



Technical Bulletin – Flammability Standards Industry Flammability Performance & Test Methods

There are a variety of test methods used to establish the fire performance characteristics of expanded foam products. Flammability test methods are very specific and the results are generally dependent on the thickness tested. Meeting the requirements of one test does not indicate passage of another. Small-scale, medium-scale, or even large-scale fire tests do not necessarily represent how a material will perform in an actual fire situation. Exceptions to this effect are generally given after test results. The primary fire performance test methods used to specify expanded foam products are:

- ASTM E84:** Surface Burning Characteristics of Building Materials
- UL 94:** Test for Flammability of Plastic Materials for Parts in Devices and Appliances
- ASTM E162:** Surface Flammability of Materials Using a Radiant Heat Energy Source
- ASTM E662:** Specific Optical Density of Smoke Generated by Solid Materials
- ASTM D2863:** Limited Oxygen Index Test (LOI) Test Method for Measuring the Minimum Oxygen Concentration to Support Candle Like Combustion of Plastics.
- FMVSS 302:** Federal Motor Vehicle Safety Standard for Flammability of Automotive Interiors

ASTM E84 (tunnel test) – Surface Burning Characteristics of Building Materials

ASTM E84 is a measure of the relative burning characteristics of building materials as measured by flame spread and smoke density developed.

The test fixture is comprised of a test chamber or box approximately 2 feet wide x 1 foot high and 25 feet long. The sample is mounted on the ceiling of the chamber. At one end of the chamber is the flame source, (two gas burners), delivering flame upward against the surface of the sample. The gas burners release heat at a rate of approximately 5,000 btu/min and create gas temperatures near the specimen surface of up to 1600°F. The test duration is 10 minutes. The maximum flame spread is measured. The smoke is directed to the end of the tunnel where it passes through an optical measuring device (photometer system). The measurements are compared to those of 1/2" thick, select grade red oak, which is rated as 100. A product with a flame spread rating of 25 and a smoke developed rating of 50 is commonly referred to as a 25/50 rated material. ASTM E84 is considered to be a medium-scale test and has been widely adopted for use by the building code authorities to regulate the use of interior finish materials.

It should be noted that methods and devices used for mounting and supporting the test specimen could influence the flame spread and smoke developed ratings. Testing of materials that drip, melt or delaminate to such a degree that the continuity of the flame front is destroyed, results in low flame spread indices that do not relate directly to indices obtained by testing materials that remain in place.

NFPA 255, UL 723, and CAN/ULC S102-M88 are similar to ASTM E84.

Underwriter Labs (UL) 94 Flammability Rating

Underwriter Labs (UL) 94 small-scale test is divided into twelve flame categories, many of which could relate to our products. The HB (horizontal mounted) and V (vertical mounted) flame rating indicates that the material was tested in the specified mounting position and found to burn at a rate less than a

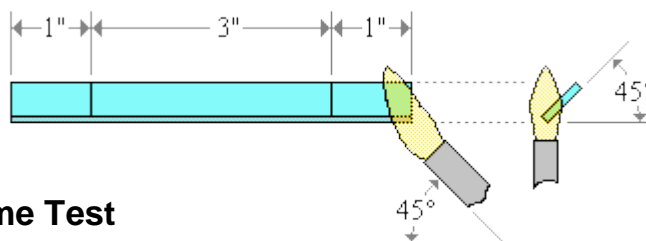
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specified maximum. The ratings also indicate whether the specimen dripped flaming particles that ignited a combustible indicator (cotton) located below the specimen. A material tested for a 94-5V rating is subjected to a more severe ignition source and must also meet the requirements of the 94-V0 test. Horizontal ratings range from HB (HBF) to HF-1, while vertical ratings range from V0, V1, etc. For single burn tests, the highest Horizontal rating is HF-1 and the highest Vertical rating is V0. For multiple burn tests, the highest Vertical Rating is 5VA.

