, and surface burning characteristics.

7.3 *Odor Emission*—A detectable odor of objectionable nature recorded by more than two of the five panel members shall constitute rejection of the material when tested in accordance with 11.5.

7.4 *Corrosiveness to Steel*—When tested and evaluated in accordance with 11.6, any corrosion resulting from the unfaced insulation in contact with steel plates shall be judged to be no greater than for comparative plates in contact with sterile cotton. (**Warning—** There are facing adhesives that can cause corrosion to steel when in contact with water or water vapor and the steel. Currently, there is no test method available to satisfy every potential corrosion application.)

7.5 *Non-Fibrous (Shot) Content*—The averaged maximum shot content of rock or slag mineral fiber products, Types I through VII as shown in Table 1, shall not exceed 30 % by weight as defined in 11.1. Non-fibrous content is not applicable to glass mineral fiber products.

7.6 *Maximum Use Temperature*—Shall be tested in accordance with 11.3, the insulation with facing shall not warp, flame or glow during hot surface exposure. No evidence of melting or fiber degradation shall be evident upon post-test inspection.

7.7 *Maximum Exothermic Temperature Rise*—Shall be tested in accordance with 11.3, the mid-point temperature shall not at any point in time exceed the hot surface temperature by more than 200°F (111°C). The 200°F (111°C) criterion applies during heat-up as well as steady state conditions. Exceeding this limit shall constitute non-compliance to specification and rejection.

8. Dimensions and Permissible Variations

8.1 The standard sizes and tolerances of mineral fiber blanket insulation ~~generally available~~ are listed in Table 2. Specific sizes and tolerances ~~can~~ shall be agreed upon between the purchaser and supplier.

8.2 The maximum density (determined in accordance with Test Method C 167) specified in Table 3 for Type(s) I through Type VII are for weight design purposes only.

TABLE 2 Sizes and Tolerances[A]

Mineral Fiber Blanket		
	Sizes	Tolerances
Length		
Rolls	50 ft. (15 m) 75 ft. (23 m) 100 ft. (30 m) 150 ft. (48 m) 200 ft. (61 m)	−0 in., excess permitted
Blanket	24 in. (610 mm) 36 in. (914 mm) 48 in. (1219 mm) 96 in. (2438 mm)	±½ in. (12.7 mm)
Width		
Rolls	24 in. (610 mm) 48 in. (1219 mm) 96 in. (2438 mm)	±½ in. (12.7 mm)
Blanket	12 in. (305 mm) 24 in. (610 mm) 36 in. (914 mm) 48 in. (1219 mm)	±½ in. (12.7 mm)
Thickness		
	1 in. (25.4 mm) to 6 in. (152 mm) in ½in. (12.7 mm) increments	−⅛in. (3.2 mm) excess permitted

[A]Other sizes available upon request.

TABLE 3

	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
Maximum density, lb/ft^3 (kg/m^3), for weight design purposes only	6.0 (96)	6.0 (96)	6.0 (96)	8.0 (128)	10 (160)	10 (160)	12 (192)

9. Workmanship

9.1 The insulation shall have good workmanship and shall not have defects which adversely affect its installation and performance qualities.

10. Sampling

10.1 Inspection and qualification of the insulation shall be in accordance with Criteria C 390, or as otherwise specified in the purchase order or contract as agreed upon between the purchaser and the supplier.

11. Test Methods

11.1 *Non-Fibrous (Shot) Content of Inorganic Fibrous Thermal Insulation*—Shall be tested in accordance with Test Method C 1335.

11.2 *Apparent Thermal Conductivity*:

11.2.1 The thermal conductivity as a function of temperature for the representative specimens shall be determined with data obtained from a series of thermal tests utilizing Test Methods C 177, C 518, or C 1114 as appropriate for the material under study. Specimen shall be tested unfaced and at a maximum thickness of 2 in. (51 mm).

11.2.1.1 Test Method C 518 shall not be used at temperatures or resistances other than those in the range of the calibration.

11.2.1.2 Test Method C 1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C 177.

11.2.2 The test method selected shall have proven correlation with C 177 over the temperature range of conditions used. In cases of dispute, C 177 shall be considered as the final authority for material having flat geometry.

