



Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service ¹

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1. Scope

1.1 This specification covers 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 both outdoor and indoor applications.

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

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
- 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
- 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

- C1263 Test Method for Thermal Integrity of Flexible Water Vapor Retarders
- D3389 Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)
- D3776 Test Methods for Mass Per Unit Area (Weight) of Fabric
- D3786 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for Temperature Corresponding To Vapor-Liquid Ratio Of 20 For Gasoline And Gasoline-Oxygenate Blends (Bomb Method) (Withdrawn 1993)³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 Test Method for Flame Resistance of Textiles (Vertical Test)

2.2 Other Standards:

- 3E Plus^R Insulation Thickness Computer Program North American Insulation Manufacturers Association (NAIMA)⁴
- MIL-C-20079H Military Specification Cloth, Glass; Tape, Textile Glass and Thread, Glass and Wire Reinforced Glass⁵

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 *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

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

⁴ Available from North American Insulation Manufacturers Association (NAIMA), 44 Canal Center Plaza, Suite 310 Alexandria, VA 22314, <http://www.naima.org>

⁵ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://www.dodssp.daps.mil>.

the assembly to be installed, then later removed and reinstalled, without using any new insulation or fabric materials.

3.2.2 *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.

3.2.3 *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 on another.

3.2.4 *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.

3.2.5 *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.

3.2.6 *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.

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:
High Temperature Fiber Blanket per Specification **C892**, any Type or Grade
Needled Glass Fiber Mechanically Bonded Felt per Specification **C1086**

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

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 or fluorocarbon, that is suitable for both interior and exterior use, and having the properties as shown in **Table 1**.

4.3 Material for the inner jacket shall be the same as for the outer jacket for surface temperatures less than 500°F (260°F°C).

4.3.1 For surfaces from 501°F (261°C) to 1000°F (538°C) where leaks of process fluids are not expected, the inner layer and gussets shall be one of the following:

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 inch (0.20 mm) diameter wire with nominal 6 to 8 openings per in.

4.3.2 For surfaces from 501°F (261°C) to 1000°F (538°C) 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 insulation material and the outer fabric or wire mesh.

4.4 Lacing hooks and lacing anchors shall be made of 12 Gauge, Type 304 stainless steel.

4.5 Tie-Down Straps:

4.5.1 *Outdoor Applications*—These tie-down straps shall be constructed of one of the following three types of material: (1) the same material as the outer jacket, (2) a woven glass fiber fabric, or (3) a tape of suitable thickness with the same coating as the outer jacket material. If the same material as the outer jacket is used, then a double thickness is required with an edge trim sewn in place along both edges. Edge trim shall be applied

TABLE 1 Physical and Performance Requirements for Fabrics

	Plain, heat cleaned glass fiber fabric ^A	Glass fiber fabric coated with Silicone, for exterior applications	Glass fiber fabric coated with Silicone, for interior applications only	Fiber fabric coated with Fluorocarbon
Weight (minimum) oz/sq. yd (g/m ²) per ASTM D3776	17.7 (602)	16.5 (561)	13.5 (455)	15 (510)
Breaking Strength lbs/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)
Tear Strength lbs (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 psi (kg/cm ²) per Test Method D3786	Not Applicable	200 (14)	150 (9.77)	200 (14)
Abrasion Resistance per Test Method D3389	See ^A	CS-10 Wheel, 500g loads 500 revs, 15% weight loss max	CS-10 Wheel, 500g loads 500 revs, 15% weight loss max	CS-10 Wheel, 500g loads 500 revs, 15% weight loss max
Color	beige	Gray	Optional	Gray
Temperature Resistance °F (°C) per Test Method C1263	1000° F (538° C)	500° F (260° C)	500° F (260° C)	600° F (315° C)
Flame Resistance Test Method D6413	See ^A	Char Length 1 in. max. (25.4cm) Afterglow 3 seconds max. Flame out 1 second max.	Char Length 1 in. max. (25.4cm) Afterglow 3 seconds max. Flame out 1 second max.	Char Length 1 inch max. (25.4cm) Afterglow 3 seconds max. Flame out 1 second max.

