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# Standard Guide for Flexible Removable Insulation Covers[1]

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## 1. Scope

1.1 This guide recommends the criteria to be considered in specifying removable insulation covers for surfaces operating in air at temperatures above ambient.

1.2 A removable insulation cover is fabricated from a fibrous insulation material encased in a tailored fabric or wire mesh enclosure, or both. The fabric seams are typically held together with thread, metal rings, or staples, or combination thereof. These covers must be designed and fabricated to allow a close fit with tight joints over piping, elbows, flanges, valves, and tanks. They are intended to be easily removed and replaced to allow for periodic access to the surfaces they cover.

1.3 In addition to thermal performance, there are other performance requirements of removable covers. These may include, but are not limited to:

1.3.1 Temperature exposure,

1.3.2 Chemical and weather exposure,

1.3.3 Acoustical, and

1.3.4 Fire endurance.

1.4 The materials from which the cover is made may include, but are not limited to:

1.4.1 Insulation media,

1.4.2 Fabric, metal mesh enclosure, or foil enclosure,

1.4.3 Seam materials (thread, metal hooks, etc.), and

1.4.4 Attachment system (hook and loop attachment, straps, wire, etc.).

1.5 The shape, size, and physical design of the cover varies depending on the object to be covered. The cover may consist of more than one piece. Pipes, valves, pumps, and flanges are typical objects to be covered. In many cases, on-site measurements need to be made to ensure an acceptable fit.

1.6 The values stated in SI units shall be regarded as the standard. The values given in parentheses are provided for information only.

1.7 This guide does not intend to establish the criteria required in the design of the equipment over which removable insulation covers are used, nor does this guide establish or recommend the applicability of removable insulation covers over all surfaces.

1.8 It is the responsibility of the user, user's agent, or both, to determine applicability of this guide to their specific application and to inform the equipment designer of the intent to insulate so that appropriate design criteria can be established.

1.9 *This standard does not purport to address all of the safety problems, 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*

1.10 *This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use*

## 2. Referenced Documents

2.1 *ASTM Standards:*

C 165 Test Method for Measuring Compressive Properties of Thermal Insulation[2]

C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations[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 335 Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation[2]

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

C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method[2]

C 547 Specification for Mineral Fiber Pipe Insulation[2]

C 553 Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications[2]

C 592 Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)[2]

C 795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel[2]

[1] This guide 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] *Annual Book of ASTM Standards*, Vol 04.06.

C 892 Specification for High Temperature Fiber Blanket Thermal Insulation[2]
C 1393 Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
D 471 Test Method for Rubber Property—Effect of Liquids[3]
D 751 Test Methods for Coated Fabrics[4]
D 1117 Methods of Testing Nonwoven Fabrics[5]
D 1682 Test Methods for Breaking Load and Elongation of Textile Fabrics[5]
D 1683 Test Method for Failure in Sewn Seams of Woven Fabrics[5]
D 1894 Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting[6]
D 2176 Test Method for Folding Endurance of Paper by the M.I.T. Tester[7]
D 4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)[8]
E 84 Test Method for Surface Burning Characteristics of Building Materials[9]
E 119 Test Methods for Fire Tests of Building Construction and Materials[9]
E 596 Test Methods for Laboratory Measurements of Noise Reduction of Sound-Isolating Enclosures[2]
G 26 Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[10]

2.2 *U.S. Military Standard:*

MIL-I-16411 Military Specification, Insulation Felt, Thermal, Glass Fiber[11]

2.3 *Other Standards:*

AATCC Method 35, Water Resistance Scrim Test[12]
NFPA 701—Standard Method for Fire Test for Flame-Resistant Textiles and Films[13]
UL 1709—Fire Resistance Test for Petrochemical Facility Standard Elements[14]

## 3. Physical and Chemical Properties

3.1 There are several areas of performance that should be considered when specifying removable covers:

3.1.1 General physical and chemical properties,
3.1.2 Resistance to temperature,
3.1.3 Chemical resistance,
3.1.4 Weather resistance,
3.1.5 Fire endurance,
3.1.6 Acoustical performance, and
3.1.7 Service life.

