

# BUNSEN BURNER TESTS - SMALL FLAME IGNITION AND FLAME SPREAD TESTS

## UL-94 (EN 60695 11-10 AND ASTM D 635-03 AND D 3801-00)

These are simple, practical and widely used tests for ignitability and flame spread using a fairly realistic set of fire scenarios. They provide the often quoted V-0, V-2 and HB ratings.

The Underwriter's Laboratory designed this standard to serve as a preliminary indication of a plastic's acceptability, for use as part of a device or appliance with respect to its flammability, rather than the hazards of a material under actual fire conditions. UL 94 flammability testing is the first step toward obtaining a plastic's recognition and subsequent listing in the "Plastics Recognized Component Directory" (former known as "Yellow Cards").

"UL 94" contains the following tests: 94HB and 94V, 94VTM, 94-5V, 94HBF and 94HF, and 94RP.

The **94HB** test describes the Horizontal Burn method.

**94V** is used for the Vertical Burn (upwards) method and is more stringent test than 94HB. Both tests are used for plastics and rubbers and are based on the use of a small gas flame.

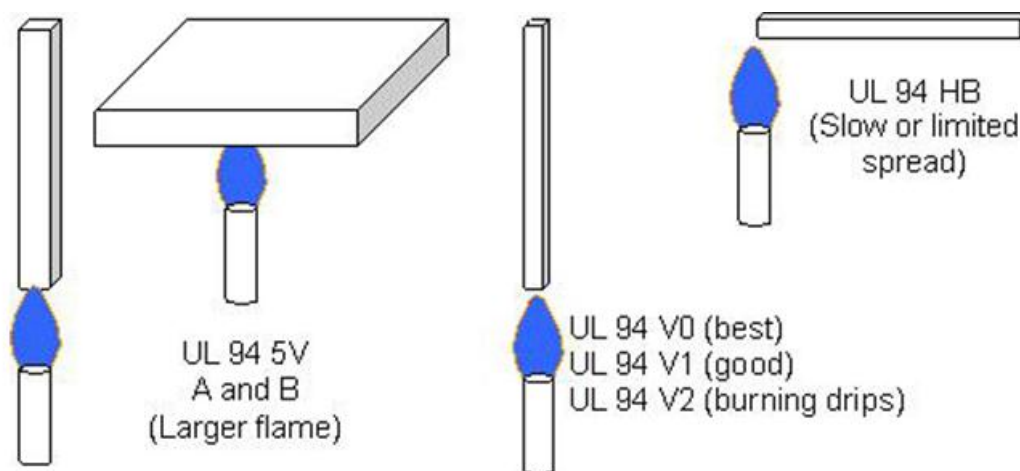
**94VTM** is generally similar to 94V but is used for very thin materials (films).

The **94HBF** and **HF** are horizontal, small flame tests and are used for non-structural foam materials i.e., acoustical foam.

The **94-5V** test is similar to the 94V test but is more severe and uses a larger flame for the vertical burn method and a horizontal sheet for the flame penetration test. It is used for enclosures for products that are not easily moved or are attached to a conduit system.

**94RP** is a flame spread rating based on the ASTM E162 radiant panel test (not available at UCLan).

**The following is a schematic diagram and a brief description of three tests that apply to stock shape products (sheet, rod, tube, film and foam) and the classification schemes.**



For most of these tests, specimens are conditioned to typical ambient conditions and are also dried for seven days at 70°C.

### **Summary of UL 94 Ratings for 94-5V, 94V and 94HB tests.**

Similar ratings are given for 94VTM (film) and 94HF (foam) tests.

#### **5VA**

##### **Surface Burn**

Burning stops within 60 seconds after five applications of five seconds to of a 125mm flame (larger than that used in the 94V test) to each of five vertical test bars and to each of five horizontal plaque specimens. The flame shall not generate burning drips and shall not burn-through (no hole) a horizontal plaque specimen. Materials shall also meet 94V requirements. This is the highest (most flame retardant) UL94 flame test rating.

#### **5VB**

##### **Surface Burn**

This is similar to 5VA but the flame is permitted to burn-through (hole formed) the horizontal plaque specimen.

