



Designation: C1695 – 22

Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service¹

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1. Scope

1.1 This specification addresses the minimum requirements for materials and fabrication of flexible removable and reusable blanket insulation for hot service, from above ambient temperatures to 1000°F (538°C).

1.2 This specification separately addresses industrial applications, outdoor commercial applications, and indoor commercial applications. Blanket insulation for industrial applications and outdoor commercial applications must be weather resistant and resistant to liquid chemicals. Blanket insulation for indoor commercial applications is limited to 500°F (260°C) maximum use temperature, is not required to be either weather resistant or resistant to chemicals, and is typically used for HVAC, plumbing, and other light grade indoor piping systems that distribute steam or water, or both.

1.3 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.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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.*

¹ This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.40 on Insulation Systems.

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2. Referenced Documents

2.1 *ASTM Standards:*²

- C168 Terminology Relating to Thermal Insulation
- C553 Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- C892 Specification for High-Temperature Fiber Blanket Thermal Insulation
- C1086 Specification for Glass Fiber Mechanically Bonded Felt Thermal Insulation
- C1129 Practice for Estimation of Heat Savings by Adding Thermal Insulation to Bare Valves and Flanges
- C1676 Specification for Microporous Thermal Insulation
- C1728 Specification for Flexible Aerogel Insulation
- D3389 Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)
- D3776/D3776M Test Methods for Mass Per Unit Area (Weight) of Fabric
- D3786/D3786M Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
- D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
- D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
- D5189 Test Method for Temperature Corresponding To Vapor-Liquid Ratio Of 20 For Gasoline And Gasoline-Oxygenate Blends (Bomb Method) (Withdrawn 1993)³
- D5587 Test Method for Tearing Strength of Fabrics by Trapezoid Procedure
- D6413/D6413M Test Method for Flame Resistance of Textiles (Vertical Test)

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 The last approved version of this historical standard is referenced on www.astm.org.

2.2 Other Standards:

MIL-C-20079H Military Specification Cloth, Glass; Tape, Textile Glass and Thread, Glass and Wire Reinforced Glass⁴

3. Terminology

3.1 *General*—Definitions included in Terminology **C168** shall apply to the terms used in this specification.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *coated fabric, n*—A woven fabric coated with a rubber or plastic compound such that the woven fabric material itself is not exposed to the environment.

3.2.2 *commercial applications for removable blanket insulation, n*—applications of flexible removable/reusable blanket insulation that do not require high physical abuse resistance but do require protection from leaking water or steam, or both, such as might be found in HVAC or plumbing piping systems.

3.2.3 *D-ring, n*—a section of heavy wire which forms a complete loop in either a rectangular shape or the shape of the capital letter “D”, that is used in removable insulation blankets for attaching a fabric strap that secures the blanket around a pipe component or piece of equipment.

3.2.4 *hook and loop fastener, n*—a woven molded fabric material that has small hooks on one part and small loops on the other such that, when pressed together, they adhere to one another and further, requiring a significant force to separate one another.

3.2.5 *industrial applications for removable blanket insulation, n*—applications for flexible removable/reusable blanket insulation that require higher physical abuse resistance, protection from the weather and leaking chemicals, and can be exposed to outdoor conditions.

3.2.6 *lacing anchor, n*—a metal disk, located on the outside of an insulation blanket, that is secured to a pin that passes through the blanket; the assembly is used to wrap tire wire around so as to secure an insulation blanket around a pipe component or piece of equipment.

3.2.7 *lacing hook, n*—a metal hook that is located on the outside surface of an insulation blanket and that is secured through the blanket; tie wire is wrapped around it so as to secure an insulation blanket around a pipe component or piece of equipment.

3.2.8 *removable and reusable blanket insulation, n*—An insulation blanket, encased in woven fabric and/or woven wire mesh, that has attachment mechanisms designed to allow the assembly to be installed, then later removed and reinstalled, without using any new insulation or fabric materials.

