



Designation: **C1668—19 C1668 – 20**

Standard Specification for Externally Applied Reflective Insulation Systems on Rigid Duct in Heating, Ventilation, and Air Conditioning (HVAC) Systems¹

This standard is issued under the fixed designation C1668; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers the requirements and physical properties of reflective insulation systems applied externally to Rigid Heating, Ventilation, and Air Conditioning (HVAC) duct systems operating at or below 250°F (121.1°C). These insulation systems consist of one or more low-emittance surfaces, such as metallic foil or metallic deposits, mounted on substrates to produce reflective air spaces. Reflective insulation systems derive thermal performance from surfaces with an emittance of no greater than 0.1 facing enclosed air spaces.

1.2 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.

1.3 *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.*

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[C168 Terminology Relating to Thermal Insulation](#)

[C335 Test Method for Steady-State Heat Transfer Properties of Pipe Insulation](#)

[C390 Practice for Sampling and Acceptance of Thermal Insulation Lots](#)

[C411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation](#)

[C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions](#)

[C1258 Test Method for Elevated Temperature and Humidity Resistance of Vapor Retarders for Insulation](#)

[C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings](#)

[C1371 Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers](#)

[E84 Test Method for Surface Burning Characteristics of Building Materials](#)

[E96/E96M Test Methods for Water Vapor Transmission of Materials](#)

[E2599 Practice for Specimen Preparation and Mounting of Reflective Insulation, Radiant Barrier and Vinyl Stretch Ceiling Materials for Building Applications to Assess Surface Burning Characteristics](#)

2.2 *Other Test Method:*

[TAPPI Standard T-512 sp-02 Creasing of Flexible Packaging Material Paper Specimens for Testing](#)³

3. Terminology

3.1 *Definitions:*

3.1.1 Unless otherwise noted, the terms used in this specification conform to Terminology [C168](#).

¹ This specification is under the jurisdiction of ASTM Committee [C16](#) on Thermal Insulation and is the direct responsibility of Subcommittee [C16.21](#) on Reflective Insulation.

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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 Available from Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092, [http://www.tappi.org](#).

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *HVAC ducts*—as pertaining to this standard, ducts having rigid rectangular or circular cross-section used to transfer air from the air handling equipment to the conditioned space and return.

3.2.2 *insulation spacers*—material used to form enclosed air spaces that are interior to the reflective insulation system.

3.2.3 *reflective insulation*—thermal insulation consisting of one or more low emittance surfaces, bounding one or more enclosed air space(s). C168

4. Classification

4.1 Products covered by this specification are classified according to the substrate material and have the physical properties as listed in **Table 1**.

4.1.1 *Type A*—Product with polyethylene foam substrate.

4.1.2 *Type B*—Product with polyethylene bubble pack substrate.

4.1.3 *Type C*—Product with fiberglass substrate.

4.1.4 *Type D*—Product with polyester fiber substrate.

4.1.5 *Type E*—Product with kraft paper substrate.

5. Ordering Information

5.1 Specify the required thermal resistance.

5.2 Specify the number of layers of insulation, width, thickness of the insulation system and the configuration of the duct(s) to be insulated.

5.3 Special markings, when required, shall be specified.

5.4 Special performance requirements, when required.

6. Materials and Manufacture

6.1 Reflective insulation shall consist of low-emittance surface(s) with substrates and adhesives required to meet the specified thermal performance and physical properties. Air spaces shall be maintained by use of insulation spacers.

6.2 Multiple layer reflective insulation shall be designed to attain the intended separation of layers. The design separation shall be maintained by the use of proper size, location and method of securing the insulation spacers to the duct system.

6.3 *Dimensions*—Insulation and properly sized insulation spacers shall be furnished in dimensions specifically agreed upon between the producer and the buyer.

7. Physical Properties

7.1 *Emittance*—Low-emittance surfaces used for this insulation shall have a surface emittance of 0.1 or less, as determined in accordance with **10.1**.

7.2 *Water Vapor Permeance*—The water vapor permeance shall be determined in accordance with **10.2** and shall meet the requirements of **Table 1**.

7.3 *Surface Burning Characteristics*—Surface Burning Characteristics shall be determined in accordance with **10.3**. The maximum flame spread index shall not exceed 25 and the maximum smoke developed index shall not exceed 50.

7.4 *Aging Resistance*—The laminates of the reflective insulation shall be tested for aging resistance in accordance with **10.4**. Three specimens shall be tested. The test specimens shall be shielded from condensate that drips from the ceiling of the humidity chamber during the test.

7.4.1 After exposure the specimens shall be evaluated for visible corrosion and delamination. For purposes of corrosion evaluation, disregard the outer 0.25 in. (6 mm) perimeter. No tested specimen shall exhibit visible corrosion or unaided delamination of layers.