#### **V-0**

##### **Vertical Burn**

The 20mm flame is applied for ten seconds to the base of each of five vertical test bars. Burning stops within 10 seconds for the first flame application and flames plus after glow within 30 seconds after the second flame applications. The total burn time for all tests shall not exceed 50 seconds. Specimens shall not burn to the upper clamp and shall not generate burning drips.

#### **V-1**

##### **Vertical Burn**

As V0 but burning shall stops within 30 seconds for the first application and flames plus after glow within 60 seconds after the second application. The total burn time for all tests shall not exceed 250 seconds. Specimens shall not burn to the upper clamp and shall not generate burning drips.

#### **V-2**

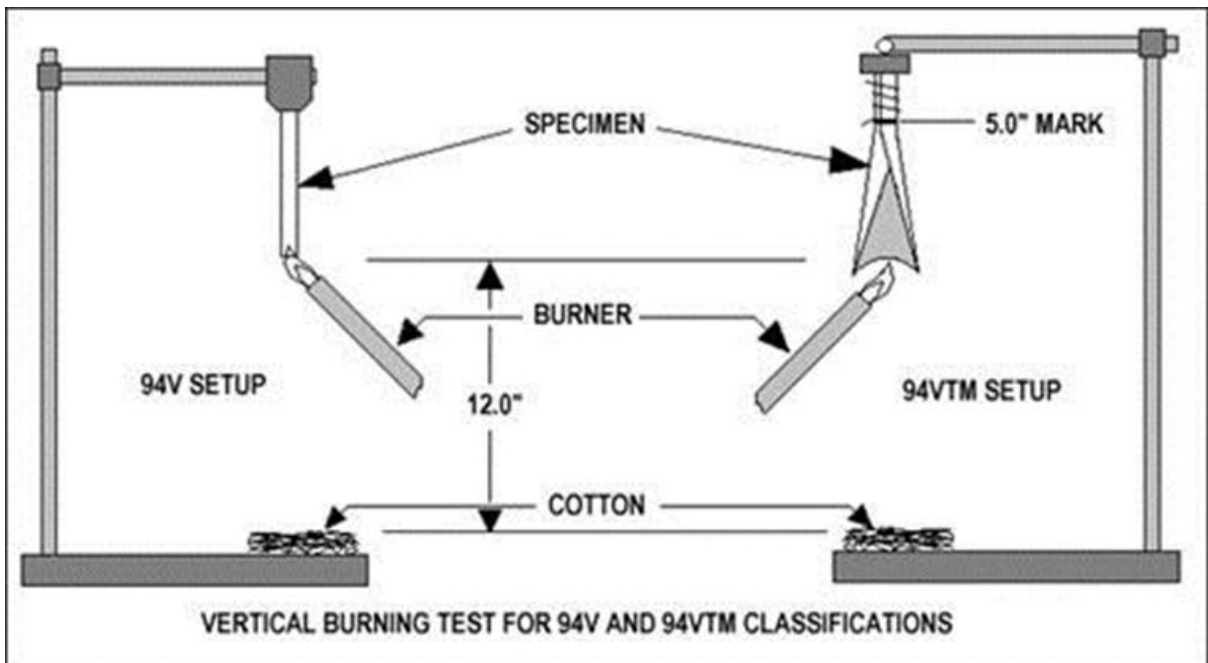
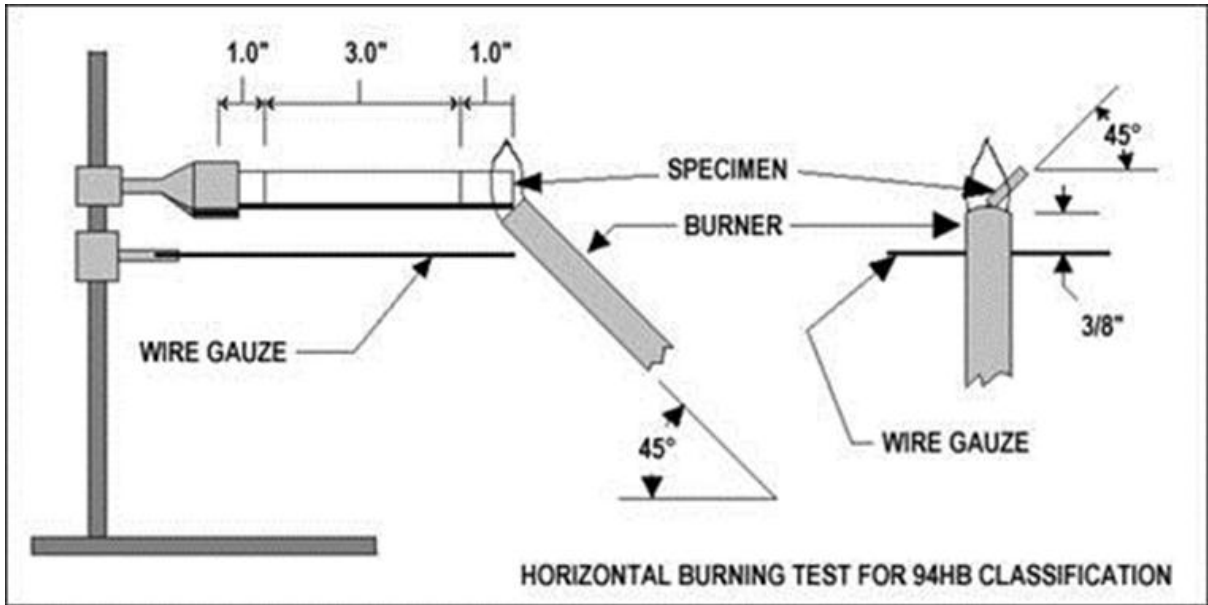
##### **Vertical Burn**

