

Standard for Air Barriers: Low-Density Open-Cell Semi-Rigid Spray-Applied
Polyurethane Foam – Material Specification

Published

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Foreword

The procedures used to develop this document and those intended for its further maintenance are described D-114-017 rev 3 ABAA Policy for Balloting Official ABAA Documents.

Please submit any questions or any feedback on this document to abaa@airbarrier.org.

Introduction

This material specification provides a standardized approach for the evaluation of air barrier low-density open-cell semi-rigid materials. The ABAA Technical Committee has approved the criteria included in this document through the ABAA document approval process.

This document does not include any requirements for the aging of the material.

1 Scope

This document provides the material property requirements and test methods to determine these properties for *low-density open-cell semi-rigid spray-applied rigid polyurethane foam* that is manufactured on site and used as an air barrier material in buildings, whether applied on a building site or in a prefabrication (manufacturing) facility. The material also provides a thermal insulation function.

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.

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

The *low-density open-cell semi-rigid 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).

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.

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.

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 Normative References

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 document.

Documents published by the Air Barrier Association of America, Inc.
1600 Boston Providence Hwy, Walpole, MA 02081 USA
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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 C1498, *Standard Test Method for Hygroscopic Sorption Isotherms of Building Materials*

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 D2247, *Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity*

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

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 Terms and Definitions

For definitions of general terms related to building construction used in this document, refer to ASTM E631 Terminology. Specific terms and symbols used in this document have been listed below.

3.1

accredited testing laboratory

organization accredited to ISO 17025 by a member of the IAF/ILAC Multilateral Agreement, possessing the necessary competence to test material to the specific test method

3.2

air barrier material

primary element that provides a continuous barrier to the movement of air

3.3

accredited spray polyurethane foam contractor (contractor)

individual, organization or corporation who is responsible for meeting all requirements and obligations for the installation.

3.4

certified spray polyurethane foam installer (installer)

individual 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.

3.5

low-density open cell semi-rigid 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 open cell product that has a density of approximately 12 to 27 kg/m³ (0.76 to 1.74 lbs/ft³)

3.6

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 low-density open-cell spray-applied semi-rigid polyurethane foam material in-situ

4 Requirements

4.1 General Requirements

The *foam material* shall be site manufactured (installed) by an accredited *contractor* using a certified *installer* in accordance with the instructions given by the *supplier*.

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 before the expiration date of the chemicals declared by the *supplier*.

4.2 Detailed Requirements

The installed material shall meet the material property values specified in Table 1.

TABLE 1:
 REQUIREMENTS FOR PHYSICAL PROPERTIES

Property	Unit	Requirements		Test Method
		Min.	Max.	
Air Leakage Rate at a pressure difference of 75 Pa (1.57 psf) at the supplier's declared thickness	L/(s·m ²)	-	0.0200	ASTM E2178
	CFM/ft ²	-	0.0040	
Apparent Core Density	kg/m ³	12.1	27.9	ASTM D1622
	lbs/ft ³	0.76	1.74	
Compressive Strength	kPa	60	169	ASTM D1621
	psi	8.7	24.5	
Dimensional Stability at 28 days % Volume Change at:				ASTM D2126
-20°C (4°F)	%	-	-2 +1	
80°C (175°F)	%	-	-2 -9	
70°C (160°F), 97 ± 3% RH	%	-	-2 -3	
Fungi Resistance	-	No growth	-	ASTM C1338
Gap Bridging – Declare gap width and temperature tested	-	Declare	-	ABAA T0004
Hygroscopic Sorption Isotherms – Equilibrium Moisture Content by Weight	%	Declare	-	ASTM C1498
Open Cell Content, Volume	%	90	-	ASTM D6226
Surface Burning Characteristics Flame Spread Index (FSI)	-	-	75	ASTM E84
Smoke Development Index (SDI)	-	-	450	
Tensile Strength	kPa psi	90 13	- -	ASTM D1623
Thermal Resistance for a 25 mm thick specimen	m ² ·°C/W R-Value	Declare		ASTM C518
Water Resistance in 100% RH	visual	-	No change in color, blistering, etc.	ASTM D2247
Water Vapor Transmission Rate for a 50 mm thick specimen – water and desiccant method	ng/(Pa·s·m ²) Perms	Declare		ASTM E96

4.3 Health and Safety Requirements

The supplier shall ensure that the material covered by this document is included in a Safety Data Sheet (SDS) that is available to the public. The SDS shall describe any known health hazards to installers or the occupants of buildings. The supplier's installation instructions and SDS shall include any personal protection that may be required during the installation process.

5 Testing

5.1 Sampling

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 C390. 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.

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 components.

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

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 section 5.1.

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.

A single batch (lot) of each of the 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 *accredited 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.

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 1,200 mm x 1,200 mm (48-inch x 48-inch).

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

Unless otherwise specified, sample panels (with the polyethylene board attached) shall be conditioned in accordance with ASTM D618, Procedure A [i.e., 88 h at $(23 \pm 2)^{\circ}\text{C}$ [$(73 \pm 5)^{\circ}\text{F}$], $(50 \pm 5)\%$ RH] prior to cutting and testing for material properties.

5.4 Preparation of Specimens

Unless otherwise specified in the test method, the specimens shall be cut from the center of the sample panels described in Subsection 5.2. The edge of any specimen shall not be less than 30 cm (12-inch) 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.

Unless otherwise specified in the test method, all specimens shall be obtained from the conditioned sample panels by cutting the specimen to the size required for the testing apparatus using a table saw, band saw or similar equipment. A hot wire or similar equipment shall not be used.

Unless otherwise specified in the test method, cut all specimens such that the testing is conducted parallel to the direction of rise.

