



## Standard Specification for Adhesives for Duct Thermal Insulation<sup>1</sup>

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*This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.*

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### 1. Scope

1.1 This specification covers minimum material requirements, and safety precautions in application, for adhesives to bond thermal insulation duct liner on the interior surfaces of sheet metal air conditioning ducts; and for coating exposed edges and joints of duct liner thermal insulation to minimize erosion of insulation fibers by air movement.

1.2 *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.* For specific precautionary statements, see Sections 7 and 9.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

C 168 Terminology Relating to Thermal Insulating Materials<sup>2</sup>

D 93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester<sup>3</sup>

D 903 Test Method for Peel or Stripping Strength of Adhesive Bonds<sup>4</sup>

D 1151 Test Method for Effect of Moisture and Temperature on Adhesive Bonds<sup>4</sup>

E 84 Test Method for Surface Burning Characteristics of Building Materials<sup>5</sup>

#### 2.2 Other Standards:

NFPA No. 30, Flammable and Combustible Liquids Code<sup>6</sup>

SMACNA Duct Liner Application Standard<sup>7</sup>

ACGIH Threshold Limit Values<sup>8</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *threshold limit value (TLV)*—the concentration in parts of vapor per million parts of air, by volume at 25°C and 101.3 kPa (1 atm) pressure. This value is an indication of the relative inhalation toxicity hazard of vapors from volatile solvents used in adhesives. Data on TLV of materials are published annually by ACGIH.

3.1.2 For definitions of other terms on thermal insulating materials used in this specification, see Terminology C 168.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *flammable vehicle*—in an adhesive, the liquid portion having a flash point as determined by Test Methods D 93.

3.2.2 *nonflammable vehicle*—in an adhesive, the liquid portion having no flash point as determined by Test Methods D 93.

### 4. Classification of Adhesives

4.1 Adhesives supplied under this specification are classified as follows:

4.1.1 *Type I*—An adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will pass the edge-burning test of 6.2.

4.1.2 *Type II*—An adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will not pass the edge-burning test of 6.2.

4.1.3 *Type III*—An adhesive in which the vehicle is flammable in the liquid (wet) state and which will pass the edge-burning test of 6.2.

4.1.4 *Type IV*—An adhesive in which the vehicle is flammable in the liquid (wet) state and which will not pass the edge-burning test of 6.2.

### 5. Ordering Information

5.1 Attention of the purchaser is directed to the fact that four types of adhesives are available under this specification. If the purchaser does not specify which type is desired, the supplier shall furnish Type I only. Other purchaser options are described in 6.1.4 and 6.1.5.

### 6. Physical Requirements

#### 6.1 Requirements Applicable to All Types:

6.1.1 *Bonding Strength*—The adhesive shall have a bonding strength of not less than 0.5 lb/in. (9.0 g/mm) of width after testing under each condition of room tempera-

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<sup>2</sup> Annual Book of ASTM Standards, Vol 04.06.

<sup>3</sup> Annual Book of ASTM Standards, Vol 05.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 15.06.

<sup>5</sup> Annual Book of ASTM Standards, Vol 04.07.

<sup>6</sup> National Fire Protection Assn., Batterymarch Park, Quincy, MA 02269.

<sup>7</sup> Sheet Metal and Air Conditioning Contractors National Assn., 4201 Lafayette Center Drive, Chantilly, VA 22021.

<sup>8</sup> American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Dr., Cincinnati, OH 45240.

ture, high humidity, and heating, as specified in 7.2, 7.3, and 7.4.

6.1.2 *Bond Retention After Heat-Aging*—Duct liner fiber shall remain bonded to at least 75 % of the total area of each specimen after testing as specified in 7.5.

6.1.3 *Flame Spread and Smoke Developed*—Adhesive for duct liner shall have a fire hazard classification not to exceed 25 for flame spread and 50 for smoke developed. Classification shall be determined by Test Method E 84. A report from a qualified testing laboratory to indicate that fire hazard classification does not exceed that specified is acceptable. Tests shall be conducted as stated in 7.6.

6.1.4 *Storage Stability*—The adhesive shall meet the requirements specified herein after completion of storage for a period of 6 months under the conditions specified in 7.8. If acceptable to the purchaser, and instead of performing a storage stability test on each shipment, the manufacturer shall provide evidence that previous commercial lots of the adhesive have met satisfactorily the 6 months storage stability requirement.

6.1.5 *Other Physical Requirements*—Other requirements may be mutually agreed upon between the purchaser and the seller. These requirements may include viscosity, bonding time, solids content, color, and odor.