TABLE 1 Classification Criteria

Property	Type A	Type B	Type C	Type D	Type E
Emittance	≤	≤	≤	≤	≤
Max. Flame Spread Index	0.10	0.10	0.10	0.10	0.10
Max. Smoke Developed Index	25	25	25	25	25
Hot Surface Performance	50	50	50	50	50
Water Vapor Permeance (perms)	Min. 250°F 0.02	Min. 250°F 0.02	Min. 250°F 0.02	Min. 250°F 0.02	Min. 250°F 0.02
	or less	or less	or less	or less	or less

7.4.2 After exposure re-measure the emittance of the samples. No test specimen shall have greater than 0.04 deviation from the original emittance measurement and must remain under 0.1.

7.5 *Adhesive Performance*—Adhesives when used shall show no sign of bleeding when tested in accordance with the test procedure in 10.5. Disregard bleeding at cut edges. Bleeding or delamination, shall be cause for rejection.

7.6 *Pliability*—Specimens tested in accordance with the procedure in 10.6 shall not show cracking or delamination.

7.7 *Fungi Resistance*—Specimens shall not have growth greater than the comparative item (southern yellow pine) when tested in accordance with 10.7. Use interpretation of results in 7.2 of Test Method C1338.

7.8 *Thermal Resistance*—Determine the thermal resistance in accordance with procedures in 10.8. The surface-to-surface R-value of a test assembly shall not be less than 95 % of the label value when tested in accordance with 10.8.

7.9 *Hot-Surface Performance*—Determine the Hot-Surface performance in accordance with procedures in 10.9. The minimum temperature requirement is 250°F (121.1°C).

8. Workmanship, Finish, and Appearance

8.1 The insulation system shall be manufactured, packaged and shipped in such a manner that, when received, it shall be suitable for installation.

9. Sampling

9.1 Sampling shall be performed in accordance with Practice C390.

10. Test Methods

10.1 *Emittance*—The emittance of the product shall be tested in accordance with Test Method C1371.

10.2 *Water Vapor Permeance*—The permeance of the insulation product shall be tested in accordance with Test Method E96/E96M (Desiccant Method).

10.3 *Surface Burning Characteristics*—The surface burning characteristics shall be determined in accordance with Test Method E84 and Practice E2599.

10.4 *Aging Resistance*—The aging resistance of the product shall be determined in accordance with Test Method C1258.

10.5 Adhesive Performance

10.5.1 Bleeding and Delamination:

10.5.2 *Scope*—This test method covers the determination of bleeding and delamination of the reflective insulation.

10.5.3 *Significance and Use*—It is necessary that reflective insulation not show adhesive bleeding or delamination since there is a potential for loss of structural integrity, a change to the emittance or a change in water permeability, or both.

10.5.4 *Sampling*—A minimum of three specimens of the reflective insulation, with dimensions of approximately 3 by 6 in. (7.62 by 15.24 cm), shall be tested. The specimens shall be cut from separate locations on a roll or panel of the insulation.

10.5.5 *Procedure*—Suspend the specimens vertically in an oven and heat to a temperature of $356 \pm 10^\circ\text{F}$ ($180 \pm 5^\circ\text{C}$) for at least 5 hours. Determine, under 5× magnification; has the adhesive bled or exuded through the surface, or has separation of the foil from substrate (delamination) occurred.

10.5.6 *Precision and Bias*—No information is presented about either precision or bias of this test method for determining Bleeding and Delamination, since the test results are non-quantitative.

10.6 Pliability:

10.6.1 *Scope*—This test method covers the determination of cracking or delamination of the reflective insulation due to folding and bending. Any reflective insulation product that does not require bending during installation shall be exempt from the requirements of this section.

10.6.2 *Significance and Use*—It is necessary that reflective insulation not crack or delaminate since these are contributing factors to loss of structural integrity and change in water permeability.

10.6.3 *Sampling*—A minimum of three specimens of the reflective insulation shall be subjected to two tests: one specimen shall contain a factory produced edge.

10.6.4 *Procedure*—Immediately prior to testing: (a) The specimens shall be conditioned at a temperature of $70 \pm 2^\circ\text{F}$ ($21.1 \pm 1.1^\circ\text{C}$) and a relative humidity of $50 \pm 5\%$ for a period of no less than 24 hours, for the first test. The second test shall be at $32 \pm 2^\circ\text{F}$ ($0 \pm 1.1^\circ\text{C}$) for a period of no less than 24 hours. (b) The foil laminate shall be folded in accordance with TAPPI Standard T-512 sp-02 and the folded edge smoothed, using light finger pressure. The finished laminate shall not crack or delaminate when folded to an 180° bend.

10.6.5 *Precision and Bias*—No information is presented about either precision or bias of TAPPI Standard T-512 sp-02 for determining cracking or delamination, due to folding or bending, since the test is qualitative.

10.7 *Fungi Resistance*—The fungi resistance of the product shall be determined in accordance with Test Method C1338.