3.2 *Physical Properties of the Insulation Media*:

3.2.1 The specifier should indicate acceptable requirements for:

3.2.1.1 Insulation media, in accordance with Specifications C 553, C 547, C 592, C 892, C 1393, or MIL-I-16411,

3.2.1.2 Thermal conductivity, in accordance with Test Method C 177 (at no fewer than four different mean temperatures),

3.2.1.3 Density, in accordance with Test Methods C 167,

3.2.1.4 Thickness recovery and compressive strength, in accordance with Method C 165,

3.2.1.5 Flexibility, in accordance with Specification C 553, and

3.2.1.6 Stress corrosion and chemical analysis, in accordance with Specification C 795.

3.3 *Physical Properties of the Fabric Enclosure System*:

3.3.1 The specifier should indicate acceptable criteria for physical properties as follows:

3.3.1.1 Breaking load, in accordance with Test Methods D 1682,

3.3.1.2 Tear strength, trapezoidal, in accordance with Methods D 1117,

3.3.1.3 Burst strength, in accordance with Method D 751,

3.3.1.4 Folding endurance, M.I.T., in accordance with Test Method D 2176,

3.3.1.5 Abrasion resistance, Wyzenbeek, in accordance with Test Method D 4157,

3.3.1.6 Coefficient of friction, in accordance with Test Method D 1894,

3.3.1.7 Water resistance, rain test, in accordance with AATCC Method 35,

3.3.1.8 Flammability, in accordance with Test Method E 84 and NFPA 701, small scale,

3.3.1.9 Enclosure system seam failure, in accordance with Test Method D 1683,

3.3.1.10 Enclosure system seam water resistance, rain test, in accordance with AATCC Method 35, and

3.3.1.11 Attachment system breaking load, in accordance with Test Methods D 1682.

3.4 *Physical Properties of the Assembled Cover*:

3.4.1 The specifier should indicate acceptable assembled cover performance criteria as follows:

3.4.1.1 Thermal conductance, in accordance with Test Method C 335,

3.4.1.2 Weight and dimensions,

3.4.1.3 Vibration resistance,

3.4.1.4 Ease of installation and removal,

3.4.1.5 Hot surface performance, in accordance with Test Method C 411, and

3.4.1.6 Enclosure permeability to water or to liquid chemicals, or both.

3.5 *Temperature Endurance*:

3.5.1 The specifier should indicate acceptable properties of the assembled cover and of its components after exposure to

[3] *Annual Book of ASTM Standards*, Vol 09.01.
[4] *Annual Book of ASTM Standards*, Vol 09.02.
[5] *Annual Book of ASTM Standards*, Vol 07.01.
[6] *Annual Book of ASTM Standards*, Vol 08.01.
[7] *Annual Book of ASTM Standards*, Vol 15.09.
[8] *Annual Book of ASTM Standards*, Vol 07.02.
[9] *Annual Book of ASTM Standards*, Vol 04.07.
[10] *Annual Book of ASTM Standards*, Vol 06.01.
[11] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.
[12] Available from American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.
[13] Available from National Fire Protection Assoc., 470 Atlantic Ave., Boston, MA 02210.
[14] Available from Underwriters' Laboratory, 333 Pfingsten Rd., Northbrook, IL 60062.

the highest expected temperature difference and service temperature. Some of these may be:

3.5.1.1 Cover thermal conductance,

3.5.1.2 Insulation material flexibility,

3.5.1.3 Insulation material thickness recovery and compressive strength,

3.5.1.4 Cover vibration resistance,

3.5.1.5 Fabric or metal mesh abrasion resistance, folding endurance strength, trapezoidal tear strength, and tensile strength,

3.5.1.6 Seam breaking load, and

3.5.1.7 For coated or impregnated fabrics, any delamination, stiffening, or other physical changes in the coating should be noted. The specifier should indicate the maximum allowable change in physical properties.

3.5.2 The specifier should indicate acceptable standards for the appearance of the cover after high temperature exposure. These could include the color and condition of the fabric jacket for both plain and coated fabrics.