UL94 ratings are generally required for household use appliance enclosures, acoustical foams, or other non-structural applications. The UL94 flame rating groups materials into categories based on their flammability. UL94 covers two types of testing: vertical burn and horizontal burn. See below:

Horizontal Testing (HB)

Procedure: A specimen is supported in a horizontal position and is tilted at 45°. A flame is applied to the end of the specimen for 30 seconds or until the flame reaches the 1-inch mark. If the specimen continues to burn after the removal of the flame, the time for the specimen to burn between the 1 and 4 inch marks are recorded. If the specimen stops burning before the flame spreads to the 4-inch mark, the time of combustion and damaged length between the two marks is recorded. Three specimens are tested for each thickness. The pass/fail criteria are listed below:



Horizontal Flame Test

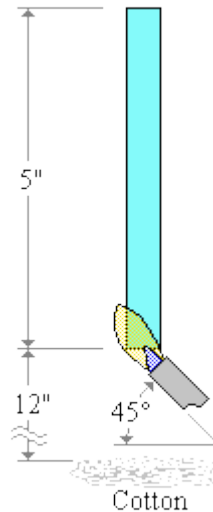
Horizontal Rating	Requirements
HB	<ul style="list-style-type: none"> Specimens must not have a burning rate greater than 1.5 inches/minute for thicknesses between 0.120 and 0.500 inches and 3 inches/minute for thicknesses less than 0.120 inches. Specimens must stop burning before the flame reaches the 4 inch mark.

Vertical Testing (V0, V1, V2)

Procedure: A specimen is supported in a vertical position and a flame is applied to the bottom of the specimen. The flame is applied for ten seconds and then removed until flaming stops at which time the flame is reapplied for another ten seconds and then removed. Two sets of five specimens are tested. The two sets are conditioned under different conditions. The pass/fail criteria are listed below:

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Vertical Flame Test

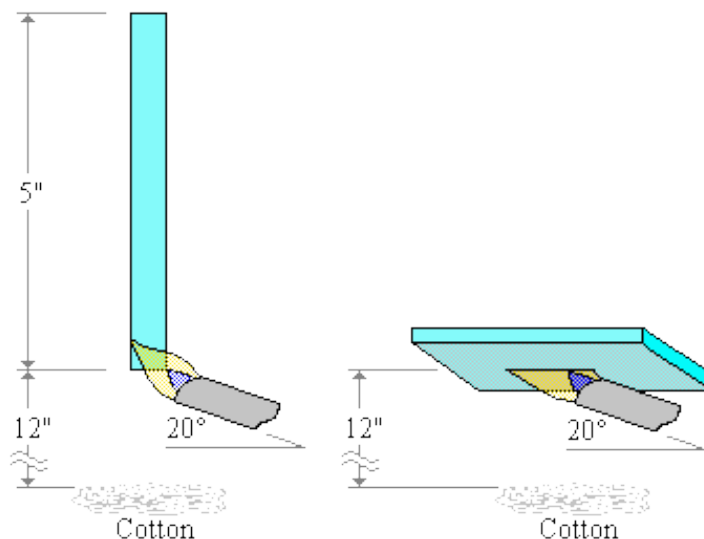
Vertical Ratings	Requirements
V0	<ul style="list-style-type: none"> • Specimens must not burn with flaming combustion for more than 10 seconds after either test flame application. • Total flaming combustion time must not exceed 50 seconds for each set of 5 specimens. • Specimens must not burn with flaming or glowing combustion up to the specimen holding clamp. • Specimens must not drip flaming particles that ignite the cotton. • No specimen can have glowing combustion remain for longer than 30 seconds after removal of the test flame.
V1	<ul style="list-style-type: none"> • Specimens must not burn with flaming combustion for more than 30 seconds after either test flame application. • Total flaming combustion time must not exceed 250 seconds for each set of 5 specimens. • Specimens must not burn with flaming or glowing combustion up to the specimen holding clamp. • Specimens must not drip flaming particles that ignite the cotton. • No specimen can have glowing combustion remain for longer than 60 seconds after removal of the test flame.

