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Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)¹

This standard is issued under the fixed designation C592; 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.

1. Scope

1.1 This specification covers the composition, dimensions, and physical properties of ~~metal-mesh covered~~ mineral fiber (rock, slag, or glass) metal mesh covered and industrial type blanket and blanket-type pipe insulation (typically on 24 in. (610 mm) diameters or ~~larger~~ larger). Its use ~~on~~ is for cooled surfaces at temperatures operating below ambient to 0°F (-18°C) and on heated surfaces on expansion joints to large diameter vessels and tanks operating at temperatures up to 1200°F (649°C). Specific applications outside the actual use temperatures shall be agreed upon between the manufacturer and purchaser.

1.2 For satisfactory performance, properly installed protective vapor retarders or barriers shall be used on below ambient temperature applications to reduce movement of moisture/water vapor through or around the insulation towards the colder surface. Failure to use a vapor retarder can lead to insulation and system damage. Refer to Practice C921 to aid material selection. Although vapor retarder properties are not part of this specification, properties required in Specification C1136 are pertinent to applications or performance.

1.3 The orientation of the fibers within the blanket is primarily parallel to the heated surface. This specification does not cover fabricated pipe and tank wrap insulation where the insulation has been cut and fabricated to provide fiber orientation that is perpendicular to the heated 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 See Supplementary Requirements for modifications to sections in this standard only when specified by purchaser in the contract or order from the U.S. Military specifications utilized by the U.S. Department of Defense, Department of the Navy, and the Naval Systems Command.

1.6 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.

1.7 *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 requirements prior to use.*

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

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

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

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

~~E795 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 C16.23 on Blanket and Loose Fill Insulation.

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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.

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

C921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

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

C1058 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

C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus

C1136 Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

C1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials

C1335 Test Method for Measuring Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation

C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings

E84 Test Method for Surface Burning Characteristics of Building Materials

E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750C

2.2 *Other Document:*

CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies³

3. Terminology

3.1 Terminology C168 shall be the terms used in this specification.

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 *metal-mesh covered blanket*—mineral fiber thermal insulation held together by metal-mesh facings on one or both sides with heat-resistant metal ties attached through the blanket from one face to the other.

3.2.3 *metal-mesh covered blanket-type pipe*—mineral fiber thermal insulation sized to fit around a large Nominal Pipe Size (NPS) and held together by metal-mesh facings on one or both sides with heat-resistant metal ties attached through the blanket from one face to the other.

3.2.4 *industrial type (faced and unfaced) blanket*—mineral fiber thermal insulation without a metal mesh covering.

3.2.5 *industrial type (faced and unfaced) blanket-type pipe*—mineral fiber thermal insulation without a metal mesh covering and sized to fit around a large Nominal Pipe Sizes (NPS)

4. Classification

4.1 Mineral fiber ~~metal-mesh covered~~ blanket insulation covered by this specification shall be classified into the ~~three~~four types shown in Table 1. ~~The classification is based upon the maximum use temperature and apparent thermal conductivity.~~ TYPE I, II, and III are classified as metal-mesh covered blankets and TYPE IV is classified as industrial type, non-metal-mesh covered (faced & unfaced) blanket. The classification is based upon the maximum use temperature and apparent thermal conductivity. 12

5. Ordering Information

5.1 The type, dimensions, maximum use temperature, and metal mesh covering or facings for one or both sides, or a combination thereof, shall be specified by the purchaser. A product certification shall be specified in the purchase order.

6. Materials and Manufacture

6.1 *Composition*—Mineral fiber ~~metal-mesh covered~~ blanket shall be composed of rock, slag, or glass processed from the molten state into fibrous form, bonded with or without an organic ~~binder, and binder~~; the metal-mesh covered blanket is secured with metallic supporting facing(s), tie-wires or metal stitching. Asbestos shall not be used as an ingredient or component part of the product.

