

Standard for Air and Water Resistive Barriers - Medium Density Closed Cell Rigid Spray Polyurethane Foam - Material Specification

1. Scope

1.1 This document provides the material property requirements and test methods to determine these properties for *medium density closed cell spray-applied rigid polyurethane foam* that is manufactured on site and used as an air and/or water resistive barrier material in buildings, whether applied on a building site or in a prefabrication (manufacturing) facility. The material provides a vapor retarded and thermal insulation function depending on the installed thickness.

1.2 The *spray polyurethane foam system supplier* produces a liquid resin, which when combined with the corresponding polymeric isocyanate on a fixed ratio basis (normally one to one) and sprayed onto a substrate produces material meeting the requirements in this document. Therefore, the requirements set out by the *supplier* for installation, including requirements for the qualification of contractors and installers forms an integral part of the manufacturing process for the finished product. Therefore, the installation process set out by the *supplier* and any installation standard for this material is integral for meeting the requirements of this document.

1.3 The *medium density closed cell spray-applied rigid polyurethane foam* shall only be manufactured/produced/installed in accordance with the spray polyurethane foam system *supplier's* instructions. Responsibilities of the manufacturer, the contractor and the installer are set out by the manufacturer, any installation standard and the site quality assurance program.

1.4 The *medium density closed cell spray-applied rigid polyurethane foam* shall not be used when the continuous service temperature of the substrate is outside the range of -60 to +80 °C (-76 to +176 °F).

1.5 The test methods listed in this document are used to determine the values for the material properties. These values are intended for use in specifications, product evaluations and quality control. They are not intended to predict in situ end-use product performance.

1.6 Only metric SI units of measurement are used in this document. If a value for measurement is followed by a value in other units in parentheses, the second value is approximate. The first stated value is the requirement.

1.7 The testing and evaluation of a product against this document may require the use of materials and/or equipment that could be hazardous. This document does not purport to address all the safety aspects associated with its use. Anyone using this document has the responsibility to consult the appropriate authorities and to establish appropriate health and safety practices in conjunction with any existing applicable regulatory requirements prior to its use.

2. Referenced Documents

2.1 The documents shown below are referenced in the text of this document. Unless otherwise stated elsewhere in this document such reference shall be considered to indicate the edition and/or revisions of the document available at the date on which the Committee approved this Standard.

Documents published by the American Association of Textile Chemists and Colorists (AATCC)
PO Box 12215 Research Triangle Park, NC 27709-2215

AATCC 127, Water Resistance: Hydrostatic Pressure Test

Documents published by the Air Barrier Association of America, Inc.
1600 Boston Providence Hwy, Walpole MA 02081 USA
Telephone: (866) 956-5888 Fax: (866) 956-5819
www.airbarrier.org

ABAA T0002, Standard Test Method for Pull-Off Strength of Adhered Air and Water Resistive Barriers Using an Adhesion Tester

ABAA T0004, Standard Test Method for Determining Gap Bridging Ability of Air and Water Resistive Barrier Materials

Documents Published by the American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959 USA
Telephone: (610) 832-9585 Fax: (610) 832-9555
www.astm.org

ASTM C390, Standard Practice for Sampling and Acceptance of Thermal Insulation Lots

ASTM C518, Test Method for Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus

ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings

ASTM D618, Standard Practice for Conditioning Plastics for Testing

ASTM D1621, Test Method for Compressive Properties of Rigid Cellular Plastics

ASTM D1622, Test Method for Apparent Density of Rigid Cellular Plastics

ASTM D1623, Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

ASTM D2126, Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging

ASTM D2842, Test Method for Water Absorption of Rigid Cellular Plastics

ASTM D5385, Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes

ASTM D6226, Standard Test Method for Open Cell Content of Rigid Cellular Plastics

ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials

ASTM E631, Standard Terminology of Building Construction

ASTM E2178, Standard Test Method for Air Permeance of Building Materials

3. Terminology

3.1 For definitions of general terms related to building construction used in this document, refer to ASTM E 631 Terminology. Specific definitions and symbols used in this document have been listed below.

