Unlocking the Mystery of UL 94 Flame Ratings

By Daniel Kubick, Rogers Corporation

Over the course of many years, I have been asked the same question – does Rogers Corporation have UL recognition of their materials? UL offers many options for recognition, but most often customers are looking for the UL 94 flame rating on the material.

Underwriters Laboratories (UL) is an independent safety certification organization. As a global safety science leader, UL helps companies to demonstrate safety, enhance sustainability, strengthen security, deliver quality, manage risk, and achieve regulatory compliance. Consistent testing and requirements for the industry help build consumer confidence.

UL 94 flame ratings are essential for evaluating fire hazard potential as well as improving the overall safety of an application. The standard tests the flammability of plastics materials used as parts in devices and appliances. Though UL 94 is designed to address plastics, it is also used in elastomers, cellular foams, and sponges.

The UL 94 standard covers testing for the flammability of polymeric materials that are used as parts for devices and appliances. Flame ratings are primary indicators of how a material will perform in a particular application in terms of how they will ignite and propagate flame.

Flame ratings are particularly important in areas where fire safety is critical to reliability, such as electronics, electrical equipment, appliances, automotive, aerospace, and medical. Use of the standard in many market segments over the years has greatly increased as more emphasis is being placed on the materials going into an application.

Let's dive into the actual tests within the UL 94 standard. There are six different tests which can performed under the standard. Each has its own set of criteria for passing or failure of the test.

I will focus on the three main tests typically requested by customers in the gasket fabrication industry: Vertical (V-0), Horizontal (HB), and Horizontal (HBF) burning performance.

The gold standard for most industries is the UL94 V-0 50-Watt recognition for a material. It shows the capability of a material to extinguish and not spread any flame in the event of a fire event.

UL 94 flame ratings evaluate flammability characteristics based on how the material burns when exposed to a flame, including ignition resistance, flame propagation, dripping, and self-extinguishing and configuration.

UL Flame Rating	ASTM Test Method
Horizontal Burning Test	ASTM D635 – Test method for rate of burning of self-supporting plastics in a horizontal position.
50W (20mm) Vertical Burning Test	ASTM D3801 – Test method for the comparative burning of solid products in a vertical position.
500W (125mm) Vertical Burning Test	ASTM D5048 – Test method for measuring the comparative burning characteristics and resistance to burn through of solid plastics using a 125mm flame.
Radiant Panel Flame Spread Test	ASTM E162 – Test method for surface flammability of materials using radiant heat energy source.
Thin Material Vertical Burning Test	ASTM D4804 – Test method for determining the flammability characteristics of nonrigid solid plastics
Horizontal Burning Foamed Material Test	ASTM D4986 – Test method for horizontal burning characteristics of cellular polymeric materials.

Flame ratings are broken down into several classifications, including horizontal and vertical burn test configurations.

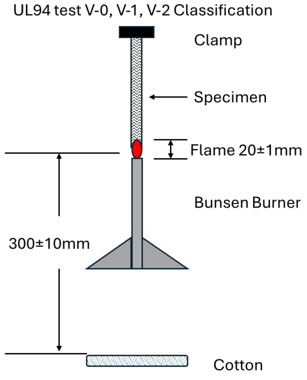
Each of the five tests below has a level of severity which needs to be determined for a particular application.

A design engineer will provide guidance on what is required for their application. This guidance is often arrived at by working with an underwriter's project manager to decide the level of flame resistance needed for an application.

Flame Rating Hierarchy	500 Watt (125mm) Vertical Burn	50 Watt (20mm) Vertical Burn	Thin Materials Vertical Burn	Horizontal Burning Foam Material	Horizontal Burn	Severity
	5VA	V-0	VTM-0	--	--	More ↑
	5VA	V-1	VTM-1	HF-1	--	
	--	V-2	VTM-2	HF-2	--	
	--	--	--	HBF	HB	Less

The 50 Watt (20mm) vertical burn is the test most discussed in reference to the UL94 standard.

The test involves a standard specimen of 125mm±5mm by 13.0mm±0.5mm provided to the lab in both a minimum thickness and maximum thickness not to exceed 13.0mm. Other than material thickness and color, which will be shown in the final



recognition, the material's density is not reported but is known by the manufacturer.

Two sets of samples are prepared for the test. One is an as-received sample, preconditioned for 48 hours at 23°C at 50% humidity. The second is conditioned in an air-circulating oven for 168 hours at 70°C, then cooled to room temperature prior to testing.

The test is conducted by placing a Bunsen burner under the vertical sample with an application time of 10 seconds. It is then quickly withdrawn from the sample. A piece of cotton is placed below the sample to record flaming particles or drips. The time to extinguish is recorded. The flame is then placed under the second sample for a flame application of 10 seconds, and again withdrawn from the sample. Time to extinguish is recorded.

