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An American National Standard

Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation[1]

This standard is issued under the fixed designation C 921; 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.

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

1. Scope

1.1 This practice lists significant properties of thermal insulation jacketing materials and test methods for determining them.

1.2 This practice applies to jacketing materials applied over thermal insulation for piping, ducts, and equipment operating at temperatures from − 40 to 1200°F (−40 to 649°C), ambient temperatures from − 60 to 130°F (−51 to 54°C), and surface temperatures from − 60 to 200°F (−51 to 93°C).

1.3 This practice includes jacketing materials used over thermal insulation whether the insulation be in the form of rigid pipe or board, semirigid or blanket, or field applied materials that are self-supporting, including cements.

1.4 This practice does not include covers or other retaining walls that contain loose fill, other nonsupporting insulation materials, or conduits or containers for buried insulation systems.

1.5 This practice does not include mastics and coatings and their reinforcements.

1.6 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information only.

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 limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip[2]

A 366/A366M Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality[2]

B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate[3]

C 168 Terminology Relating to Thermal Insulating Materials[4]

C 835 Test Method for Total Hemispherical Emittance of Surfaces from 20 to 1400°C[4]

D 777 Test Methods for Flammability of Treated Paper and Paperboard[5]

D 781 Test Methods for Puncture and Stiffness of Paperboard, and Corrugated and Solid Fiberboard[6]

D 828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus[7]

E 84 Test Method for Surface Burning Characteristics of Building Materials[8]

E 96 Test Methods for Water Vapor Transmission of Materials[4]

2.2 *Military Standard:*

MIL-STD-810C Environmental Test Methods[9]

3. Terminology

3.1 *Definitions*—Terminology C 168 apply to the terms used in this practice.

4. Classification

4.1 *Type I—Vapor Barrier*—For use over insulation on pipes, ducts, or equipment operating at temperatures below ambient at least part of the time or wherever a vapor barrier is required.

4.2 *Type II—Water Vapor Permeable*—For use over insulation on pipes, ducts or equipment operating above ambient temperatures or wherever a vapor barrier is not required.

5. Materials and Manufacture

5.1 Jacketing materials may be composed of a single material or a lamination of several components. The material may be in the form of rolls or sheets or preformed to fit the surface to which they are to be applied. The materials may be applied

[1] This practice is under the jurisdiction of ASTM Committee C-16 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 01.03.

[3] *Annual Book of ASTM Standards*, Vol 02.02.

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

[5] Discontinued. See 1980 *Annual Book of ASTM Standards*, Part 20.

[6] Discontinued. See 1984 *Annual Book of ASTM Standards*, Vol 15.09.

[7] *Annual Book of ASTM Standards*, Vol 15.09.

[8] *Annual Book of ASTM Standards*, Vol 04.07.

[9] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

in the field or may be a factory-applied composite with the insulation.

5.2 *Metallic*:

5.2.1 Metallic jacketing materials are those whose primary material (usually the component of greatest thickness) is metal such as aluminum, steel, and stainless steel. The metal may be smooth or corrugated, with aluminum also available in embossed. The dimensions of corrugations (pitch and depth) may be specified by the purchaser for interchangeability, constant rigidity, and control of sizes. The inner surface of aluminum and steel jacketing materials is usually coated or covered with a moisture resistant film to retard the possible corrosive effect of the insulation to which they are applied.

5.2.2 Aluminum jacketing materials are manufactured from Specification B 209, Type 3003, 3004, 3105, 5005, 5010, 5052, or 11001 aluminum, temper ranges from H14 (half hard) through H19 (full hard). Where ambient conditions are severe, the outer surface of the aluminum is coated to prevent corrosion. Thicknesses generally available are from 0.006 to 0.040 in. (0.15 to 1.02 mm).

5.2.3 Steel jacketing materials are manufactured from Specification A 366/A 366M, Type 1010, 1015, or 1020 steel. The outer surface is most often protected by aluminizing, galvanizing, or coating with plastic film or enamel to retard exterior corrosion, or a combination thereof. Thicknesses generally available are from 0.010 to 0.018 in. (0.25 to 0.46 mm).

5.2.4 Stainless steel jacketing materials are manufactured from Specification A 167, Type 301, 302, 303, 304, or 316 stainless steel, hardness B85 (soft annealed). Thicknesses generally available are from 0.010 to 0.019 in. (0.25 to 0.48 mm).

5.3 *Nonmetallic*:

5.3.1 Laminated jacketing materials are manufactured from combinations of plastic films, metallic foils, fabric scrims, cloths, papers, or felts selected to obtain the required performance characteristics.

5.3.2 Textile or cloth jacketing materials are woven or knitted of textile yarns. Commonly available forms are 4, 6, or 8 oz/yd^2(0.14, 0.20 or, 0.27 kg/m^2) cotton canvas, various weaves of glass fiber yarns, presized glass cloth, knit or woven plastic fibers, or weaves of asbestos fibers.

5.3.3 Plastic jacketing materials are manufactured in forms ranging from very soft and flexible to hard and rigid. Plastics include poly(vinyl chloride), poly(vinyl fluoride), acrylic polymer, poly(vinyl acetate), and acrylonitrile-styrene-butadiene. The thicknesses generally available are from 0.003 to 0.035 in. (0.08 to 0.89 mm).

5.3.4 Saturated felt jacketing materials are manufactured from various base felts or cloths which have been impregnated with bitumen or resinous materials. Most commonly available are inorganic (asbestos) and organic (rag) felts. Both are produced in numerous basic weights ranging from 15 to 55 lb per section of 108 ft^2(0.68 to 2.49 kg per m^2).