4. Materials

4.1 Insulation shall be of a flexible fibrous material acceptable for the maximum temperature of the application. Acceptable materials must be one of the following:

4.1.1 High Temperature Fiber Blanket per Specification **C892**, any Type or Grade.

4.1.2 Needled Glass Fiber Mechanically Bonded Felt per Specification **C1086**.

4.1.3 Mineral Fiber Blanket, per Specification **C553**, of the Type suitable for the application.

4.1.4 Microporous Thermal Insulation, per Specification **C1676**, of the Type and Grade suitable for the application.

4.1.5 Flexible Aerogel Insulation, per Specification **C1728**, of the Type, Grade, and Category suitable for the application.

4.1.6 Alternative insulation materials shall only be used with design engineer/specifier or purchaser’s prior approval.

4.2 Material for the outer jacket, liner and straps, where used, shall be woven glass fiber cloth that has been treated with a water resistant compound, such as silicone rubber or polytetrafluoroethylene (PTFE), that is suitable for both interior and exterior use, and having the properties as shown in **Table 1**.

4.3 The Surface Temperature Limit for glass fiber fabric coated with Silicone rubber shall be a minimum of 500°F (260°C). The Surface Temperature Limit for glass fiber fabric coated with PTFE shall be a minimum of 600°F (315°C). Material for the inner jacket shall be the same as for the outer jacket for surface temperatures less than the selected material’s Surface Temperature Limit.

4.3.1 For surfaces exceeding the Surface Temperature Limits of either glass fiber fabric coated with Silicone rubber or PTFE up to 1000°F (538°C) where leaks of process fluids are not expected, the inner layer and gussets shall be one of the following, or in combination:

4.3.1.1 a plain, heat cleaned, glass fiber fabric,

4.3.1.2 a Type 304 stainless steel wire knitted mesh made from 0.008 in. (0.20 mm) diameter wire with nominal 6 to 8 openings per inch (25.4 mm).

4.3.2 For surfaces exceeding the Surface Temperature Limits of either glass fiber fabric coated with Silicone rubber or PTFE and where leaks of process fluids are expected, such as flange pairs and valves, the inner layer and gussets shall be as specified in 4.3.1 and 4.3.1.1 above but also with Type 304 stainless steel foil that has a minimum thickness of 0.001 in. (0.025 mm). This foil shall be placed between the hot surface and the insulation material.

4.4 All hardware such as D-rings, buckles, tags, quilting pins, lacing hooks and insulation anchors, etc. shall be made of Type 304 stainless steel. Where lacing hooks and lacing anchors are used, they shall be 12 or 14 Gauge.

4.5 Tie-Down Straps:

4.5.1 *Industrial Applications and Outdoor Commercial Applications*—These tie-down straps shall be constructed of the same material as the outer jacket with a double thickness and an edge trim sewn in place along both edges.

4.5.2 *Indoor Commercial Applications Only*—These tie-down straps shall be constructed either of the same materials as for applications specified in 4.5.1, or stand-alone hook and loop fastener materials with a minimum upper service temperature of 220°F (104°C). Minimum width of the hook and loop