^AMeets MIL-C-20079H, Type 1, Class 9

to prevent exposed fabric edges. Ends of the straps shall be turned under $\frac{1}{4}$ (6.35mm) to $\frac{1}{2}$ (13mm) inch and double-stitched to prevent unraveling.

4.5.2 *Indoor Applications only*—These tie-down straps shall be constructed either of the same materials as for Outdoor Applications, specified in 4.5.1, or of a hook and loop fastener material with a maximum use temperature of 220°F (104°C). Minimum width of the hook and loop fastener material shall be 0.75 in. (19 mm).

4.6 Drawstrings shall be made from 100% textured glass fiber sleeving with plain weave, $\frac{3}{8}$ in. inside diameter and 0.03 in. wall thickness. Drawstrings shall be suitable for 1000°F (538°C) services.

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 inch (0.53 mm) diameter, minimum 20 lbs (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 lbs (8.16 kg). breaking strength.

4.9 All hardware such as D-rings, buckles, tags, etc., shall be Type 304 stainless steel.

5. 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 $\frac{1}{4}$ in. (6mm).

5.2 Fabricate blankets to allow easy access to valve packing glands and flange bolts 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 Force-folding or bending of blankets is not allowed.

5.5 Blankets shall be fabricated with a minimum 2 in. (50 mm) of overlap at the end flap to overlap the adjacent insulation.

5.6 Blankets shall be fabricated with parting faces at the blanket low point to facilitate drainage, if possible. Otherwise, a drainage grommet shall be installed at the blanket low point.

5.7 Any single blanket or blanket piece shall not exceed 45 lbs (20.4 kg). Blankets with a finished weight of 45 lbs (20.4 kg) or less shall be fabricated in one piece.

6. Construction

6.1 Outdoor Applications:

6.1.1 All fabric seams shall be either sewn or held together with 16 gauge type 304 stainless steel hog ring staples on 1" to 3" (25 to 75 mm) centers. Machine stitching shall be used wherever practical. Hand stitching shall be used when machine sticking is impractical. Sewing shall be double straight stitched with minimum 7 stitches per inch. Each row shall be parallel and spaced a minimum of $\frac{1}{8}$ in. (3.2 mm) to a maximum of $\frac{1}{2}$ in. (12.7 mm) apart.

6.1.2 All blanket seams shall be turned in or under and sewn to prevent any raw edges from being exposed on any surface.

6.1.3 Gusset-type (straight sides) construction shall be utilized for all blanket thicknesses greater than 1 in. (25mm).

6.1.4 Fabric seams shall be inside seams, except that it is possible that the final closing seam is an outside seam.

6.1.5 Secure insulation within the jacketing with quilting pins, lacing hooks, or insulation anchors to prevent insulation from settling within the cover. These supports shall penetrate the cold face jacketing and the insulation core, but not the hot face jacketing. Point protectors shall be used to prevent penetration of the hot face jacketing.

6.2 Indoor Applications only:

6.2.1 All fabric seams shall be as specified for Outdoor Applications in 6.1.1.

6.2.2 Gusset-type (straight sides) construction shall be utilized for all blanket thicknesses greater than 2 in. (50 mm). Secure insulation within the jacketing as for the Outdoor Applications or with sewn seams passing through the blanket material on both the hot and cold side.

7. Tie-Down/Anchor Strap Construction

7.1 Outdoor Applications:

7.1.1 The terminal ends of splits in blankets shall utilize flaps or drawcord/flaps to seal the blankets from wind and water. Flaps shall have no gaps where they come in contact with adjacent insulation.

7.1.2 Use D-ring type buckles or hook-and-loop tie-down/anchor straps, or both. Lacing hooks and wire shall not be used unless approved by the Purchaser.

7.1.3 If Purchaser's approval has been given for the use of lacing hooks and wires, the lacing hooks shall be tufted to the cold face jacketing. If lacing hooks penetrate the hot face, the hooks shall be secured by self-locking washers with a patch of the hot face jacketing material sewn over the washer. A silicone rubber patch shall be placed between the washer and the blanket.

7.1.4 Ends of straps shall be turned under $\frac{1}{4}$ in. (6.3 mm) to $\frac{1}{2}$ in. (12.7 mm) and double stitched to prevent unraveling.

