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# Tech Notes

## TESTING PROTOCOL

### Fire Retardant Gel Coats

# Testing Protocol for Fire Retardant Gel Coats

**Background:** The glass fiber reinforced composites (fiberglass) have been widely used in building, mass transit and industrial applications. Some these products are made from fire resistance raw materials. The fire resistance testing is conducted to determine flammability, surface burning characteristic and optical density of smoke generated type tests.

The ASTM E84, ASTM E162, ASTM E662 and UL 94 tests are widely utilized in the industry to determine the suitability of the gel coat and resin products used in glass fiber reinforced (fiberglass) composites.

The testing on the building materials are driven by the end use of the product that it is being intended for. In addition most of the code requirements are driven typically by the authority having jurisdiction (AHJ). This can be either the local code or the purchaser of the product intended for its end use.

**Reference:** ASTM E84 - 10 Standard Test Method for Surface Burning Characteristics of Building Materials.

ASTM E162 - 09 Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source

ASTM E662 - 09 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

UL 94 The Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing

**Testing  
Criteria:**

## 1) ASTM E84

This test method is intended to provide only comparative measurements of surface flame spread and smoke density measurements with that of select grade red oak and fiber-cement board surfaces under the specific fire exposure conditions. This test method exposes a 24-ft (7.32-m) long by 20-in. (508-mm) wide specimen to a controlled air flow and flaming fire exposure adjusted to spread the flame along the entire length of the select grade red oak specimen in 5 ½min.

This test method does not provide measurement of heat transmission through the tested surface, the effect of aggravated flame spread behavior of an assembly resulting from the proximity of combustible walls and ceilings and classifying or defining a material as noncombustible, by means of a flame spread index by itself.

Rating	Flame Spread	Smoke Index
A	0 – 25	0 - 450
B	25 – 75	0 - 450
C	75 - 200	0 - 450

## **2) ASTM E162**

This test method provides a laboratory test procedure for measuring and comparing the surface flammability of materials when exposed to a prescribed level of radiant heat energy. It is intended for use in measurements of the surface flammability of materials exposed to fire. The test is conducted using small specimens that are representative, to the extent possible, of the material or assembly being evaluated. (Example: in terms of their thickness, layering, and any potential substrate.)

The rate at which flames will travel along surfaces depends upon the physical and thermal properties of the material, product or assembly under test, the specimen mounting method and orientation, the type and level of fire or heat exposure, the availability of air, and properties of the surrounding enclosure. In this procedure, the specimens (6 inches by 18 inches) are subjected to one or more specific sets of laboratory fire test conditions. If different test conditions are substituted or the end-use conditions are changed, it is not always possible by or from this test to predict changes in the fire-test-response characteristics measured. Therefore, the results are valid only for the fire test exposure conditions described in this procedure.

Test results are calculated using 1) Flame Spread Factor ( $F_s$ ), 2) Temperature Rise ( $^{\circ}\text{C}$ ), 3) Heat Evolution Factor ( $Q$ ), 4) Flaming Drippings (m:s) and 5) Test Duration (m:s) as Radiant Panel Index ( $I_s$ ) based on five individual test data.

## **3) ASTM E662**

This test method provides a means for determining the specific optical density of the smoke generated by specimens of materials and assemblies under the specified exposure conditions. Values determined by this test are specific to the specimen or assembly in the form and thickness tested and are not to be considered inherent fundamental properties of the material tested. It is likely that closely repeatable or reproducible experimental results are not to be expected from tests of a given material when specimen thickness, density, or other variables are involved.

The photometric scale used to measure smoke by this test method is similar to the optical density scale for human vision. However, physiological aspects associated with vision are not measured by this test method. Correlation with measurements by other test methods has not been established. At the present time no basis is provided for predicting the density of smoke generated by the materials upon exposure to heat and flame under other fire conditions. The test method is of a complex nature and the data obtained are sensitive to variations.

In this procedure, the specimens are subjected to one or more specific sets of laboratory test conditions. If different test conditions are substituted or the end-use conditions are changed, it is not always possible by or from this test method to predict changes in the fire-test-response characteristics measured. Therefore, the results are valid only for the fire test exposure conditions described in this procedure.

Results are expressed in terms of specific optical density which is derived from a geometrical factor and the measured optical density or as measurement of the concentration of smoke. The results are intended for use in research and development and not as a basis for ratings for regulatory purposes.

**Testing  
Criteria:**

#### 4) UL94 V-0, V-1, V-2 FLAMMABILITY STANDARD

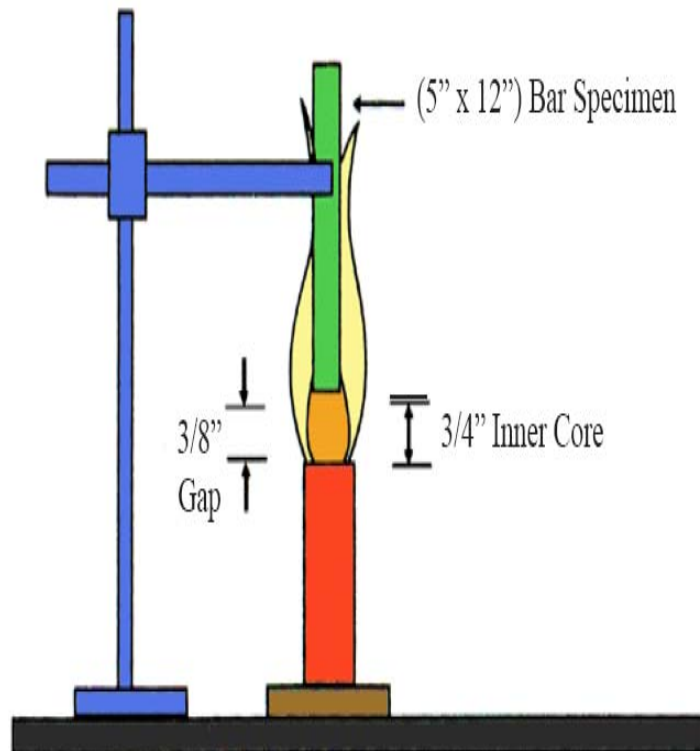
There are 12 flame classifications specified in UL 94 that are assigned to materials based on the results of these small-scale flame tests. These classifications listed in descending order for each of the following three groupings are used to distinguish a material's burning characteristics after test specimens have been exposed to a specified test flame under controlled laboratory conditions.

Six of the classifications relate to materials commonly used in manufacturing enclosures, structural parts and insulators found in consumer electronic products (5VA, 5VB, V-0, V-1, V-2, HB). Specimen: Length 125 mm (5 in) x Width 13 mm (0.5 in) x Thickness [typically 0.7 mm (1/32 in) or 1.5 mm (1/16 in) or 3.0 mm (1/8 in)].

To pass UL94 V-0 flame must be out in ten seconds, no glow beyond thirty seconds, and no burning material can fall.

To pass UL94 V-1 flame must be out in thirty seconds, no glow beyond sixty seconds, and no burning material can fall.

To pass UL94 V-2 flame must be out in thirty seconds, no glow beyond sixty seconds, and burning material can fall.



**ASTM E84  
Images:**

**The Substrate**



**Before Testing**



**After Testing**



**ASTM E162**

**Image:**



**ASTM E662**

**Image:**