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.

Check the opposing faces of the test specimens and confirm that they are flat and parallel. Do not use test specimens that are distorted.

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

5.5 Test Methods

Each test shall be conducted with virgin specimens and shall be independent from each other. All tests shall be conducted at $23 \pm 5^{\circ}\text{C}$ ($73 \pm 10^{\circ}\text{F}$), $50 \pm 5\%$ RH, unless otherwise required by the test method, and the materials and specimens used for testing shall be within this atmosphere range.

5.5.1 Air Leakage Rate – Material

The air leakage rate of the material shall be determined in accordance with ASTM E2178. The specimen's thickness shall be determined by the supplier at which the specimen will meet the air leakage rate requirements. The specimens shall 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 supplier declared thickness.

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

5.5.2 Apparent Core Density

The apparent core density shall be determined in accordance with ASTM D1622 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.

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

5.5.3 Compressive Strength

The compressive strength shall be determined in accordance with ASTM D1621, Procedure A, using five core specimens measuring 150 mm x 150 mm x 50 mm (6-inch x 6-inch x 2-inch) each.

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

5.5.4 Dimensional Stability

Dimensional stability shall be determined in accordance with ASTM D2126, except that the sample panel shall be conditioned at $23 \pm 2^\circ\text{C}$ ($73 \pm 5^\circ\text{F}$) and $50 \pm 5\%$ RH for 14 days.

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.

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 $-20 \pm 3^\circ\text{C}$ ($-4 \pm 5^\circ\text{F}$), ambient humidity;
- B 28 days at $80 \pm 3^\circ\text{C}$ ($175 \pm 5^\circ\text{F}$), ambient humidity; and
- C 28 days at $70 \pm 3^\circ\text{C}$ ($160 \pm 5^\circ\text{F}$), $97 \pm 3\%$ RH.

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

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.

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

5.5.5 Fungi Resistance

The fungi resistance shall be determined in accordance with ASTM C1338 using three specimens measuring 150 mm x 150 mm x 25 mm (6-inch x 6-inch x 1-inch).

The results of the three specimens shall be reported individually as a percentage of fungal growth on the surface area being tested.

5.5.6 Gap Bridging Ability

The gap bridging ability shall be determined in accordance with ABAA T0004 using five specimens. The material shall be installed at the supplier's minimum required installation thickness and the joint to be treated in accordance with the manufacturer's instructions.

The results of the five specimens shall be reported individually as the gap size and the temperature the material was tested at.

5.5.7 Hygroscopic Sorption Isotherms – Equilibrium Moisture Content by Weight

The water vapor sorption of the material shall be determined in accordance with ASTM C1498 using three specimens measuring 150 mm x 150 mm (6-inch x 6-inch).

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

5.5.8 Open-Cell Content, Volume

The open-cell content volume shall be determined in accordance with ASTM D6226 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.

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

5.5.9 Surface Burning Characteristics: Flame Spread Index (FSI) and Smoke Development Index (SDI)

The surface burning characteristics of the material shall be determined in accordance with ASTM E84. Install the material on 6 mm (1/4 inch) fiber-cement board in accordance with the supplier's published installation requirements and at the supplier's maximum allowed installation thickness.

The flame spread index and smoke development index of the two specimens shall be reported individually, not averaged together.

5.5.10 Thermal Resistance

The thermal resistance for a 25 mm (1-inch) specimen shall be determined in accordance with ASTM C518. Three specimens shall be aged 180 days at $23 \pm 2^\circ\text{C}$ ($73 \pm 5^\circ\text{F}$) or 90 days at $60 \pm 2^\circ\text{C}$ ($140 \pm 5^\circ\text{F}$). Tests shall be conducted at a mean temperature of $23 \pm 2^\circ\text{C}$ ($73 \pm 5^\circ\text{F}$).

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

5.5.11 Water Resistance in 100% Relative Humidity

The water resistance of the material shall be determined in accordance with ASTM D2247 using three specimens 100 mm x 150 mm (4-inch x 6-inch). The specimens shall be placed on a rack in the chamber.

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

5.5.12 Water Vapor Transmission Rate

The water vapor transmission rate of three $50 \text{ mm} \pm 1 \text{ mm}$ ($2 \pm 1/16$ -inch) thick specimens shall be determined in accordance with both the desiccant method (Procedure A) and the water method (Procedure B) of ASTM E96 at a temperature of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 5^\circ\text{F}$). The size of the specimen shall be in accordance with the test apparatus.

The results shall be reported as the average of the three specimens for each procedure.

5.5.13 Reporting Requirements

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

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 Supplier's name, address, production facility address and material designation
- B Material description including name and type
- C Lot number and manufactured date
- D Sampling information
- E Name and location of laboratory performing the tests, and the accreditation body for the laboratory
- F Description of thermal resistance test apparatus, calibration standards used and their source
- G Report of all test results according to the test methods, with the same precision as the requirements listed in Table 1, comparison of the results to the requirements in Table 1 and indicate whether the property was passed or failed
- H Declaration of conformity with this document
- I An appendix to the report shall contain the data used to generate the above items

6 Labelling

Each container shall be clearly marked with the following information:

- A Supplier's name
- B Material name
- C Type of material (e.g., air barrier low-density spray foam)
- D Country of manufacturer
- E Lot number
- F Storage temperature range
- G Expiration date

7 Supplier Documentation

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

The supplier shall make available, upon request, the following:

- A Description of the material including their properties
- B Safety data sheet (SDS)
- C Instructions for safe handling, use and disposal of the material
- D Physical properties for the material
- E Limitations for use of the material
- F Installation instructions

8 Keywords

air barrier, spray-applied polyurethane foam