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V2	<ul style="list-style-type: none"> • Specimens must not burn with flaming combustion for more than 30 seconds after either test flame application. • Total flaming combustion time must not exceed 250 seconds for each set of 5 specimens. • Specimens must not burn with flaming or glowing combustion up to the specimen holding clamp. • Specimens can drip flaming particles that ignite the cotton. • No specimen can have glowing combustion remain for longer than 60 seconds after removal of the test flame.
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Vertical Testing (5VA, 5VB)

Testing is done on both bar and plaque specimens. Procedure for Bars: A bar specimen is supported in a vertical position and a flame is applied to one of the lower corners of the specimen at a 20° angle. The flame is applied for 5 seconds and is removed for 5 seconds. The flame application and removal is repeated five times. Procedure for Plaques: The procedure for plaques is the same as for bars except that the plaque specimen is mounted horizontally and a flame is applied to the center of the lower surface of the plaque. The pass/fail criteria are listed below:



Vertical Flame (5V Multiple Burn Type) Test



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Vertical Rating	Requirements
5VA	<ul style="list-style-type: none"> Specimens must not have any flaming or glowing combustion for more than 60 seconds after the five flame applications. Specimens must not drip flaming particles that ignite the cotton. Plaque specimens must not exhibit burnthrough (a hole).
5VB	<ul style="list-style-type: none"> Specimens must not have any flaming or glowing combustion for more than 60 seconds after the five flame applications. Specimens must not drip flaming particles that ignite the cotton. Plaque specimens may exhibit burnthrough (a hole).

ASTM E162 (radiant panel test) Test Method for Surface Flammability of Materials Using a Radiant Heat Source

The radiant panel test is a small-scale test method (sample size 6”x 18”) which determines a flame spread index. It is often required for mass transit, railway and some building applications. ASTM E162 is only a test method and the requirements must be supplied by the end user. A flame-spread index of 25 MAX is a typical requirement. Other applications may require higher or lower MIN or MAX values.

ASTM E662 (NBS Smoke Chamber Test) Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

The smoke chamber test method measures the attenuation of a light beam by smoke accumulated within a closed chamber. It is a small-scale test (sample size 3”x 3”), has two modes (flaming and non-flaming). It is often required for mass transit, railway and some military applications. ASTM E662 is only a test method and the requirements must be supplied by the end user. A typical smoke density requirement for either the flaming or non-flaming modes would be Ds 90 of 100 and Ds 4 min. of 200. Other applications may require higher or lower MIN or MAX values.

ASTM D2863 Limited Oxygen Index Test (LOI) Test Method for Measuring the Minimum Oxygen Concentration to Support Candle Like Combustion of Plastics.

The Limited Oxygen Index test method measures the minimum amount of oxygen needed to sustain combustion of a material.

Federal Motor Vehicle Safety Standard (FMVSS 302)

The Federal Motor Vehicle Safety Standard (FMVSS 302) is a horizontal burn test, somewhat similar to UL 94 HBF. The test requires that the sample burn slower than 4”/minute or be self-extinguishing. As with many flammability tests, the thinner the sample the more difficult it is to pass the test. Some



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Automotive OEM's have specific test requirements including temperature and/or humidity aging. Some countries have equivalent test specifications, which vary with country and region. Other technical equivalent industry standards include; SAE J369, ISO 3795, ASTM D5132 and FMVSS 302

Large Scale Testing

Large scale testing is intended to more closely reflect actual fire situations. Examples of such testing would be the Uniform Building Code Room Fire Test (UBC Standard 26-3, or technical equivalents; FM 4880, UL 1715, and NFPA 286). During these tests, fire properties such as heat release, mass loss and optical smoke density are measured as a function of time. FM 4880/UL 1715, and UBC 8-2.

Notes: Consult the specific JSP Fire Retardant (FR) material datasheet for details on the specific product rating.
Specific Federal and State Building Codes should be consulted for specific flammability rating requirements.

Reference Standards: ASTM – American Standard for Testing and Materials
ISO – International Standards Organization
FMVSS- Federal Motor Vehicle Safety Standard
SAE – Society of Automotive Engineers
UL – Underwriters Laboratories
FM – Factory Mutual
NFPA – National Fire Protection Association

For further information, contact your JSP Technical Group Representative