6.2 *Edge Burning Test for Types I and III Adhesives*—In addition to the general requirements stated above, Types I and III adhesives shall meet the following requirement: When tested by the method described in 7.7, there shall be no residual flame or continuous burning of any specimen for more than 3 s after the test flame is extinguished.

## 7. Test Methods

7.1 *Significance and Use*—The tests described herein are intended to evaluate the suitability of the adhesive for service in bonding fibrous glass thermal insulation duct liner by exposing specimens to simulated service conditions. The edge-burning test (7.7) is useful for distinguishing between adhesive types to identify flame-retardance after curing of the adhesive.

### 7.2 *Bonding Strength at Room Temperature:*

7.2.1 Prepare the specimens in accordance with Test Method D 903. The specimens shall be composed of 18-gage (0.05-in., 1.3-mm) galvanized steel bonded to 8-oz (0.3-kg/m<sup>2</sup>) cotton canvas. The galvanized steel shall have been cleaned with solvent and dried.

7.2.2 Apply the adhesive by brushing or spraying in accordance with the manufacturer's recommendation for thickness. Apply the adhesive to the metal surface only. As soon as the applied adhesive has become tacky as determined by finger pressure, bond the canvas to the metal. Immediately after bonding, roll the canvas with a hand roller weighing 5 lb per lineal inch of roller (90 kg/m) (that is, a roller 4 in. long should have a total weight of 20 lb), to ensure uniform contact between adherends. Condition the specimens for 24 h at a relative humidity of  $50 \pm 2$  % at  $73.4 \pm 2^\circ\text{F}$  ( $23 \pm 1^\circ\text{C}$ ). Test the specimens as described in Test Method D 903 except that the rate of travel of the power-actuated grip of the testing machine shall be 2 in. (50 mm)/min.

7.3 *Bonding Strength at High Humidity*—Prepare the specimens as described in 7.1 except that after the 24-h

conditioning period specified, further condition the specimens by exposure to a relative humidity of 95 % minimum at  $73.4 \pm 2^\circ\text{F}$  ( $23 \pm 1^\circ\text{C}$ ) for 24 h. Conduct the testing as specified in Test Method 903 immediately after removal of the test specimens from the conditioning atmosphere and preferably under the same conditions. The rate of jaw separation of the testing machine shall be 2 in. (50 mm)/min.

7.4 *Bonding Strength While Heated*—Prepare the specimens as described in 7.1 except that after the 24-h conditioning period specified, further condition the specimens for 7 days in a circulating air oven maintained at a temperature of  $158 \pm 2^\circ\text{F}$  ( $70 \pm 1^\circ\text{C}$ ). Conduct the testing as specified in Test Method D 903 at a temperature of  $158 \pm 2^\circ\text{F}$  ( $70 \pm 1^\circ\text{C}$ ) at 2 in. (50 mm)/min jaw separation speed.

7.5 *Bond Retention After Heat Aging*—Prepare a flat piece of 18-gage (0.05-in., 1.3-mm) galvanized steel 6 by 16 in. (150 by 400 mm) by cleaning with solvent and drying. Apply the adhesive to one side by brushing or spraying in accordance with the manufacturer's recommendation for thickness. As soon as the adhesive has become tacky, as determined by finger pressure, bond to it a single thickness of 1-in. (25-mm) thick by 6 by 16-in. (150 by 400-mm) duct liner insulation of 3-lb/ft<sup>3</sup> (48-kg/m<sup>3</sup>) nominal density conforming to SMACNA Duct Liner Application Standard. Immediately after bonding, use the hand roller on the duct liner as described in 7.2.2 to ensure uniform contact between adherends. Using a sheet metal break or other suitable forming technique, after 1 h at room temperature, bend the specimen to a rectangular tubular shape with the duct liner on the inside, thus forming a hollow duct 4 by 4 by 6 in. (100 by 100 by 150 mm). Prepare two such specimens. Allow the formed specimens to age for 24 h at room temperature. Using test exposure No. 11 of Test Method D 1151, expose the specimens for 90 days at  $158^\circ\text{F}$  ( $70^\circ\text{C}$ ) in a circulating air oven with uncontrolled humidity. Remove the specimens and condition them as described in 6.2.3 of Test Method D 1151. Unbend each specimen so that it is essentially flat. Then remove the duct liner insulation by pulling away from the metal beginning at the edges. Observe and report the proportion of the total specimen area to which fibers of duct liner insulation remain bonded.

