



Designation: C 1149 – 97

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
Reprinted from the Annual Book of ASTM Standards. Copyright ASTM

Standard Specification for Self-Supported Spray Applied Cellulosic Thermal Insulation¹

This standard is issued under the fixed designation C 1149; 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.

1. Scope

1.1 The specification covers the physical properties of self-supported spray applied cellulosic fibers intended for use as thermal insulation or an acoustical absorbent material, or both.

1.2 This specification covers chemically treated cellulosic materials intended for pneumatic applications where temperatures do not exceed 82.2°C (180°F) and where temperatures will routinely remain below 65.6°C (150°F).

1.2.1 *Type I*—Material applied with liquid adhesive and suitable for either exposed or enclosed applications.

1.2.2 *Type II*—Materials containing a dry adhesive that is activated by water during installation and intended only for enclosed or covered applications.

1.2.3 *Type III*—Materials containing adhesive that is mixed with water during installation and intended for use on the attic floor of a building.

1.3 This is a material specification only and is not intended to deal with methods of application that are supplied by the manufacturer.

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

1.5 *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:

C 168 Terminology Relating to Thermal Insulating Materials²

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus²

C 236 Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box²

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²

C 739 Specification for Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation²

C 976 Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box²

E 84 Test Method for Surface Burning Characteristics of Building Materials³

E 605 Test Methods for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members³

E 736 Test Method for the Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members³

E 759 Test Method for Effect of Deflection of Sprayed Fire-Resistive Material Applied to Structural Members³

E 859 Test Method for Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members³

E 970 Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source³

3. Terminology

3.1 *Definitions*—Definitions in Terminology C 168 shall apply in this specification.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *constant mass*—no change in successive weighings in excess of 0.5 % of specimen mass taken at 4-h intervals unless otherwise specified. Specimen should not be always increasing in weight or decreasing in weight.

3.2.2 *cured*—the state of the finished product after it has achieved constant mass.

3.2.3 *curing*—the process in which the liquid vehicle is removed. Normally achieved in ambient building conditions with forced air convection to hasten the evaporation process.

3.2.4 *prepared sample*—samples prepared in accordance with Section 5 and cured to constant mass prior to conducting the specific tests. The prepared samples, after reaching constant mass, as defined in 3.2.1, shall have a density within ± 10 % of the manufacturer's recommended design density.

3.2.5 *self supporting*—a product that can be tested by the criteria imposed by this specification and that will require no support other than itself or the substrate to which it is attached.

¹ This specification is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.23 on Blanket and Loose Fill Insulation.

Current edition approved June 10, 1997. Published June 1998. Originally published as C 1149-90. Last previous edition C 1149-90.

² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 04.07.

3.2.6 *specimen*—definition of specimen as used in this specification shall be the same as that for *prepared sample* in 3.2.4.

3.2.7 *sprayed fiber*—chemically treated cellulosic materials, that are pneumatically conveyed and mixed with water or adhesive, or both, at the spray nozzle and become self-supporting when cured.

4. Physical Properties

4.1 Materials and Manufacture:

4.1.1 The basic material shall consist of virgin or recycled wood based cellulosic fiber.

4.1.2 Suitable chemicals shall be introduced to provide flame resistance, improved processing, adhesive/cohesive properties, and handling and application characteristics.

4.1.3 The basic material shall be processed into a form suitable for installation by pneumatic conveying equipment and the simultaneous mixing with liquid at the spray nozzle.

4.2 *Density*—Type I, Type II, and Type III samples shall be within $\pm 10\%$ of the manufacturer's stated values when tested in accordance with 6.1.

4.3 *Thermal Resistance*—Type I, Type II, and Type III samples shall be within $\pm 10\%$ of the manufacturer's stated values when tested in accordance with 6.4.

4.4 *Surface Burning Characteristics*—Type I, Type II, and Type III samples shall have a maximum flame spread rating of 25 and a maximum smoke developed rating of 50 when tested in accordance with 6.2.

4.4.1 *Critical Radiant Flux*—Type III samples shall have a critical radiant flux equal to or greater than 0.12 W/cm^2 when tested in accordance with 6.2.1.

4.5 Adhesive/Cohesive Strength:

4.5.1 *Type I*—The applied material shall have a minimum adhesive/cohesive bond strength per unit area of five times the weight of the material under the test plate when tested in accordance with Test Method E 736.

4.5.2 *Type II*—The applied product shall have a minimum adhesive/cohesive bond strength per unit area of two times the weight of the material under the test plate when tested in accordance with Test Method E 736.

4.5.3 *Type III*—The applied material shall have a minimum adhesive/cohesive bond strength per unit area equal to or greater than the weight of the material under the test plate at the density determined as per 6.1 when tested in accordance with 6.3.

