Useful information on:

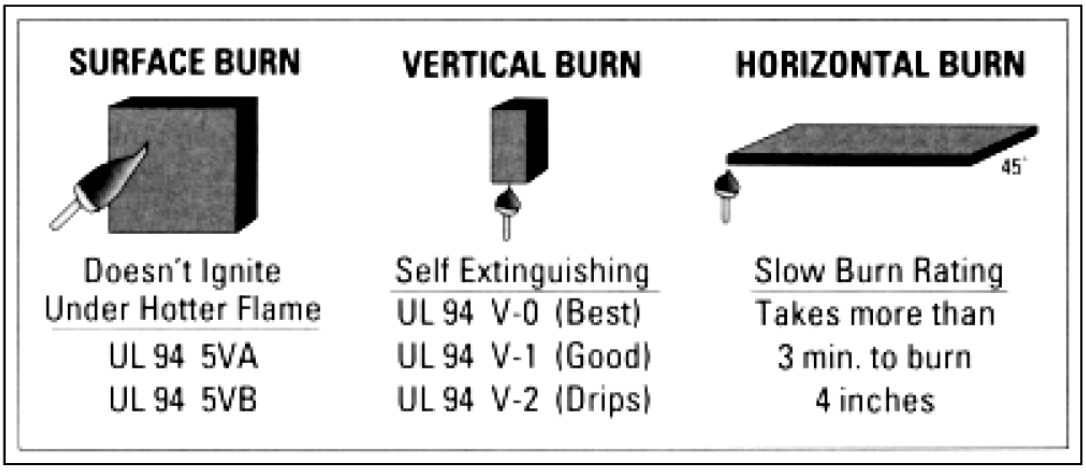
UL 94:
Test for Flammability of Plastic Materials for Parts in Devices and Appliances

UL intends this standard to serve as a preliminary indication of a plastics acceptability for use as part of a device or appliance with respect to its flammability. It is not intended to reflect the hazards of a material under actual fire conditions.

UL 94 flammability testing is the first step toward obtaining a plastic recognition and subsequent listing in the "Plastics Recognized Component Directory" (former known as "Yellow Cards"). UL 94 contains the following tests: 94HB, 94V, 94VTM, 94-5V, 94HBF, 94HF and Radiant Panel.

The 94HB test describes the Horizontal Burn method. Methods 94V and 94VTM are used for Vertical Burn, a more stringent test than 94HB. The 94-5V test is for enclosures for products that are not easily moved or are attached to a conduit system. The 94HBF and HF are used for non-structural foam materials i.e., acoustical foam. Radiant panel test is an ASTM (E162) test to determine the flame spread of a material that may be exposed to fire.

The following is a brief description of three tests that apply to stock shape products (sheet, rod, tube and film) and how the rating system works. This is not meant as a procedure for running the tests nor as a way of determining the acceptability of a material for a particular application. Those who would like more details should contact UL or obtain a copy of this and other UL Standards by visiting the UL's Standards Department web site, at http://ulstandardsinfonet.ul.com/.

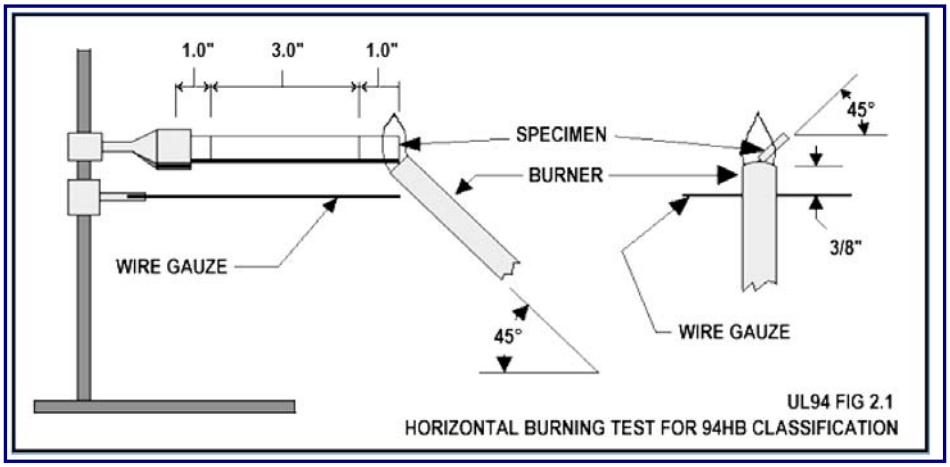


UL 94 Flammability Ratings Summary

5VA Surface Burn	Burning stops within 60 seconds after five applications of five seconds each of a flame (larger than that used in Vertical Burn testing) to a test bar. Test specimens MAY NOT have a burn-through (no hole). **This is the highest (most flame retardant) UL94 rating.**
5VB Surface Burn	Burning stops within 60 seconds after five applications of five seconds each of a flame (larger than that used in Vertical Burn testing) to a test bar. **Test specimens MAY HAVE a burn-through (a hole).**
V-0 Vertical Burn	Burning stops within 10 seconds after two applications of ten seconds each of a flame to a test bar. **NO flaming drips are allowed.**
V-1 Vertical Burn	Burning stops within 60 seconds after two applications of ten seconds each of a flame to a test bar. **NO flaming drips are allowed.**
V-2 Vertical Burn	Burning stops within 60 seconds after two applications of ten seconds each of a flame to a test bar. **Flaming drips ARE allowed**
H-B Horizontal Burn	Slow horizontal burning on a 3mm thick specimen with a burning rate is less than 3"/min or stops burning before the 5" mark. H-B rated materials are considered "self-extinguishing". **This is the lowest (least flame retardant) UL94 rating**

94HB Horizontal Burning Test

This is generally considered the easiest test to pass and materials that pass any of the V or VTM tests will usually be accepted by UL for applications that require 94HB. To be sure, check with the UL representative assigned to the device in which the film will be used. The 94HB rating would typically be acceptable for portable, attended, intermittent-duty, household-use appliance enclosures (i.e., hair dryers) or for decorative parts.