7.6 *Flame Spread and Smoke Developed*—Prepare test specimens on 1/4-in. (6-mm) asbestos-cement board, and test as specified in Test Method E 84. Prepare specimens in triplicate. Prepare the specimens using the lowest coverage specified by the manufacturer, that is, that coverage which will yield the maximum recommended thickness of adhesive. Allow sufficient drying time to elapse before testing the specimens to assure that any residual volatile ingredients shall not exceed 1 weight %.

7.6.1 If the results of two tests differ by more than 10 flame spread points, test the third specimen and report all three results.

### 7.7 *Edge-Burning Test* (applicable to Types I and III):

NOTE—This is a small-scale test for which precision and bias have not been determined. It is useful for quality control evaluations.

7.7.1 *This test 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.*

7.7.2 Coat three specimens of 2-in. thick by 10-in. long by 3-in. wide (50 by 250 by 75-mm) duct liner insulation of 3-lb/ft<sup>3</sup> (48-kg/m<sup>3</sup>) nominal density, conforming to SMACNA Duct Liner Application Standard, on the cut-edge face with the adhesive under test. Prepare the 2-in. thick specimens by laminating two 1-in. (25-mm) thick pieces (back-side to back-side) with the adhesive under test. Control the application and thickness in the following manner: Place a piece of smooth household aluminum foil on a smooth hard horizontal surface. Apply to it a coat of wet adhesive at least 11 in. long and 3 in. wide (280 by 75 mm). Apply with a metal blade about 1/16 in. (1.6 mm) thick, having cut into the working edge a notch 3 in. long and 1/16 in. deep.

7.7.3 Pour a pool of adhesive at one end of the aluminum foil strip and, using the notched blade held at an angle of 90° to the surface, spread the adhesive uniformly over the foil, leaving a path of wet adhesive 3 in. (75 mm) wide and of uniform thickness.

7.7.4 Immediately after the wet adhesive is drawn out in this way, lay a strip of duct liner insulation into it, with the 2-in. (50-mm) wide face of the cut edge downward. Use sufficient pressure to assure complete contact between the wet adhesive and the entire cut-edge face of the duct liner insulation.

7.7.5 After 10 s contact, peel away the duct liner insulation from the wet adhesive and allow to dry, coated face upward, at room temperature for 24 h. Prepare three such specimens.

7.7.6 Suspend the specimen from a suitable clamp at an angle of 45° in a draft-free location with the adhesive-coated surface facing downward. Adjust the flame of a butane gas-fueled cigarette lighter so that it is 1.5 to 2.0 in. (38 to 50 mm) high. Alternatively, a micro-bunsen burner using propane gas fuel adjusted to the same height may be used. The lighter or burner should have firm support. Position the clamped specimen so that the lower end of the coated surface is suspended in the vertical flame which impinges upon it 1 in. (25 mm) above the bottom edge and not more than 1/2 in. (12.5 mm) above the gas jet orifice of the opened lighter or micro-bunsen burner.

7.7.7 After 15 s extinguish the ignition flame and observe the length of time the adhesive-coated face continues to burn. Report the results of all three tests.

7.8 *Storage Stability*—Store the adhesive for a period of 6 months in an airtight container under normal heated warehouse storage conditions, that is, 40 to 100°F (5 to 35°C). At the end of this period stir the adhesive moderately and subject it to the tests specified in Section 6.

7.9 *Precision and Bias*—For methods described in 7.2, 7.3, 7.4, 7.5, and 7.7 no statement is made about either the precision or the bias, since the result merely indicates whether there is conformance to the criteria for acceptance.

## 8. Marking

8.1 Each container of adhesive shall be marked clearly with this specification number, type of adhesive, name and address of the manufacturer, the net contents, the product identification by name or code number or both, and a manufacturing lot number. Adequate directions for use, and the technique of application shall be included. Safety precautions to be taken during application shall be stated clearly (see Section 9). The TLV of the volatile solvents contained in the adhesive shall be stated on the label. Adhesives liable to damage by freezing shall be labeled prominently “KEEP FROM FREEZING.”

## 9. Safety Precautions in Application

9.1 The user should observe strictly the directions of the adhesive manufacturer for the proper use of the product supplied to assure that the adhesive is applied in a safe and effective manner.

9.2 The user should observe safety precautions indicated on the product label. In particular, adequate ventilation shall be provided so that the threshold limit value (TLV) of the adhesive (as stated on the label) is not exceeded.

9.3 For Types III and IV adhesives, the user should observe the fire hazard precautions required by NFPA No. 30, Chapter V, for industrial plants. Flammable adhesives Types III and IV should not be applied in confined spaces such as the interior of installed air ducts and plenums.

## 10. Keywords

10.1 adhesive; duct liner; insulation

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