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

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

7.1.5 Strap length and number of straps for blankets shall be sufficient to ensure a snug and proper fit without gaps or sagging of the blanket.

7.1.6 Tie-down strap length shall have a minimum of 6 in. (150 mm) excess length for pulling and securing.

7.1.7 Drawcords shall be used where terminal ends of blankets need to be drawn down around adjacent insulation, valve bonnets, nozzles, etc., to seal the covers from wind and water

7.1.7.1 Blanket shall incorporate flaps at the terminal ends. Drawcord shall be located within this flap.

7.1.7.2 Tie-down/anchor straps adjacent to cover terminal ends shall be spaced a minimum of 2 in. (50 mm) back from the drawcord flaps.

7.1.7.3 Cord length shall be sufficient to allow a minimum of 6 inches (150 mm) of cord to protrude from each end of the flap when it is drawn down.

7.1.7.4 Cut ends of braided sleeving cord shall be turned back inside the sleeving a minimum of 1 in. (25 mm) and double-stitched to prevent fraying.

7.1.7.5 A double stitch shall be located at the middle of the flap to secure the cord and prevent it from pulling out.

7.2 *Indoor Applications only:*

7.2.1 Securement of blankets shall be either on of the following options:

7.2.1.1 As specified in 7.1.2.

7.2.1.2 With lacing hooks and wire.

7.2.1.3 With hook and loop fastener material

7.2.2 On service applications less than 500°F (260°C), it is acceptable for lacing hooks to pass though the hot side fabric.

7.2.3 When hook and loop fastener material is used for securement, each piece shall be attached to the blanket with staples, sewn thread, or rivets.

8. Identification Tags

8.1 *Outdoor Applications:*

8.1.1 Stainless steel identification tags shall be permanently attached to the outside of the blanket and shall list a description of the item being insulated (Ex: 8in., 150 psi gate valve) with date the blanket was first installed. The identification legend shall be mechanically embossed on the tag. Information contained on each tag shall be specified by the purchaser.

8.1.2 The tag shall not be riveted directly to the cold face jacketing. Tags shall be riveted to a strap comparable to the tie-down/anchor strap. This strap shall be secured to the cold face jacketing to allow the strap to double as a handle or lifting loop.

8.1.3 Blankets utilizing multi-piece construction shall be appropriately tagged for assembly.

8.2 *Indoor Applications:*

8.2.1 Identification tags shall be constructed either as specified in 8.1.1 above or of a water resistant, non-metallic material, with a maximum use temperature of 220°F (104°C) attached to each blanket. If the latter is selected, attachment shall be by sewing thread, staples, or rivets.

8.2.2 Identification tags shall list either a numerical identification (Ex: Valve No. P-47) or a description of the item being insulated (Ex.: 8 in. 150 psi gate valve) with the date the blanket was first installed.

8.2.3 Blankets utilizing multi-piece construction shall be appropriately tagged for assembly.

9. Inspection

9.1 The purchaser reserves the right to inspect the blankets during manufacture. The contractor shall replace or correct any materials or installations that do not meet the requirements of this practice.

10. Rejection

10.1 Failure to comply with the requirements in this specification shall constitute cause for rejection. Rejection shall be reported to the manufacturer or seller promptly and in writing. The manufacturer and supplier have the right to verify rejected products.

11. Thickness Table

11.1 The users shall determine required insulation thicknesses from their economic and climatic conditions. This can be done using Practice C680 or 3E Plus^R Insulation Thickness Computer Program, or other heat transfer program found acceptable to the specifier.

11.2 Energy savings, compared to uninsulated surfaces, can be estimated using Practice C1129.

11.3 The following values are given as examples of Minimum Blanket Thickness for given Service Temperatures:

Service Temperature	Minimum Blanket Thickness
For use up to 400°F (204°C)	1.0 in. (25 mm)
For use up to 600°F (316°C)	2.0 in. (51 mm)
For use up to 800°F (427°C)	3.0 in. (76 mm)
For use up to 1000°F (538°C)	4.0 in. (102 mm)

12. Keywords

12.1 coated fabric ; plain fabric; removable blanket ; removable/reusable blanket; removable/reusable insulation; reusable blanket

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