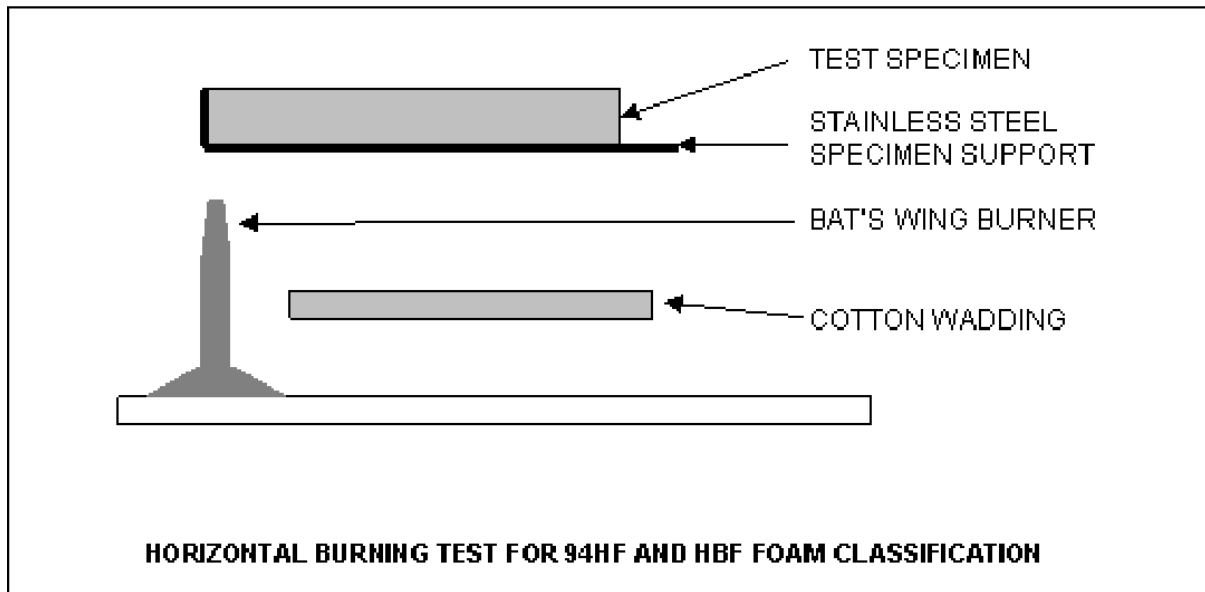
As for V2 except that the generation of burning drips is allowed.

#### **H-B**

##### **Horizontal Burn**

Burning over a 75mm distance of less than 75mm/min for specimens of less than 3mm thick or less than 40mm/min for specimens of 3 to 13mm thick or less than 100mm from the end of the specimen in the flame. This is the lowest (least flame retardant) UL94 flame test rating.





Detailed criteria for UL94V test. Other UL94 vertical tests have similar criteria

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