11.2.3 Practice C 1058 ~~may~~ shall be used to obtain recommended test temperature combinations for testing purposes.

11.2.4 As specified in C 1045, the range of test conditions must include at least one test where the hot surface temperature is greater than, or equal to, the hot limit of the temperature range of desired data and at least one test where the cold surface temperature is less than, or equal to, the cold limit of the temperature range desired. Additional tests, at least two additional, shall be distributed somewhat evenly over the rest of the temperature range.

11.2.5 Final analysis of the thermal data shall be conducted in accordance with C 1045 to generate a thermal conductivity versus temperature relationship for the specimen.

11.2.6 Final step of C 1045 analysis would be to calculate the thermal conductivity using the equations generated at a set of mean temperatures for comparison to the specification.

(**Warning—** While it is recommended that the specification data be presented as conductivity versus temperature, several existing specifications may contain mean temperature data from tests conducted at specific hot and cold surface temperatures. In these cases, the conductivity as a function of temperature from the C 1045 analysis may provide different results. To insure that the data is compatible, a C 680 analysis, using the conductivity versus temperature relationship from C 1045 and the specific hot and cold surface temperatures, is required to determine the effective thermal conductivity for comparison to the specification requirements.)

11.3 *Maximum Use Temperature and Exothermic Temperature Rise*—Shall be tested in accordance with Test Method C 411 and the hot surface performance section of Practice C 447 at the manufacturer's maximum recommend thickness for each temperature. The test surface shall be at the intended surface temperature when test begins. No special requirements for heat-up shall be specified by the manufacturer to qualify product compliance with either maximum use temperature or maximum exothermic temperature rise.

11.4 *Surface Burning Characteristics*—Test in accordance with Test Method E 84. For Canada, test in accordance with Test Method CAN/ULC-S102–M88. Test with facing and adhesive in place, if facing is intended to be on the end product.

11.5 *Odor Emission*—Test in accordance with Test Method C 1304.

11.6 *Corrosion to Steel*—Test in accordance with the corrosiveness method of Specification C 665.

11.7 *Flexibility and Rigidity*—Test in accordance with Test Method C 1101/C 1101M (except use 1 in. (25.4 mm) thick material) for classifying the flexibility of mineral fiber blanket insulation.

11.8 *Water Vapor Sorption*—Test in accordance with Test Method C 1104/C 1104M for determining the water vapor sorption of unfaced mineral fiber insulation.

12. Qualification Requirements

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

12.1.1 Flexibility,

12.1.2 Maximum use temperature,
12.1.3 Apparent thermal conductivity,
12.1.4 Water vapor sorption,
12.1.5 Odor emission,
12.1.6 Surface burning characteristics,
12.1.7 Corrosiveness, and
12.1.8 Shot content.

13. Inspection

13.1 The following requirements ~~are~~ shall be generally employed for purposes of acceptance sampling of lots or shipments of qualified insulation:
13.1.1 Dimensional tolerance, and
13.1.2 Workmanship.

14. Rejection

~~14.1 Material that fails~~
14.1 Failure to conform to the requirements ~~of~~ in this specification ~~may be rejected.~~ shall constitute cause for rejection. Rejection ~~should~~ shall be reported to the manufacturer or seller promptly and in writing. The manufacturer and supplier have the right to verify rejected products.

15. Certification

15.1 When specified in the purchase order or contract, the manufacturer's or seller's certification shall be furnished to the purchaser stating that samples representing each lot have been manufactured, tested, and inspected in accordance with this specification and the requirements have been met. A report of the test results shall be furnished when specified in the purchase order or contract.

16. Packaging and Package Marking

16.1 *Packaging*—Unless otherwise specified, the insulation shall be packaged in the manufacturer's standard commercial containers.
16.2 *Markings*—Unless otherwise specified, each container shall be plainly marked with the manufacturer's name, manufacturer's address, the product name, type, quantity, nominal dimensions, facing, manufacturer's lot or date code, and the generic identification of the material in the container.
16.3 When specified in the purchase order or contract, each container shall also be marked with the appropriate Specification alpha-numeric number and type.

17. Keywords

17.1 blanket; glass fiber; high temperature; mineral fiber insulation; rock fiber; shot; shot content; slag fiber