6. Physical Requirements

6.1 Typical jacketing materials requirements are listed in Table 1. When specification values are needed, these values may be used. In addition, limiting values for water vapor permeance, puncture resistance, tensile strength, outdoor durability, humidity resistance, and heavy mechanical protection and hemispherical emittance values may be agreed upon between the parties concerned. It may also be agreed between the parties concerned that fire resistance permanence may be determined by reexamining surface burning characteristics under Test Method E 84 in the same manner as the flame spread classification is determined.

TABLE 1 Typical Requirements

Flame spread classification:		
Flame spread, max	25	see 9.1.4
Smoke developed, max	50	
Leachability resistance of fire retardant additives (applicable to paper containing products only):		
% increase in char length, max	20	see 9.1.5
Mold and mildew resistance:		
Mold growth sustenance	none	see 9.1.6
Dimensional stability:		
% length change, max	0.25	see 9.1.8
Low-temperature resistance	Remains flexible; no delamination	see 9.1.9 and 9.1.11
High temperature resistance	Remains flexible; no delamination	see 9.1.10 and 9.1.11

7. Standard Sizes

7.1 Jacketing materials are available in rolls or sheets for field or factory application. Standard sizes vary with the type of material and the shape of the insulated form.

7.2 Nonmetallic materials are available in rolls with widths from 24 to 72 in. (0.61 to 1.83 m) and lengths from 150 to 1500 ft (45.7 to 457.2 m).

7.3 Metallic materials are available in rolls with widths from 3 to 4 ft (0.9 to 2.1 m) and lengths of 100 ft (30.5 m). Sheets are available in widths from 26 to 44 in. (0.66 to 1.12 m) and lengths of 100 ft (30.5 m).

7.4 Where sizes and dimensional tolerances are required, they shall be as agreed upon by the manufacturer and the purchaser.

8. Workmanship and Finish

8.1 The product shall be free of laminate separations, holes, tears, cuts, or creases and shall show no visual defects that will affect serviceability.

9. Test Methods

9.1 The properties enumerated in this practice shall be determined in accordance with the following methods:

9.1.1 *Water Vapor Transmission*—Test Methods E 96, Procedure A.

9.1.2 *Puncture Resistance*—Test Methods D 781.

9.1.3 *Tensile Strength*—Test Method D 828.

9.1.4 *Flame Spread Classification*—Test Method E 84. Obtain classification for the composite product; adhere jacketing material to the insulation as it is used in service.

9.1.5 *Leachability Resistance of Fire Retardant Additives*—(applicable to paper-containing products only):

9.1.5.1 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 described 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.

9.1.5.2 *Apparatus*—(*a*), 1000-mL beakers, deionized water, paper towels, (*b*) char test equipment as described in Test Methods D 777, and (*c*) measuring rule graduated in 1⁄10 in. (2.5 mm).

9.1.5.3 *Sample Preparation*—Cut ten samples 2¾ by 8¼ in. (69.9 by 209.6 mm) from the test sheet in pairs, a pair being two samples cut from adjacent positions. Immerse five of the samples, one from each pair, fully in 700 mL of deionized water at room temperature for 15 min. Remove the samples from the water and blot up excess water with a paper towel. Dry the samples for 15 min at 200 ± 5°F (93 ± 3°C). Condition the leached specimens together with the corresponding unleached specimens for 24 h at 73 ± 2°F (23± 1°C) and 50 ± 2 % relative humidity.

9.1.5.4 *Procedure*—Conduct the char test on all ten specimens in accordance with Test Method D 777. Measure the char length to 0.1 in. (2.5 mm).

9.1.5.5 *Calculation*—Compute the char length increase of each pair of samples as follows:

$$C = 100\,(X_2 - X_1)/X_1$$

where:

C = increase of char length, %
X_2 = char length of leached specimen, and
X_1 = char length of unleached specimen.

Average the five values for comparison to specifications.

9.1.6 *Mold and Mildew Resistance*—MIL-STD-810C.

9.1.7 *Humidity Resistance*—Expose three specimens, 12 by 12 in. (304.8 by 304.8 mm), for 30 days at 120°F (49°C) and 97 ± 3 % relative humidity, and then examine for degradation and delamination. The degree of acceptibility may be determined by the user, based upon the intended application.

9.1.8 *Dimensional Stability*—Condition three specimens, 12 by 12 in. (304.8 by 304.8 mm), at 75°F (24°C) and 50 % relative humidity for 24 h, measured in length to 1⁄64 in. (0.4 mm) in both directions before and after oven drying at 200°F (93°C), with the resulting length changes calculated.

9.1.9 *Low-Temperature Resistance*—Examine 15 specimens (three specimens for each temperature) 12 by 12 in. (304.8 by 304.8 mm), for flexibility and delamination after 4-h exposure at 30°F (−1°C), 0°F (−18°C), − 20°F (−29°C), − 40°F (−40°C), and − 60°F (−51°C). Test specimens at these temperatures for flexibility and delamination, and rate at the lowest temperature passed, when tested in accordance with 9.1.11.

9.1.10 *High-Temperature Resistance*—Examine six specimens (three specimens for each temperature) 12 by 12 in. (304.8 by 304.8 mm), for flexibility and delamination after 4 h exposure at 150°F (66°C) and 200°F (93°C). Test specimens after they have been returned to room temperature and rate at the highest temperature at which they exhibited flexibility, when tested in accordance with 9.1.11.

9.1.11 *Flexibility*—Bend a specimen, 12 by 12 in. (304.8 by 304.8 mm), rapidly by hand 180 deg around a ½-in. nominal size iron pipe, held at the same temperature as the test specimens. Cracking, rupture, or delamination shall constitute nonflexibility.

9.1.12 *Hemispherical Emittance*—Test Method C 835.