6.2 *Facings:*

6.2.1 Types of facings for one or both sides of blanket units shall be specified. When both sides are to be faced, units are permitted to have the same or different types on the two sides. ~~(Warning—The~~

6.2.1.1 The user of this specification is advised that the maximum use temperature of some facings and adhesives will be lower than the maximum use temperature of the insulation. For example, usually galvanized hexagonal wire-woven netting and tie wires or stitching perform well under continuous exposure to temperatures up to 392°F (200°C). Exposure to temperatures above this limit will cause the outer free zinc layer to peel. Though there are potential or occasional concerns for corrosion conditions at various temperatures, galvanized wire, stitching, or facings are not recommended for temperatures above 500°F (260°C). In addition, the user of this specification shall ensure that sufficient insulation thickness is installed so that none of the accessory items (facings, adhesive, coatings, and lagging) are exposed to temperatures above their maximum use temperature. As a general rule, Practice C680 shall be used to determine surface temperatures.)

³ Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

³ Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, <http://www.ul.com>.

TABLE 1 Physical Requirements

Properties	Type I	Type II	Type III	Type IV ^A
Maximum use temperature °F (°C)	850 (454)	1200 (649)	1200 (649)	
Maximum use temperature °F (°C) (see 6.2.1) (Excluding metal mesh facings and metal tie-wires/stitching) (see 6.2.1) (Excluding metal-mesh all facings and metal tie-wires/stitching)	<u>850 (454)</u>	<u>1200 (649)</u>	<u>1200 (649)</u>	<u>1200 (649)</u>
Apparent Thermal Conductivity ^A				
Apparent Thermal Conductivity ^B (Excluding metal mesh facings and metal tie-wires/stitching) (Excluding all facings and metal tie-wires/stitching)				
max Btu, in./h ft ² °F (W/m K)				
Mean Temperature, °F (°C)				
25 (-4)	0.21 (0.030)	0.21 (0.030)	0.23 (0.033)	
25 (-4)	0.21 (0.030)	0.21 (0.030)	0.23 (0.033)	0.23 (0.033)
75 (24)	0.25 (0.036)	0.25 (0.036)	0.24 (0.035)	
75 (24)	0.25 (0.036)	0.25 (0.036)	0.24 (0.035)	0.24 (0.035)
100 (38)	0.27 (0.039)	0.27 (0.039)	0.26 (0.038)	
100 (38)	0.27 (0.039)	0.27 (0.039)	0.26 (0.038)	0.26 (0.038)
200 (93)	0.34 (0.049)	0.34 (0.049)	0.31 (0.045)	
200 (93)	0.34 (0.049)	0.34 (0.049)	0.31 (0.045)	0.31 (0.045)
300 (149)	0.43 (0.062)	0.42 (0.060)	0.37 (0.053)	
300 (149)	0.43 (0.062)	0.42 (0.060)	0.37 (0.053)	0.37 (0.053)
400 (204)	0.55 (0.079)	0.53 (0.076)	0.44 (0.063)	
400 (204)	0.55 (0.079)	0.53 (0.076)	0.44 (0.063)	0.44 (0.063)
500 (260)	0.70 (0.101)	0.64 (0.092)	0.52 (0.075)	
500 (260)	0.70 (0.101)	0.64 (0.092)	0.52 (0.075)	0.52 (0.075)
600 (316)	0.75 (0.108)	0.75 (0.108)	0.60 (0.087)	
600 (316)	0.75 (0.108)	0.75 (0.108)	0.60 (0.087)	0.60 (0.087)
700 (371)	0.86 (0.124)	0.86 (0.124)	0.70 (0.101)	
700 (371)	0.86 (0.124)	0.86 (0.124)	0.70 (0.101)	0.70 (0.101)
Linear Shrinkage, max % at maximum use temperature	4.0	4.0	4.0	
Linear Shrinkage, max % at maximum use temperature	4.0	4.0	4.0	4.0
Water Vapor Sorption, ^B max % by weight	5.0	5.0	1.25	
Water Vapor Sorption, ^C max % by weight	5.0	5.0	1.25	1.25
Surface Burning Characteristics				
Maximum flame spread index	25	25	25	
Maximum flame spread index	25	25	25	25
Maximum smoke developed index	50	50	50	
Maximum smoke developed index	50	50	50	50
Density maximum, ^C lb/ft ³ (kg/m ³)	10 (160)	12 (192)	8 (128)	8 (128)
Density maximum, ^D lb/ft ³ (kg/m ³)	10 (160)	12 (192)	8 (128)	8 (128)

^A Type IV is for the Industrial Type, non-metal-mesh covered blankets only.