4.6 *Smoldering Combustion*—Type I, Type II, and Type III products, when tested in accordance with 6.5, shall have a weight loss no greater than 15 % of the specimen weight and shall exhibit no evidence of flaming.

4.7 *Fungi Resistance*—Type I, Type II, and Type III products, when tested in accordance with 6.6, shall not promote more fungal growth than the control in at least two of the three replicate specimens. (See Specification C 739, 1986 edition, paragraph 5.4.)

4.8 *Corrosion*—Type I, Type II, and Type III products, when tested in accordance with 6.7, shall demonstrate no perforations in the 3-mil metal coupons when observed in close proximity to a 40-W appliance light bulb. Notches extending less than 3 mm into the coupon edge can be ignored.

4.9 *Moisture Vapor Absorption*—Moisture absorption of Type I, Type II, and Type III products shall be no more than 15 % when tested in accordance with 6.8.

4.10 *Odor*—Type I, Type II, and Type III applied products shall have no strong, objectionable odor when tested in accordance with 6.9.

4.11 Flame Resistance Permanency:⁴

4.11.1 The importance of an insulation's product to maintain its fire retardant characteristics is recognized. A task group is currently studying methods to ascertain if there is a long term deterioration of fire performance characteristics of cellulose insulation. Should the need for a permanency test method be determined by this task group and a test method developed and finalized, it will become a part of this specification.

4.12 Additional Characteristics for Type I Product:

4.12.1 *Substrate Deflection*—Type I applied product shall not spall, crack, or delaminate when tested in accordance with 6.11 of this specification.

4.12.2 *Air Erosion*—Type I applied product shall pass the air erosion test described in 6.10 of this specification.

5. Specimen Preparation

5.1 Prepare specimens using manufacturer's recommended equipment and procedures and at manufacturer's maximum recommended thickness. Cure specimens to constant mass at $23 \pm 3^\circ\text{C}$ ($73.4 \pm 5.4^\circ\text{F}$) and $50 \pm 5\%$ relative humidity unless otherwise specified in a specific test procedure. All specimens shall be within $\pm 10\%$ of the manufacturer's recommended installation density.

6. Test Methods

6.1 *Density*—Density of each sample shall be determined in accordance with Test Methods E 605.

6.2 *Surface Burning Characteristics*—The surface burning characteristics of Type I, Type II, and Type III products shall be determined in accordance with Test Method E 84.

6.2.1 *Critical Radiant Flux*—The critical radiant flux performance of Type III material shall be determined in accordance with Test Method E 970-89.

6.3 *Adhesive/Cohesive Strength*—The adhesive/cohesive strength of the spray applied fiber insulation shall be determined in accordance with Test Method E 736.

6.4 *Thermal Resistance*—Samples shall be prepared as in Section 5. The thermal resistance of the spray applied cellulosic fiber insulation shall be as determined by the average of four specimens tested in accordance with Test Methods C 177, C 518, C 236 or C 976. The referee method shall be Test Method C 177. When Test Method C 518 or C 177 is used, the surface irregularities will be trimmed to provide uniform thickness. When the hot box method is used, the test will be on the insulation component only or alternatively; if tested as a system, the results reported shall include all components of system evaluated.

6.5 Smoldering Combustion:

6.5.1 *Scope*—This test method determines the resistance of the insulation to smolder, under specific laboratory conditions.

⁴ This statement on flame resistant permanency was added in March 1997.

6.5.2 *Significance and Use*—Insulation materials that readily smolder could have an adverse effect on the surrounding structure in the event of exposure to fire or heat sources.

6.5.3 *Apparatus for Smoldering Combustion Test:*

6.5.3.1 *Specimen Holder*—The specimen holder shall be an open-top 203 ± 2 mm (8 ± 0.08 in.) square box, 100 ± 2 mm (4 ± 0.08 in.) in height, fabricated from 18 United States standard gage stainless steel sheet with the vertical edges of the box overlapped, not to exceed 7 mm (0.27 in.) in seam width, and joined to be watertight.

6.5.3.2 *Specimen Holder Pad*—During the test the specimen holder shall rest upon a pad of unfaced glass fiberboard having dimensions equal to the bottom of the specimen holder. The glass fiberboard shall be approximately 25 mm (0.98 in.) thick, with a density of 40 ± 4 kg/m (2.5 ± 0.25 lb/ft).

6.5.3.3 *Laboratory Scales*, capable of weighing the specimen holder and sample with an accuracy of ± 0.2 g (0.007 oz).

6.5.3.4 *Drill Press*, with vertical movement capabilities in excess of 114 mm (4.5 in.) and fitted with an 8 mm (0.315 in.) diameter drill bit with a minimum usable length of 102 mm (4.0 in.) when chucked.

