



Designation: C 916 – 85 (Reapproved 2001)^{ε1}

Standard Specification for Adhesives for Duct Thermal Insulation¹

This standard is issued under the fixed designation C 916; 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.

^{ε1} NOTE— Sections 7.3 and 7.4 were editorially revised in October 2001.

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 Materials²

D 93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester³

D 903 Test Method for Peel or Stripping Strength of Adhesive Bonds⁴

D 1151 Test Method for Effect of Moisture and Temperature on Adhesive Bonds⁴

E 84 Test Method for Surface Burning Characteristics of Building Materials⁵

2.2 Other Standards:

NFPA No. 30, Flammable and Combustible Liquids Code⁶

SMACNA Duct Liner Application Standard⁷

ACGIH Threshold Limit Values⁸

¹ This specification is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.33 on Thermal Insulation Finishes and Thermal Transmission.

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² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 05.01.

⁴ Annual Book of ASTM Standards, Vol 15.06.

⁵ Annual Book of ASTM Standards, Vol 04.07.

⁶ National Fire Protection Assn., Batterymarch Park, Quincy, MA 02269.

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

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

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 temperature, 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/m²) 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 ± 2 % at 73.4 ± 2°F (23 ± 1°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 7.2 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 ± 2°F (23 ± 1°C) for 24 h. Conduct the testing as specified in Test Method D903 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 at While Heated*—Prepare the specimens as described in 7.2 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 ± 2°F (70 ± 1°C). Conduct the testing as specified in Test Method D 903 at a temperature of 158 ± 2°F (70 ± 1°C) at 2 in. (50mm)/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/ft³ (48-kg/m³) 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°F (70°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 ¼-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 1—This is a small-scale test for which precision and bias have not been determined. It is useful for quality control evaluations.