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Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation¹

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

1. Scope

1.1 This specification covers vapor retarders for thermal insulation, specifically, flexible materials with permeance of 0.15 perm ($8.63 \text{ ng}\cdot\text{Pa}^{-1} \cdot \text{s}^{-1} \cdot \text{m}^{-2}$) or lower and surface burning characteristics of 25 flame spread/50 smoke or lower. These materials are intended for use at surface temperatures of -20 to 150°F (-29 to 66°C). It does not cover mastics or barrier coatings applied in liquid form, nor materials intended for use as weather barriers.

1.2 This is a material specification and does not imply that an installed system using these materials will provide the physical properties specified in Section 6.

1.3 This specification provides physical requirements for vapor retarders. Practice C755 provides assistance in solving problems related to moisture vapor transmission through thermal insulation materials.

1.4 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.

1.5 The following precautionary caveat pertains to the test methods portion only, Section 10, of this specification: *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.*

1.6 *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 C16.33 on Insulation Finishes and Moisture.

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2. Referenced Documents

2.1 ASTM Standards:²

- C168 Terminology Relating to Thermal Insulation
- C755 Practice for Selection of Water Vapor Retarders for Thermal Insulation
- D774/D774M Test Method for Bursting Strength of Paper (Withdrawn 2010)³
- C1258 Test Method for Elevated Temperature and Humidity Resistance of Vapor Retarders for Insulation
- C1263 Test Method for Thermal Integrity of Flexible Water Vapor Retarders
- C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings
- C1878 Test Method for Surface Water Resistance of Vapor Retarders for Thermal Insulation
- D828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
- D882 Test Method for Tensile Properties of Thin Plastic Sheeting
- D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- E84 Test Method for Surface Burning Characteristics of Building Materials
- E96/E96M Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

2.2 TAPPI Standards:

- T461 Flame Resistance of Treated Paper and Paperboard

3. Terminology

3.1 *Definitions*—Definitions in Terminology C168 apply to terms used in this specification.

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. Classification

4.1 Classification of vapor retarders, with the exception of Type IX, is based on physical properties.

4.1.1 Type IX, in addition to physical property requirements, has specific structural requirements.

4.2 Physical property requirements are listed in **Table 1**.

5. Materials and Manufacture

5.1 Vapor retarders, with the exception of Type IX, are constructed of various films, metallic foils, fabrics, papers and reinforcements, alone or in combination as a lamination.

5.2 Metallic foils, the most commonly used being aluminum of a minimum gauge, are the only materials expected to provide the impermeable component in a vapor retarder required for Type IX.

5.2.1 Type IX vapor retarders must contain at a minimum the following components in the structure:

5.2.2 One layer of metallic foil with a minimum thickness of 0.00095 in. (24.1 μ) or

5.2.3 Multiple layers of metallic foil with a cumulative minimum thickness of 0.0012 in. (30.5 μ)

5.2.4 A fully laminated, continuous protective substrate on at least one side of the foil layers

5.3 Types VII-X vapor retarders contain water resistant outer surfaces.

6. Physical Properties

6.1 Maximum permeance for a specific type vapor retarder shall be as shown in **Table 1** when tested in accordance with **10.1**. Values for permeance requirements are rounded to two decimals.

6.2 All vapor retarders shall demonstrate a flame spread of 25 or less and smoke developed of 50 or less when testing the finish side (the side opposite that contacting the insulation) in accordance with **10.2**.

6.3 Minimum tensile strength for a specific type vapor retarder shall be as shown in **Table 1** when tested in accordance with **10.3**.

6.4 Maximum dimensional change for a specific type vapor retarder shall be as shown in **Table 1**, when tested in accordance with **10.4**.

6.5 All type vapor retarders shall not sustain growth of fungi when tested in accordance with **10.5**.

6.6 All type vapor retarders shall not crack or delaminate at temperatures from -20 to 150°F (-29 to 66°C) when tested in accordance with **10.6**.

6.7 Minimum burst strength for a specific type vapor retarder shall be as shown in **Table 1** when tested in accordance with **10.7**.

6.8 Vapor retarders containing paper or paper products shall not demonstrate an increase in char length of more than 20 % when tested in accordance with **10.8**.

6.9 All type vapor retarders shall not corrode or delaminate, nor demonstrate, after exposure, a permeance greater than the maximum allowable for the type being tested, when tested in accordance with **10.9**.

6.10 Maximum water weight per area absorbed by the service-exposed side of Type VII-X vapor retarders shall be as shown in **Table 1** when tested for surface water resistance in accordance with **10.10**.

7. Dimensions, Mass, and Permissible Variations

7.1 Dimensions for roll or sheeted materials shall be as specified by the purchaser.

7.2 Tolerance for roll materials shall be $\pm 1/8$ in. (± 3 mm) on width and $+5, -0$ % on length.

7.3 Tolerance for sheeted materials shall be $\pm 1/8$ in. (± 3 mm) on length and width.

8. Workmanship, Finish, and Appearance

8.1 There shall be no defects in materials or workmanship that will affect the required performance of the vapor retarder.