⁴ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

TABLE 1 Physical and Performance Requirements for Fabrics

	Plain, heat cleaned glass fiber fabric ^A	Glass fiber fabric coated with silicone rubber, for exterior applications	Glass fiber fabric coated with silicone rubber, for interior applications only	Glass fiber fabric coated with PTFE
Weight (minimum) oz/sq. yd (g/m ²) per Test Methods D3776/D3776M	17.7 (602)	16.5 (561)	13.5 (455)	16.5 (561)
Breaking Strength (minimum) lb/inch (kg/cm) per Test Methods D5034 or D5035	Warp 200 (35.7) Fill 100 (17.9)	Warp 225 (40.19) Fill 175 (31.26)	Warp 125 (22.4) Fill 100 (17.9)	Warp 225 (40.19) Fill 175 (31.26)
Tearing Strength (minimum) lb (kg) per Test Method D5587	See ^A	Warp 40 (18.14) Fill 25 (11.33)	Warp 30 (13.6) Fill 20 (9.1)	Warp 40 (18.14) Fill 25 (11.33)
Burst Strength (minimum) psi (kg/cm ²) per Test Method D3786/D3786M	Not Applicable	200 (14)	150 (9.77)	200 (14)
Abrasion Resistance per Test Method D3389	See ^A	CS-10 Wheel, 500 g loads 500 revs, 15 % weight loss max	CS-10 Wheel, 500 g loads 500 revs, 15 % weight loss max	CS-10 Wheel, 500 g loads 500 revs, 15 % weight loss max
Color	beige	Gray – Other colors are acceptable that meet buyer's color needs	Gray – Other colors are acceptable that meet buyer's color needs	Gray – Other colors are acceptable that meet buyer's color needs
Flame Resistance Test Method D6413/D6413M	See ^A	Char Length 1 in. max. (25.4 cm) Afterglow 3 seconds max. Flame out 1 second max.	Char Length 1 in. max. (25.4 cm) Afterglow 3 seconds max. Flame out 1 second max.	Char Length 1 in. max. (25.4 cm) Afterglow 3 seconds max. Flame out 1 second max.

^A Meets MIL-C-20079H, Type 1, Class 9.

fastener material shall be 0.75 in. (19 mm). Refer to **Table 2** for physical and performance requirements for hook and loop fasteners.

4.6 Drawstrings shall be suitable for the temperatures exposed to it. Suitable drawstrings include:

4.6.1 Polyester cord, 3/16 in. (5 mm) outside diameter, with fiberglass inner core. Drawstring shall be suitable to 400°F (204°C) service temperatures.

4.6.2 One hundred percent (100 %) braided glass fiber sleeving with plain weave, 3/8 in. inside diameter and 0.03 in. wall thickness. Drawstrings shall be suitable for 1000°F (538°C) services.

4.6.3 Knitted stainless steel rope, 3/16 in. (5 mm) outside diameter, suitable for 1000°F (538°C) service.

4.7 PTFE-coated glass fiber thread shall be used for service temperatures to 500°F (260°C). Glass fiber thread shall be 0.021 in. (0.53 mm) diameter, minimum 20 lb (9 kg) breaking strength.

4.8 Stainless steel thread shall be used for service temperatures above 500°F (260°C). Thread shall be minimum 0.015 in. (0.38 mm) diameter and minimum 18 lb (8.16 kg) breaking strength.

5. Geometric Design and Fabrication

5.1 Insulated items shall be pre-measured to assure a tight fit. Allowances shall be made for valve bonnet height, gland openings, protrusions, etc. so as to effectively insulate yet allow future removal and reinstallation. Maximum gap size shall be 1/2 in. (12.5 mm).

5.2 Fabricate blankets to allow easy access to manual valve controls (for example, handwheels) without having to completely remove the blanket. All valve blankets shall be designed to permit full function of the valves and not to obscure the valve's position indicator, where applicable.

5.3 For applications where leaks are expected, any leak from the packing gland or flanges must be channeled out of the blanket to prevent soaking the insulation.

5.4 Geometric design of the blankets must be such that force-folding or force-bending of blankets is not required for installation.

5.5 Blankets shall be designed to overlap the adjacent line insulation by a distance equal to the thickness of the blanket but never less than 2 in. (50 mm). Where the adjacent piping or insulation circumference is equal to or more than 9 in. (229

TABLE 2 Physical and Performance Requirements for Hook and Loop Fastener (for interior use only)

Property	
Minimum material width	0.75 in. (18 mm)
Minimum Shear Strength, New (per Test Method D5189)	8 psi (55 kPa)
Minimum Shear Strength, after 2000 cycles (per Test Method D5189)	7 psi (48 kPa)
Minimum breaking strength (per Test Method D5035)	150 lb/in. width (173 kg/cm)