^B Values for apparent thermal conductivity are for insulation and do not include mesh and wire through insulation thickness. Therefore, Practice C680 or other heat loss analysis using these data are not possible without accounting for heat losses through attaching media.

^C Some water sorption characteristics will change after the product is subjected to elevated temperatures within normal service conditions.

^D The maximum density specified is for the weight design purpose only and includes weight for the facings. Additional density requirements including the density for the blanket without facing(s) are permitted to be specified by agreement between the purchaser and the manufacturer or seller.

6.2.2 Standard Types of Metal Mesh Used as Facings:

6.2.2.1 Woven netting, No. 20 to 22 gage (0.88 to 0.73 mm) diameter, galvanized wire mesh, 1 in. (25 mm) hexagonal shaped.

6.2.2.2 Woven netting, nonferrous No. 20 to 22 gage (0.82 to 0.64 mm) diameter, 300 series stainless steel wire mesh, 1 in. (25 mm) hexagonal shaped.

6.2.2.3 Stucco expanded metal lath, (painted finish, not flattened, not galvanized) having 1.5 in. (38 mm) diamond-shaped openings, No. 18 gage (1.2 mm) thickness, weighing 1.8 lb/yd² (1010 g/m²).

6.2.2.4 Expanded metal lath, (painted finish, not flattened, not galvanized) having diamond-shaped openings, weighing 2.5 lb/yd² (1400 g/m²).

6.2.3 Other kinds or compositions of facings are permitted to be specified.

6.3 Manufacture/Fabrication:

6.3.1 ~~Metallic~~ 6.3.1 Metal mesh facing(s) or wire mesh(s) shall be secured to the insulation face on one or both side(s) with minimum (diameter) No. 28 gage (0.32 mm), 300 Series alloy, non-ferrous stainless steel tie wires or stitching no greater than 12 in. (305 mm) apart passing vertically through the blanket. Spacing (attachment pattern) for vertical steel tie wires and stitching must include rows within 2 in. (51 mm) from all edges of the blanket.

6.3.2 Minimum (diameter) No. 28 gage (0.41 mm) galvanized steel tie wires or stitching ~~are~~is permitted to be used for securement with galvanized steel facings.

6.4 Any non-metal mesh-facings for industrial type blanket and blanket-type pipe shall be adhered to the insulation face on one or both side(s).

7. Physical Requirements

7.1 *Handling and Transporting*—Each piece of ~~metal-mesh covered~~blanket insulation shall be coherent to permit handling / transportation and installation as a unit.

7.2 The blanket insulation type shall conform to the following requirements in Table 1: maximum use temperature, density (for weight design purposes only), 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 11.6.

7.4 *Corrosiveness to Steel, Copper, Aluminum*—When tested and evaluated in accordance with 11.7, the corrosion resulting from the unfaced insulation blanket in contact with metal plates shall be judged to be no greater than comparative plates in contact with sterile cotton.

7.5 *Non-Fibrous (Shot) Content*—The averaged maximum shot content of mineral fiber rock or slag type products shall not exceed ~~30%~~25 % by weight as defined in 11.3.

7.6 *Maximum Use Temperature*—When tested in accordance with 11.1, the blanket insulation 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*—When tested in accordance with 11.1, the ~~blanket mid-point~~internal temperature shall not at any time exceed the hot surface temperature by more than 100°F (55.5°C). The 100°F (55.5°C) criterion applies during heat-up as well as steady state conditions. Exceeding this limit constitutes noncompliance to specification.

~~7.8 Non-Combustibility—When tested in accordance with~~—When the blanket insulation, with all facings removed, is tested in accordance with 11.10, shall not exceed the recorded temperature rise shall not exceed more than 54°F (30°C) with no flaming and weight loss exceeding 5 %.