3.1.1 accredited spray polyurethane foam contractor (contractor)
individual, organization or corporation who is responsible for meeting all requirements and obligations for the installation.

3.1.2 certified spray polyurethane foam installer (installer)
individual (worker) who has the knowledge, skills and ability to properly install spray polyurethane foam and who is responsible for the actual spray polyurethane foam installation and the site requirements under contract.

3.1.3 medium density closed cell spray-applied rigid polyurethane foam (*foam material*)
rigid cellular plastic material that is formed in place by the catalyzed reaction of polymeric isocyanate and polyhydroxyl compounds, expanded with blowing agents and producing a 90% plus closed cell product that has a density of approximately 28 to 43 kg/m³ (1.75 to 2.80 lbs/ft³)

3.1.4 licensed spray polyurethane foam system supplier (*supplier*)
manufacturer of the polyhydroxyl compounds (resin), intended to be combined with the corresponding polymeric isocyanate, designed to be mixed and sprayed to form medium density closed cell spray-applied rigid polyurethane foam material in-situ

4. Requirements

4.1 General

4.1.1 *Medium density closed cell spray-applied rigid polyurethane foam material* shall be site manufactured (installed) by an accredited spray polyurethane foam *contractor* using a certified spray polyurethane foam *installer* in accordance with the instructions given by the *supplier*.

4.1.2 The chemical components (resin and isocyanate) shall produce the *foam material* that meets the requirements of this document when the chemical components are stored in accordance with the *supplier's* instructions and installed as required in Subsection 4.1.1 before the expiration date of the chemicals declared by the *supplier*.

4.1.3 When installed in accordance with the *supplier's* instruction the *foam material* shall not present a health hazard to the potential occupants.

4.2 Detailed

4.2.1 *Medium density closed cell spray-applied rigid polyurethane foam* shall produce the physical properties values specified in Table 1 when installed in accordance with Subsections 4.1.1 and 4.1.3 of this document.

4.3 Health and Safety

4.3.1 The *supplier* shall ensure that the procedures described in the installation instructions form an integral part of the site manufacturing process for the finished product and shall be a requirement for the installer. The instructions for the installation process shall ensure that the material does not present any health and safety hazards either during installation or to the occupants after installation.

5. Testing

5.1 Sampling

5.1.1 The accredited testing laboratory determining compliance to this document shall be responsible for the random sampling of the liquid components. Sampling shall be performed in accordance with the

principles of ASTM C 390. Enough material shall be selected on a single occasion from a single lot (of each component) to complete all testing to determine compliance with this document.

5.1.2 For testing purposes, the accredited testing laboratory shall randomly select containers of each of the liquid components and seal the containers. The containers shall be stored within the temperature range specified by the *supplier*. Sample panels must be prepared prior to the expiry date of the resin component.

5.1.3 Unless otherwise specified, the number of sample panels shall be left to the discretion of the organization determining compliance with this document.

5.2 Sample Panels

5.2.1 Sample panels of *foam material* that are representative of the installed product shall be prepared by the *supplier* and witnessed by the accredited testing laboratory. The sample panels shall be prepared using liquid components obtained in accordance with Clause 5.1.

5.2.2 Unless otherwise specified in the test method, the sample panels shall be produced by spraying the *foam material* on a 16-mm (5/8 inch) thick polyethylene board to obtain the *supplier's* designed and tested *foam material* density.

5.2.3 A single batch (lot) of liquid components shall be used to produce a complete set of sample panels required to produce individual specimens in the size and number required by the testing laboratory to conduct all the tests included in this document for a single testing occasion. Any re-testing shall be conducted using a new set of sample panels produced using a new single batch (lot) of liquid components.

5.2.4 Unless stated differently in this document or in the test method, the finished sample panels shall have a minimum thickness of 60 mm (2 3/8 inch) containing no more than one (1) skin (pass line). The size of the foam sample panels shall be a minimum of 1200 mm x 1200 mm (48 in. x 48 in.).

5.2.5 The ambient temperatures (in the area where the sample panels are produced) and the substrate temperature on which the material is sprayed shall be $(23 \pm 5) ^\circ\text{C}$ [$(73 \pm 10) ^\circ\text{F}$], and the ambient relative humidity shall not exceed 80%, unless otherwise specified and so reported.