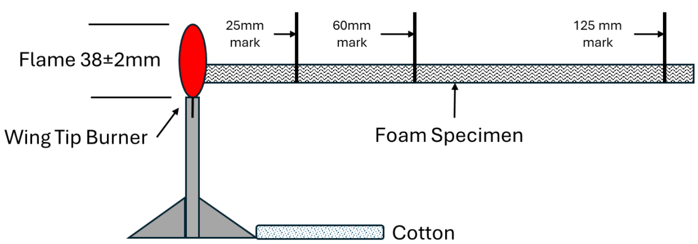
The results of both the as-is and conditioned samples are checked against the chart below. If there is a failure of a single sample, a second set of specimens are used for a confirmation of the testing.

Criteria Conditions	V-0	V-1	V-2
Afterflame time for each individual specimen t1 or t2	≤10s	≤30s	≤30s
Total Afterflame time for any condition set (t1 plus t2 for the 5-specimen set)	≤50s	≤250s	≤250s
Afterflame plus afterglow time for each individual specimen after the second flam application (t2+t3	≤30s	≤60s	≤60s
Afterflame or afterglow of any sample up to the holding clamp	No	No	No
Cotton indicator ignited by flaming particles or drops	No	No	No

The Horizontal Burn Foam (HBF) test is used for device and appliance non-structural applications.

HBF testing has always been defined by UL as related to "low-density foam materials." In early 2023, however, UL redefined their definition of "low-density" to designate foams with a density of 250 KG/M3. This change meant that many materials which had a HBF rating were removed from yellow cards. Customers could, however, test materials greater that 250 KG/M3 to the HB classification.

What is a yellow card? Many years ago, UL printed certification information on a yellow post card . This card was provided to a customer. With the digital age, UL now has this information available on-line. After looking up your product on the UL website, click on the hyper-link to obtain the electronic yellow card information.



The HBF test involves a standard specimen of 150mm±5mm by 50.0mm±1mm, provided to the lab in both a minimum thickness and maximum thickness not to exceed 13.0mm.

Other than material thickness and color, which will be shown in the final recognition, the material's density is not reported but is known by the manufacturer.

Two sets of samples are prepared for the test. The first is an as-received sample, preconditioned for 48 hours at 23°C at 50% humidity. The second is conditioned in an air circulating oven for 168 hours at 70°C, then cooled to room temperature prior to testing.

The test is conducted by placing a Bunsen burner (with a wing tip) under the horizontal sample edge to spread the flame horizontally. A piece of cotton is placed below the sample to record flaming particles or drips. A timing device is used to time travel of the flame once it reaches the 25mm gauge mark. The application time is 60 seconds, the flame is then quickly withdrawn from the sample.

The results of both as-is and conditioned samples are checked against the chart below. If there is a failure of a single sample, then a second set of specimens are used for a confirmation of the testing.

Criteria Conditions	HF-1	HF-2
Afterflame time, t1	4/5 is ≤2s 1/5 is ≤10s	4/5 is ≤2s 1/5 is ≤10s
Afterflame time plus afterglow time for each individual specimen, t1 + t2	≤30s	≤30s
Cotton indicator ignited by flaming particles or drop	No	Yes
Damage length for each individual specimen	<60mm	<60mm

Material classified for HBF:

a) A burning rate not exceeding 40mm per minute over a 100mm span, or
b) Each specimen ceases to burn before flaming or glowing and reaching the 125mm gauge mark.

Some final thoughts on making sure you receive a recognized Underwriters Laboratories product:

- Make sure the product is listed on the UL.com website under "Find a Product Certification." For access, sign up on the UL website to review materials. Only products listed on the UL website carry recognition of the UL 94 test.
- Some companies advertise meeting the requirement but, in reality, have not undergone the process of having their product recognized by Underwriters Laboratories. Companies may use third-party labs to show the materials that meet UL requirements, but these cannot be considered official results as they were not completed at a UL laboratory.
- Understand the minimum thickness at which the material is rated. Companies may not cover all thicknesses of the produced material, since UL 94 testing is easier to pass at a higher thickness and becomes more difficult as thickness is decreased.
- Ensure the color you plan to purchase is listed on the yellow card information. Colors can affect how a material burns. Some colors - such as red - are known to do worse in this test.

By understanding the needs of your material, your design process will more easily pass a UL inspection if all materials have their testing data on file. A small but often overlooked detail like flammability and material registration could lead to significant issues in the future.

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W-GFA Summer Gathering Recap

By Erin Gurney, Accurate Felt & Gasketing Mfg. Co. Inc.

The first-ever Women of the GFA Summer Gathering in Oak Brook, IL, was a wonderful success! Fourteen women from across the industry came together—some traveling from as far away as Texas, while most were from the nearby region—to connect, celebrate, and recognize their contributions to a field not always known for its strong female presence.

The event was a perfect opportunity to put faces to names, build new friendships, and strengthen the growing network of women shaping the future of gasket fabrication.

The evening was filled with meaningful conversations, shared stories, and a bit of friendly competition on the bocce court. But more than the games, it was the chance to be together in person—to learn from one another's experiences, celebrate achievements, and foster a sense of community—that made the gathering truly special.

The Women of the GFA left feeling more connected, supported, and proud of their roles in the industry. It was a powerful first meeting, and we're excited to see it grow into a cherished tradition in the years to come.