7.9 *Stress Corrosion to Austenitic Stainless Steel*—When specified, shall be tested and evaluated in accordance with 11.11.

7.10 *Fungi Resistance*— Shall be tested in accordance with 11.12; growth no greater than that on a comparative item (white birch wood) shall be considered to have passed the test method criteria.

8. Dimensions and Permissible Variations

8.1 *Dimensions*—~~Standard sizes of metal-mesh blanket insulation shall be as follows:-~~

8.1.1 Standard sizes of metal-mesh blanket insulation and non-metal-mesh industrial type blanket insulation shall be as follows:

ASTM C592-12

<https://standards.iteh.ai/catalog/standards/sist/3dcef54e-3cef-4990-889d-f203c10cac87/astm-c592-12>

Standard sizes of metal-mesh blanket insulation

Length	=	48 in. (1219 mm) and 96 in. (2438 mm)
Width	=	(except for Nominal Pipe Sizes (NPS) system) 24 in. (610 mm) and 36 in. (914 mm)
Thickness	=	1 to 6 in. (25 mm to 152 mm) ^A in ½ in. (13 mm) increments
<u>Standard sizes of non-metal-mesh industrial type blanket insulation</u>		
Length	=	48 in. (1219 mm), 96 in. (2438 mm) and up to 25 ft. (7.62 m) (except for Nominal Pipe Sizes (NPS) system)
Width	=	24 in. (610 mm), 36 in. (914 mm), and 48 in. (1219 mm)
Thickness	=	1 to 6 in. (25 mm to 152 mm) ^B in ½ in. (13 mm) increments

^AThickness over 2 in. (51 mm) may be composed of two or more blankets plied together to establish total thickness before facings applied. It is acceptable for thickness over 2 in. (51 mm) to be composed of two or more blankets plied together to establish total thickness before facings applied.

^BConsult manufacturer for maximum available thickness.

8.2 *Dimensional Tolerances*—The average measured length, width, and thickness shall differ from the manufacturer’s standard dimensions from the manufacturer by not more than the following:

		Blanket	Blanket-Type Pipe	Blanket-Type Roll
Length	=	± ½ in. (13 mm)	± ¼ in. (6 mm)	-0 in., excess permitted
Width	=	± ¼ in. (6 mm)	Not applicable	± ½ in. (12.7 mm)
Thickness	=	± ¼ in. (6 mm), -⅛ in. (3 mm)	+¼ in. (6 mm), -⅛ in. (3 mm)	-⅛ in. (3mm), (excess permitted)

8.2.1 *Pipe Diameters (Fit and Closure)*—When fitted around the appropriate size pipe, by banding on 9-in. (229-mm) centers, the longitudinal seams on both sides of the pipe insulation shall close along the entire length of the section or piece.

9. Workmanship

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

10. Sampling

10.1 Inspection and qualification of the insulation shall be in accordance with Practice C390 or as otherwise specified in the purchase order or contract as agreed upon between the purchaser, supplier, or the manufacturer, or a combination thereof.

11. Test Methods

11.1 *Maximum Use and Exothermic Temperature Rise*—The insulation blanket without any facings shall be tested in accordance with Test Method C411 and the hot surface performance section of Practice C447 at the insulation’s maximum use temperature of the insulation and at the manufacturer’s maximum recommended thickness stipulated by the manufacturer for that 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.

11.2 *Density:*

11.2.1 The thickness and density of insulation shall be tested in accordance with Test Methods C167.

11.2.2 The maximum density of a rock, slag or glass type of blanket insulation shall not exceed that shown in Table 1. When density is part of the purchase contract, the delivered product density shall be calculated on the basis of single package units excluding the container and metal-mesh-facing weights and with a tolerance of not more than -10 % on the individual package-container contents.

11.3 *Non-Fibrous (Shot) Content:*

11.3.1 The maximum non-fibrous (shot) content that would be retained on all screens (sieves) up to and including 100-mesh (150 µm) screen (sieve) as determined by the test method and calculation procedure in Test Method C1335.