5.3 Conditioning of Sample Panels

5.3.1 Unless otherwise specified, sample panels (with the polyethylene board attached) shall be conditioned in accordance with ASTM D 618, Procedure A [i.e., 88 h at $(23 \pm 2) ^\circ\text{C}$ [$(73 \pm 5) ^\circ\text{F}$], $(50 \pm 5) \% \text{ R.H.}$] prior to cutting and testing for material properties.

5.4 Preparation of Specimens

5.4.1 Unless otherwise specified in the test method, the specimens shall be cut from the center of the sample panels described in Subsection 5.2.2. The edge of any specimen shall not be less than 30 cm (12 inches) from the edge of the sample panel except for air permeance testing. Unless specified otherwise, specimens shall be 50 mm (2 inch) thick and shall contain no more than one pass line (internal skin) within the specimen for all specimens required for testing purposes. All specimens shall be cut such that the testing is conducted parallel to the direction of rise, unless otherwise specified in the test method.

5.4.2 All specimens shall be obtained from the conditioned sample panels by cutting the specimen to the size required for the testing equipment.

5.4.3 The side of the specimen opposite to the polyethylene board shall be cut to produce a flat specimen. The bottom skin produced against the polyethylene board shall be left intact.

5.4.4 The opposing faces of the test specimens shall be sufficiently flat and parallel to be used in the test apparatus. The test specimens shall not be warped.

5.5 Test Methods

5.5.1 Air Permeance

5.5.1.1 The air permeance of the material shall be determined in accordance with ASTM E 2178 using five specimens with minimum dimensions of 1200 mm x 1200 mm x 25 mm (48 inch x 48 inch x 1 inch thick) which do not contain a pass line. The “skin” produced by the polyethylene board shall be left in place and shall face the pressurized chamber of the apparatus. The exterior skin (opposite the polyethylene board skin) shall be removed when cutting the specimens to the (25 ± 3) mm ($1 \pm 1/8$ inch) thickness.

5.5.1.2 The results shall be reported as the average of the five specimens.

5.5.2 Apparent Core Density

5.5.2.1 The apparent core density shall be determined in accordance with ASTM D 1622 using five core specimens with a minimum size of 100 mm x 100 mm x 25 mm (4 inch x 4 inch x 1 inch). The specimens used for apparent core density shall not contain any pass lines.

5.5.2.2 The results shall be reported as the average of the five specimens.

5.5.3 Compressive Strength

5.5.3.1 The compressive strength shall be determined in accordance with ASTM D 1621, Procedure A, using five core specimens measuring 150 mm x 150 mm x 50 mm (6 inch x 6 inch x 2 inches) each.

5.5.3.2 The results shall be reported as the average of the five specimens.

5.5.4 Dimensional Stability

5.5.4.1 Dimensional stability shall be determined in accordance with ASTM D2126, except that the sample panel shall be conditioned at 23 ± 2 °C [(73 ± 5) °F] and 50 ± 5 % RH for 14 days.

5.5.4.2 Specimens shall be cut to 100 ± 5 mm x 100 ± 3 mm x 25 ± 3 mm ($4 \pm 1/8$ inch x $4 \pm 1/8$ inch x $2 \pm 1/8$ inch)

NOTE: The pass line will be located as close as possible to the center of the test specimen.

5.5.4.3 Five specimens shall be exposed to each of the following exposure conditions. A different set of specimens shall be used for each exposure conditions:

- a. 28 days at (-20 ± 3) °C [(-4 ± 5) °F], ambient humidity;
- b. 28 days at (80 ± 3) °C [(175 ± 5) °F], ambient humidity; and
- c. 28 days at (70 ± 3) °C [(160 ± 5) °F], 97 ± 3 % RH.

5.5.4.4 Dimensions shall be measured in at least three locations in each direction such that the volume of the specimen is most accurately evaluated.

5.5.4.5 The percentage volumetric change obtained shall be reported for each exposure and each specimen. The results are to be expressed as a “plus %” when there has been expansion and as a “minus %” when there has been shrinkage.