3.6 *Fire Endurance*— The specifier may consider establishing a maximum acceptable temperature for a surface insulated with a removable cover and exposed to a high temperature fire. The fire conditions need to be established by the specifier. Method E 119 or UL 1709 are two time-fire temperature procedures that may be considered for use.

3.7 *Resistance to Chemicals and Leaking Fluids*:

3.7.1 The specifier should indicate minimum acceptable standards for the fabric enclosure over an insulation cover after exposure to particular liquid chemicals.

3.7.2 The particular chemical, its concentration, temperature, and duration of exposure should be indicated.

3.7.3 The fabric enclosure, over the insulation, should be designed to retard the ingress of liquids that may pose a safety hazard or affect performance.

3.7.3.1 Consideration should be given to the potential for liquid or vapor ingress into the finished cover at the seams. The seam type may be selected to reduce this potential and a separate sealing operation may be needed using appropriate mastics or sealants. Penetration of coated fabric enclosures by metal hog rings or metal attachment pins may need to be avoided if liquid ingress is to be prevented.

3.7.3.2 Consideration should also be given to the use of a leak detection or venting system.

3.7.4 Chemical exposure testing should be in conformance with Test Method D 471. The specifier should indicate the duration of exposure and the minimum acceptable tensile strength, burst strength, tear strength, flexibility, and abrasion resistance for fabric materials after chemical exposure.

3.8 *Weather Resistance*:

3.8.1 The specifier should indicate acceptable standards for the fabric enclosure that is to be used outdoors.

3.8.2 Acceptable values for outer fabric tensile strength, burst strength, tear strength, flexibility, and abrasion resistance, after exposure to weather, in accordance with Practice G 26, should be established.

3.8.3 An acceptable value for fabric water resistance, in accordance with AATCC Method 35, may need to be established.

3.8.4 Acceptable values of seam break strength and fastener tensile strengths after weathering exposure may be established.

3.9 *Acoustical Properties*:

3.9.1 The specifier should consider establishing acceptable standards, at operating temperature, for the sound absorption and noise reduction for fabricated insulation covers.

3.9.1.1 Sound absorption, in accordance with Test Method C 423.

3.9.1.2 Noise reduction, in accordance with Method E 596.

## 4. Workmanship, Finish, and Appearance

4.1 The purpose for having a well-designed, well-fabricated insulation cover is (*1*) to restrict the flow of heat, reduce the transfer of sound to some specified level, or both, and (*2*) to be removable and reusable with relative ease.

4.2 It is important that covers be fabricated so that gaps are minimized at the closure points or between adjacent insulation. Such gaps can severely compromise thermal effectiveness. It is also important that the minimum designed cover thickness be maintained over most of the entire surface. Overlap seams so that they will flow away from, not into, seams.

4.3 The designer may wish to specify the quality of the covers so that the appearance is a uniform one. Attention may need to be paid to the lot designations of fabric, attachment materials, other visible cover materials, and the insulation media.

4.4 Covers should be fabricated and installed in such a way that adjacent covers should form a tight butt joint. The bare hot surface should not show and the full thickness of the insulation should be maintained. Cements, loose fibers, and mastics should not be exposed.

4.5 Where possible, on-site measurements should be made to assure correct fit of the covers on the surfaces to be insulated.

## 5. Product Marking and Design Drawings

5.1 It is recommended that the cover be permanently marked or labeled in such a way so as to identify the part for the purpose of proper relocation after removal and for reordering. Also, each insulation cover should be labeled with the name of the project and an identity code number traceable to its exact location to ensure proper installation and reinstallation, as agreed upon by the supplier and purchaser.

5.2 Location of sections insulated with the covers should be labeled on drawings. Identification numbers for the individual covers should be referenced on the drawings.

## 6. Shipping, Storage, and Handling

6.1 The specifier should determine exactly how the insulation covers are to be packaged for shipping and handling. Containers should be labeled with the cover designation if such labeling is being used.

6.2 The specifier should determine the level of cleanliness required for the insulation covers. This may require a preshipping inspection and a final inspection of the covers.

## 7. Inspection and Acceptance

7.1 Specific criteria for inspection and acceptance of materials should be established by the specifier.

## 8. Keywords

8.1 covers; hot surface; insulation; removable