6.5.3.5 *Ignition Source*—The ignition source shall be a cigarette without filter tip made from natural tobacco, 85 ± 2 mm (3.35 ± 0.08 in.) long with a tobacco packing density of 0.27 ± 0.0020 g/cm and a total weight of 1.1 ± 0.2 g (0.04 oz).

6.5.4 *Sampling*—Three specimens per sample shall be tested.

6.5.5 *Conditioning*—Sample shall be allowed to dry at $23 \pm 3^\circ\text{C}$ ($73.4 \pm 5.4^\circ\text{F}$) and $50 \pm 5\%$ relative humidity until constant mass is achieved.

6.5.6 *Test Chamber*—A draft-protected chamber or hood with a suitable exhaust system to remove products of combustion. Air velocities shall not exceed 0.5 m/s (1.64 ft/s) in the vicinity of the specimen surface when measured by a hot wire anemometer.

6.5.7 *Procedure:*

6.5.7.1 Determine tare weight of specimen holder and fiberglass shim (after drilling) to nearest 0.2 g and record weight (see 6.5.7.4).

6.5.7.2 After conditioning in accordance with 6.5.5, cut specimens 203 by 203 ± 2 mm (8 by 8 ± 0.08 in.) square to fit snugly inside the specimen holder.

6.5.7.3 After cutting specimen to the correct size, drill a hole through the thickness of the specimen at the center. Use a drill press and steel drill bit described in 6.5.3.4.

6.5.7.4 Insert drilled specimen level with top edge of specimen holder. If required, provide a shim of unfaced fiberglass (approximate 0.5 lb/ft³) under the specimen that is cut to fit holder and center drilled to align with specimen. Carefully cut excess material extending above the top edge of the specimen holder. A reciprocating electric knife or saw has been found suitable. Take care that the center drilled hole is free of debris and if the shim pad is used, that the hole is aligned through specimen and pad.

6.5.7.5 Weigh specimen and specimen holder, subtract weight of empty specimen holder and fiberglass shim if used. Record this as the starting weight of the specimen, (W_1). Calculate the density of the specimen to the nearest 0.1 lb/ft³;

density shall be within $\pm 10\%$ of the manufacturer's design density.

6.5.7.6 With the specimen in the specimen holder and placed on the insulation pad, insert well-lighted cigarette, burned no more than 8 mm (0.32 in.), into the formed cavity, with the lighted end upward and flush with the specimen surface. Place the specimen in the test chamber and allow burning of the cigarette to proceed undisturbed for at least 1 h, after which, allow specimen to remain until there is no evidence of heat or smoke and the bottom of the specimen holder is cool to the touch.

6.5.7.7 After the specimen has cooled to less than 25°C (77°F), weigh to the nearest 0.2 g and subtract the tare weight determined in 6.5.7.1 to arrive at the final net weight, (W_2).

6.5.8 *Calculation*—Calculate percent weight loss as follows:

$$WL = (W_1 - W_2)/W_1 \times 100 \quad (1)$$

where:

WL = weight loss, %,

W_1 = weight of specimen before test, g (oz), and

W_2 = final weight of specimen at completion of test, g (oz).

6.5.9 *Retest*—If all three specimens pass, the insulation passes. If more than one fails, the insulation is rejected. If any one of the three specimens should fail, conduct a retest consisting of three additional specimens. Should one of the three retest specimens fail, the insulation is rejected.

6.5.10 *Results of test:* Pass/Fail.

6.5.11 *Precision and Bias* The precision and bias of this test method has not been determined.

6.6 *Fungi Resistance:*

6.6.1 *Scope*—This test method covers the determination of the amount of resistance to the growth of fungi present in self-supported spray applied cellulosic thermal/acoustical insulation.

6.6.2 *Significance and Use*—It is necessary to ensure that spray applied cellulosic insulation materials support no greater growth of fungi than the surrounding materials of the structure being insulated. Normally the structural materials in question will be wood. Excessive growth of fungi on the insulation could result in loss of efficiency of the insulation, damage to the structure, and possible health hazards to the occupants of the insulated structure. The purpose of this test method is to provide an evaluation of the potential for fungi growth present in the insulation material relative to common wood used for framing.

6.6.3 *Apparatus*—The apparatus required to conduct this test method consists of chambers or cabinets together with auxiliary instrumentation capable of maintaining the specified conditions of temperature and humidity. The apparatus shall be constructed to keep light from entering the chamber during the test period.

6.6.4 *Sampling*—Unless specified by the purchaser, one specimen shall be selected from each of three different bags or other packages of insulation, as applicable.

6.6.5 *Procedure*—Prepare mineral salts agar in accordance with Table 1.

6.6.5.1 Sterilize the mineral salts agar by autoclaving at 121°C