5.5.4.6 The results shall be reported as the average of the five specimens.

5.5.5 Fungi Resistance

5.5.5.1 The fungi resistance shall be determined in accordance with ASTM C 1338 using three specimens measuring 150 mm x 150 mm x 25 mm (6 inch x 6 inch x 1 inch).

5.5.5.2 The results shall be reported as pass if none of the five specimens show fungi growth.

5.5.6 Gap Bridging

5.5.6.1 The gap bridging ability shall be determined in accordance with ABAA 0004 using five specimens.

5.5.6.2 The results shall be reported as pass for the Type and Class tested.

5.5.7 Open-Cell Content Volume

5.5.7.1 The open-cell content volume shall be determined in accordance with ASTM D 6226 following Appendix X1.3 Procedure 2, using three sets (2 cubes each) 25 ± 1 mm x 25 ± 1 mm x 25 ± 1 mm ($1 \pm 1/32$ inch x $1 \pm 1/32$ -inch x $1 \pm 1/32$ inch) core specimens.

5.5.7.2 The result shall be reported as an average of the three sets of specimens.

5.5.8 Pull Adhesion

5.5.8.1 The pull adhesion shall be determined in accordance with ABAA 0002 where three pulls shall be done on a single sample board that is 1m by 1m (39 inches by 39 inches) except for CMU where the three pulls will be done on three separate CMU. The pull adhesion test shall be conducted upon glass faced gypsum, OSB and medium density concrete masonry units. Substrate shall be treated in accordance with the manufacturing instructions. Declare failure mode. The results shall be averaged.

5.5.9 Surface Burning Characteristics

5.5.9.1 The surface burning characteristics and the smoke development of the material shall be determined in accordance with ASTM E 84 using a minimum of three specimens 100 mm (4 inch) thick with all skins intact. The spray polyurethane foam shall be sprayed on 6 mm (1/4 inch) cement board or 12 mm (1/2 inch) gypsum board instead of polyethylene board.

5.5.9.2 The results shall be reported as the average of the three specimens and each specimen shall be equal to or less than the requirements.

5.5.10 Tensile Strength

5.5.10.1 The tensile adhesive strength shall be determined in accordance with ASTM D 1623 using Type C specimens and using five specimens. The test shall be conducted so that the strength is determined in the same direction as the rise of the foam material.

5.5.10.2 The results shall be reported as the average of the five specimens.

5.5.11 Thermal Resistance

5.5.11.1 The thermal resistance for a 25 mm (1 inch) specimen shall be determined in accordance with ASTM C 518. Three specimens shall be aged 180 days at (23 ± 2) °C [(73 ± 5) °F] or 90 days at 60 ± 2 °C [140 ± 5] °F. Tests shall be conducted at a mean temperature of (23 ± 2) °C [(73 ± 5) °F].

5.5.11.2 The results shall be reported as the average of the three specimens.

5.5.12 Water Absorption

5.5.12.1 Water absorption shall be determined in accordance with ASTM D 2842 using the 96-h immersion method, and three specimens, 150 ± 2 mm x 150 ± 2 mm x 50 ± 1 mm ($6 \pm 1/8$ inch x $6 \pm 1/8$ inch x $2 \pm 1/16$ inch) each.

5.5.12.2 The results shall be reported as the average of the three specimens.

5.5.13 Water Resistance

5.5.13.1 Water resistance shall be determined in accordance with AATCC 127 using three specimens 50 mm (2 inch) thick specimens.

5.5.13.2 The results shall be reported as the average of the three specimens.

5.5.14 Water Vapor Transmission Rate

5.5.14.1 The water vapor transmission rate of three 50 mm ± 1 mm ($2 \pm 1/16$ inch) specimen shall be determined in accordance with both the desiccant method and the water method of ASTM E 96 at a temperature of (23 ± 2) °C [(73 ± 5) °F].

5.5.14.2 The results shall be reported as the mean value of the three specimens.

5.6 Reporting

5.6.1 Test data shall be reported in the form of a table with property, result and pass/fail columns including results for all properties listed in this document followed by a statement on whether the product met the requirements of this document.