11.3.2 A minimum of three specimens per lot (shipment) shall determine the averaged non-fibrous (shot) content. The manufacturer shall furnish certification of the shot content of the delivered product if so specified at time of purchase.

11.4 *Apparent Thermal Conductivity :*

11.4.1 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 C177, C518, or C1114 as appropriate for the material under study. Specimen shall be tested unfaced and at a maximum thickness of 2 in. (51 mm).

11.4.1.1 Test Method C518 shall not be used at temperatures or resistances other than those in the range of the calibration.

11.4.1.2 Test Method C1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C177.

11.4.1.3 Mineral fiber blanket-type insulations for pipes are typically used at 24-in. (610-mm) or larger diameter surfaces. Thermal calculations shall be based on a flat surface.

11.4.2 The test method selected shall have proven correlation with Test Method C177 over the temperature range of conditions used. In cases of dispute, Test Method C177 shall be the final authority for material having flat geometry.

11.4.3 Practice C1058 shall be used to obtain recommended test temperature combinations for testing purposes.

11.4.4 As specified in Practice C1045, 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, shall be distributed somewhat evenly over the rest of the temperature range.

11.4.5 Conduct final analysis of the thermal data in accordance with Practice C1045 to generate a thermal conductivity versus temperature relationship for the specimen.

11.4.6 The final step of Practice C1045 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~~

~~11.4.6.1 While it is recommended that the specification data be presented as thermal conductivity versus temperature, several existing specifications shall contain mean temperature data from tests conducted at specific hot and cold surface temperatures. In these cases, the thermal conductivity as a function of temperature from the Practice C1045 analysis will provide different results. To insure that the data are compatible, a Practice C680 analysis, using the thermal conductivity versus temperature relationship from Practice C1045 and the specific hot and cold surface temperatures, is required to determine the effective thermal conductivity for comparison to the specification requirements.)~~

11.5 *Surface Burning Characteristics*—Test the surface burning characteristics in accordance with Test Method E84. For Canada, test in accordance with Test Method CAN/ULC-S102. When the referenced Canadian document in this standard is referred to in applicable Canadian building codes, the editions, referenced by those building codes, shall govern. The test shall be performed with any facing in place, if facing is intended to be the end product. Tests for unfaced mineral fiber blankets are allowed provided the facings are constructed with inorganic materials and contain no organic adhesives.

11.6 *Odor Emission*—The insulation shall be tested in accordance with Test Method C1304.

11.7 *Corrosiveness to Steel, Copper, and Aluminum* —The insulation shall be tested in accordance with the corrosiveness method of Specification C665.

11.8 *Water Vapor Sorption*—The insulation shall be tested in accordance with Test Method C1104/C1104M for determining vapor sorption of unfaced mineral fiber insulation.

11.9 *Linear Shrinkage*—The insulation shall be tested in accordance with method described in Test Method C356.

11.10 *Non-combustibility*—Shall be determined with passing the requirements of Test Method E136.

11.11 *Stress Corrosion Performance for Use on Austenitic Stainless Steel*—When specified, test in accordance with Specification C795. All test specimens must include the facing and adhesive if intended to be the end product.

11.12 *Fungi Resistance*—Test in accordance with Test Method C1338 using a white birch tongue depressor as the comparative item.

12. Qualification Requirements

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

12.1.1 Maximum use and exothermic temperatures,

12.1.2 Apparent thermal conductivity,

12.1.3 Non-combustibility,

12.1.4 Water vapor sorption,

12.1.5 Odor emission,

12.1.6 Surface burning characteristics,

12.1.7 Corrosiveness,

12.1.8 Shot content,

12.1.9 Flexibility, and

12.1.10 Fungi resistance.

13. Inspection

13.1 The following requirements are employed for the purpose of acceptance sampling of lots or shipments of qualified insulation:

13.1.1 This test does not address the effects of thermal bridging due to the effect of the any tie wire system,

13.1.2 Density (when specified) (shall be calculated in accordance with 11.2.2),

13.1.3 Dimensional tolerances,

13.1.4 Compliance with facing type specification, facing attachment, and