The test uses a ½" × 5" specimen held at one end in a horizontal position with marks at 1" and 5" from the free end. A flame is applied to the free end for 30 seconds or until the flame front reaches the 1" mark (see Fig. 2.1). If combustion continues the duration is timed between the 1" mark and the 5" mark. If combustion stops before the 5" mark, the time of combustion and the damaged length between the two marks are recorded. A set of three specimens are tested.

A material that is less than 0.118" in thickness will be classified 94HB if it has a burning rate of less than 3" per minute or stops burning before the 5" mark. If one specimen from the set of three fails to comply, then a second set of three are tested. All three of this second set must comply.

94V Vertical Burning Test

This test includes three classifications – 94V-0, 94V-1 and 94V-2 – and would typically be acceptable for portable, unattended, intermittent-duty, household-use appliances (i.e., coffee makers).

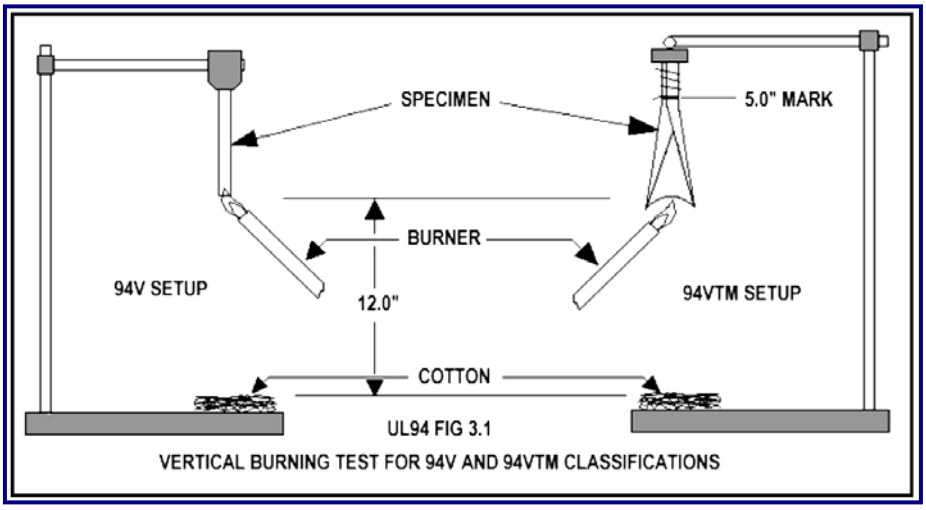
Criteria Conditions	94V-0	94V-1	94V-2
Total flaming combustion for each specimen	10s	30s	30s
Total flaming combustion for all 5 specimens of any set	50s	250s	250s
Flaming and glowing combustion for each specimen after second burner flame application	30s	60s	60s
Cotton ignited by flaming drips from any specimen	NO	NO	YES
Glowing or flaming combustion of any specimen to holding clamp	NO	NO	NO

Which classification applies to a particular application depends on many factors, including:

- Size and thickness of part.
- Distance from uninsulated live parts.
- Hot wire ignition.
- High current arc ignition.
- High voltage arc tracking rate

This test uses a ½" × 5" specimen which is held at one end in the vertical position (see Fig. 3.1). A burner flame is applied to the free end of the specimen for two 10 second intervals separated by the time it takes for flaming combustion to cease after the first application. Two sets of 5 specimens are tested. The following are recorded for each specimen:

- Duration of flaming combustion after the first burner flame application.
- Duration of flaming combustion after second burner flame application.
- Duration of glowing combustion after second burner flame application.
- Whether or not flaming drips ignite cotton placed below specimen.
- Whether or not specimen burns up to holding clamp.



VERTICAL BURNING TEST FOR 94V AND 94VTM CLASSIFICATIONS

94V Thin Material Vertical Burning Test

This test includes three classifications – 94V-0, 94V-1 and 94V-2 Materials that are thin gauge – typically £ 10 mil, or very flexible may distort, shrink or flex during the 94V test. These materials can be tested using 94VTM – the thin material version of the vertical burning test. This differs in several ways from the 94V test:

- The specimen size is 8" × 2".
- The specimen is rolled longitudinally around a ½" dia. mandrel and taped on one end. When the mandrel is removed the specimen forms a cone shape, which provides rigidity to the length of the specimen (see Fig. 3.1)
- The two flame applications have duration of three seconds instead of ten.

Although this test was designed for thinner gauge materials, any material can be tested using 94VTM as long as can be formed around a ½" mandrel. The test is performed in the same manner as 94V with the above mentioned differences. The Material Classification criteria is also the same as 94V (see Table 1.) except that no specimens shall have flaming or glowing combustion up to a mark 5" from the bottom (free end) of the specimen.

It is usually advantageous to test materials using 94VTM instead of 94V because it is usually easier to pass or get a better rating as long as the material can be bent around the ½" mandrel.

Note: UL will generally accept a 94VTM rating of similar level where a 94V material is required (i.e., 94VTM-0 = 94V-0, 94VTM-1 = 94V-1, etc... UL does, however, reserve the right to make a determination on which rating a material should have based on the application.