5.6.2 The *supplier* shall allow publication of the results in material evaluation reports or listing of each physical property test required by this document when claiming to meet this document.

5.6.3 In addition to the information specified in the individual test methods, all reports describing the testing of the material in accordance with this document shall include the following information:

- a. The *supplier's* name, address, production facility address and product designation;
- b. The type and name of the *foam material* and other material description;
- c. Lot number and manufactured date of isocyanate and resin;
- d. Expiration date or manufactured date and shelf life;
- e. Sampling information;
- f. Description of thermal resistance test apparatus, calibration standards used and their source;
- g. Name and location of laboratory performing the tests and the accreditation agency for the laboratory;
- h. Size of specimens used for each test;
- i. Report of all test results according to the test methods and apparent core density of the specimen;
- j. Summary of measured results compared to the requirements of this Standard and when applicable an indication that the property has passed/failed;
- k. Report of the average test result of all specimens tested for each test method, the values reported shall have the same precision as the requirements listed in Table 1;
- l. List in a table the reported results compared to the requirements of this Standard and state whether that material requirement has either passed or failed;
- m. Declaration of conformity with this document; and

- n. An appendix to the report shall contain the data used to generate the above items;
- o. Preparation of substrate for conducting pull adhesion testing.

6. Packaging and Labeling

6.1 Packaging

6.1.1 Unless otherwise specified, the liquid components shall be packaged in the *supplier's* standard containers or the liquid components may be transported in bulk. When bulk shipments are used, the labeling requirements shall be met by supplying a written report containing the required information.

6.2 Labeling

6.2.1 Each liquid component container shall be clearly identified as either polyisocyanate component or resin component. Each container shall be marked with the following information:

- a. Supplier's name;
- b. Product name;
- c. Component name;
- d. Type of material (e.g. medium density);
- e. Net mass of the contents of the packaged material;
- f. Country of manufacturer;
- g. Lot number; and
- h. Expiration date or date of manufacture and shelf life.

7. Supplier's Documentation

7.1 The *supplier* shall provide the *contractor* with the following:

- a. Description of the chemical components including their properties;
- b. Safety data sheet for each component;
- c. Instructions for safe handling, use and disposal of the chemical components;
- d. Type of spray equipment required and their operation parameters;
- e. Ambient temperature limitations for installation;
- f. Surface temperature, type and requirements for the substrate;
- g. Physical properties for the *foam material*;
- h. Limitations for use of the installed *foam material*;
- i. Expiry date or manufactured date and shelf life of the components;

8. Keywords

8.1 spray polyurethane foam, air barrier material, water resistive barrier

**TABLE 1
 REQUIREMENTS FOR PHYSICAL PROPERTIES**

Property	Unit	Requirements			Test Method
		Min.	Max.		
Air Permeance	L/(s·m ²) @ 75 Pa CFM/ft ² @ 1.57 psf	-	0.0200 0.0040		E 2178
Apparent Core Density	kg/m ³ lbs/ft ³	28 1.75	45 2.80		D 1622
Compressive Strength	kPa psi	170 25	280 40		D 1621
Dimensional Stability at 28 days					D 2126
% Volume Change at:	%	-	-2	+5	
-20°C (4°F)	%	-	-2	+8	
80°C (175°F)	%	-	-2	+14	
70°C (160°F), 97 ± 3% RH					
Fungi Resistance	-	No growth	-		C 1338
Gap Bridging – Declare gap width and temperature tested	-	All specimens pass	-		ABAA 0004
Open Cell Content, Volume	%	-	10		D 6226
Pull Adhesion	kPa psi	110 16	- -		ABAA 0002
Surface Burning Characteristics	-	-	75		E 84
Flame Spread	-	-	450		
Smoke Development					
Tensile Strength	kPa psi	200 30	-		D 1623
Thermal Resistance for a 25-mm thick specimen	m ² ·°C/W	Declared	-		C518
Water Absorption by Volume	%	-	4.0		D 2842
Water Resistance with a 55-cm head of water	h	5	-		AATCC 127
Water Vapor Transmission Rate for a 50-mm thick specimen – water and desiccant method	ng/(Pa·s·m ²) Perms	Declared			E 96