8.2 There shall be no defects that adversely affect the appearance of the vapor retarder.

8.3 There shall be no defects that would affect ability of user to process material.

9. Significance and Use

9.1 Entrapment of water in thermal insulation caused by condensation of water vapor that has penetrated into the insulation is detrimental to the thermal resistance of the

TABLE 1 Physical Property Requirements

Physical Properties	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Type VIII	Type IX	Type X
Permeance, max Perms ($\text{ng}\cdot\text{Pa}^{-1}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$)	0.02 (1.15)	0.02 (1.15)	0.10 (5.75)	0.10 (5.75)	0.15 (8.63)	0.15 (8.63)	0.01 (0.58)	0.02 (1.15)	0.00 (0.00)	0.01 (0.58)
Burst Strength, min psi (kPa)	55 (380)	35 (240)	55 (380)	35 (240)	55 (380)	35 (240)	70 (483)	60 (414)	80 (552)	75 (518)
Tensile, Machine Direction lb/in. width, min (N/mm width, min)	45 (7.9)	30 (5.3)	45 (7.9)	30 (5.3)	45 (7.9)	30 (5.3)	11 (1.9)	8 (1.4)	25 (4.4)	60 (10.5)
Tensile, Cross Direction lb/in. width, min (N/mm width, min)	30 (5.3)	20 (3.5)	30 (5.3)	20 (3.5)	30 (5.3)	20 (3.5)	10 (1.7)	7 (1.2)	25 (4.4)	50 (8.8)
Dimensional Change, max percent	0.50	0.50	0.50	0.50	0.50	0.50	1	1	0.5	0.5
Surface Water Resistance, max. g/m^2 water absorption	n/a	n/a	n/a	n/a	n/a	n/a	2.0	2.0	2.0	2.0

insulation. For this reason, in certain installations where temperature and moisture conditions have the potential to create a vapor driving force toward the insulation, a deterrent to the passage of such vapor into the installed insulation needs to be provided. This is the primary function of the vapor retarder.

9.2 In addition to the function stated in 9.1, a vapor retarder has the potential to provide physical protection and added strength to the insulation system.

9.3 This specification is used to specify material by physical property requirements that address the above prerequisites. The designer of an insulation system, after determining the degree of protection needed for the insulation, can use this specification to specify the appropriate type of vapor retarder when one is required.

10. Test Methods

10.1 *Water Vapor Permeance*—Test water vapor permeance in accordance with Test Methods E96/E96M, Procedure A.

10.2 *Surface Burning Characteristics*—Test in accordance with Test Method E84.

10.3 *Tensile Strength*:

10.3.1 Test the tensile strength of plastic sheet vapor retarders in accordance with Test Method D882, with results reported in pounds per inch width of specimen (Newtons per millimetre width).

10.3.2 Test the tensile strength of all other vapor retarders in accordance with Test Method D828, with results reported in pounds per inch of specimen width (Newtons per millimetre width).

10.3.3 Tested specimens shall be 2 in. (51 mm) wide with 1 in. (25 mm) between jaws.

10.3.4 Since the criterion for jaw breaks of Test Method D828 (a break within 1 in. of jaw) cannot be used with the above specimen configuration, employ visual inspection and appropriate care to ensure that the clamping action is not initiating breakage.

10.4 *Dimensional Stability*:

10.4.1 Test dimensional stability in accordance with Test Method D1204.

10.4.2 Expose the specimens to a temperature of $150 \pm 4^\circ\text{F}$ ($66 \pm 2^\circ\text{C}$) for 24 h.

10.5 *Fungi Resistance*:

10.5.1 Test fungi resistance in accordance with Test Method C1338.

10.5.2 For all tests, inoculate three specimens of the subject sample. Growth on any of the three specimens constitutes failure of the sample.

10.5.3 Test both sides of laminated products that use dissimilar materials, with the exception of a metallic foil side, which need not be tested.

10.5.4 Test either side of single layer products such as polymeric films.

10.6 *Thermal Integrity*—Test in accordance with Test Method C1263.

10.7 *Burst Strength*—Test in accordance with D774/D774M Test Method for Bursting Strength of Paper.

10.7.1 Since only one side of the vapor retarder material will be exposed in service, only that side need be evaluated for burst strength.

10.8 *Permanence of Flame Retardancy*—Test in accordance with TAPPI Test T461, Flame Resistance of Treated Paper and Paperboard.

10.9 *Elevated Temperature and Humidity Resistance*—Test in accordance with Test Method C1258.

10.10 *Surface Water Resistance*—Test the service-exposed side in accordance with Test Method C1878.

11. Sampling, Inspection, and Rejection of Defective Material

11.1 A lot of material shall be considered to be the largest quantity of a specific vapor retarder received by the purchaser under one order, or, it so designated by the manufacturer, that quantity of products identified as the particular lot.

11.2 A unit of material shall be considered to be the smallest packaged quantity of vapor retarder within a lot, that is, one roll in a lot of rolls or one bundle of sheets in a lot of sheeted material.

11.3 Inspection shall consist of any tests for specification conformance the user deems necessary. Due to the impracticality of performing some tests on an inspection basis, the user is entitled to request certification to specific test requirements.

11.4 Incoming lots shall be sampled at a minimum rate of 5 % of units received for inspection.

11.5 If any nonconformance to specification is detected within the 5 % sample, increase sampling to 10 % of the lot.

11.6 If 50 % or more of the 10 % sampled units is determined to be defective, the lot shall be considered unacceptable.

11.7 It shall be left to the discretion of the user whether to continue sampling for acceptable material. In any case, units found defective shall be considered unacceptable and rejected.

12. Certification

12.1 When specified in the purchaser order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and the requirements have been met. When specified in the purchaser order or contract, a report of the results shall be furnished.

12.2 *Qualification Requirements*—The following requirements are generally designated for initial product qualification:

12.2.1 Permeance,

12.2.2 Surface burning characteristics,

12.2.3 Tensile strength,

12.2.4 Dimensional stability,

12.2.5 Fungi resistance,

12.2.6 Thermal integrity,

12.2.7 Burst Strength,

12.2.8 Flame retardance permanence,

12.2.9 Elevated temperature and humidity resistance, and