ENTEC

UNDERSTANDING UL 94 FLAMMABILITY RATINGS

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When selecting a plastic material for an electrical  application you may be required to have a product with a UL 94 flammability rating. The Underwriters Laboratory (UL) has published their UL 94 standard entitled, Test for Flammability of Plastic Materials for Parts in Devices and Appliances. This standard was developed to describe the test requirements for flammability of plastic materials used in devices and appliances and is intended to serve as a preliminary indication of their acceptability with respect to flammability for a particular application.

The UL 94 flammability testing uses standard test specimens and is used to determine the flammability properties of plastic materials. Tests conducted on the plastic material under the specified conditions are intended to provide information for comparing the relative burning characteristics of different materials or assessing any change in burning characteristics prior to or during actual use. It should be noted that UL 94 test specimens represent small-scale testing and do not cover flammability of plastic materials when used as materials for building and construction applications.

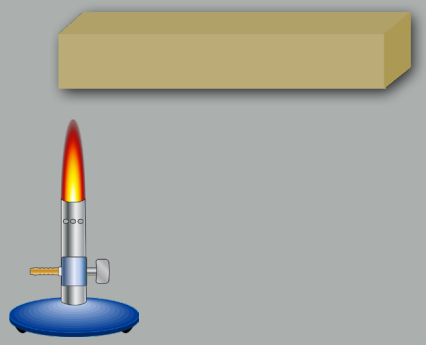
Test specimens can be injection molded, compression molded or cut from sheet. Standard test specimens are 125mm long by 13mm wide and are provided in the minimum thickness and 3mm thickness. Specimens can be supplied for approval in natural, black or colors as well as in a range of densities, melt flows or reinforcement levels.

Standard thickness for UL 94 test specimens is 1.5mm and/or 3mm thick for bars and 3mm thick for plaques. However, the test can be conducted at any thickness up to 13 mm. It is important to consider what thickness your application requires and ensure that you select a material that meets your flammability requirements at your application thickness.

Prior to testing, specimens are conditioned at 23°C and 50% relative humidity for a minimum of 48 hours. A second set of specimens is conditioned in an air-circulating oven for 168 hours at 70°C.

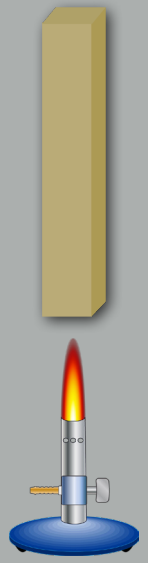
BASIC TESTING PROCEDURES

Horizontal Burn (HB)



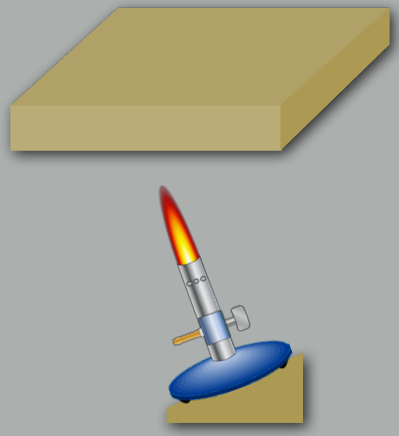
A 125mm x 13mm injection molded specimen is placed horizontally in a clamp and the bar is exposed to a calibrated flame at the unclamped end for a set time. Burn rate timing and distance on the test bar is started once flame is removed.

Vertical Burn (VO, V1 and V2)



A 125mm x 13mm injection molded bar is placed vertically and clamped at the top. At the bottom of the bar a calibrated flame is applied for a specified time. Dry surgical cotton is placed 300mm below the test specimen to catch drips. Timing begins after flame is removed.

Surface Burn (5VB & 5VA)



Material must first pass the Vertical Burn testing before surface testing is conducted. A 150mm x 150mm plaque is placed horizontally with a calibrated flame at a 20-degree angle from below the plaque. Timing begins after the flame is removed.

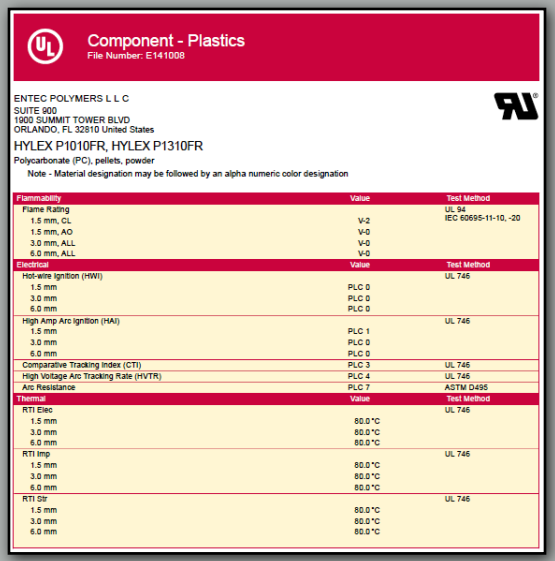
Testing conditions and requirements for the Horizontal and Vertical flammability ratings are shown in Table 1. Materials that meet the specific requirements are given a final rating of HB, VO, V1, V2, 5VB or 5VA. Flammability ratings and other properties can be found for plastic materials on their UL Yellow Card. An example UL Yellow Card is shown in Figure 1. Yellow Cards for UL listed plastic materials can be found on the UL website at www.iq.ul.com.

TABLE 1. TESTING CONDITIONS AND REQUIREMENTS FOR HORIZONTAL AND VERTICAL FLAMMABILITY RATINGS

	HB	V-2	V-1	V-0	5VB	5VA
Type	Horizontal Bar	Vertical Bar	Vertical Bar	Vertical Bar	Plaque	Plaque
Self-Extinguishing Time	N/A	Less than 30 sec	Less than 30 sec	Less than 10 sec	Less than 60 sec	Less than 60 sec
Flaming Drips	Yes	Yes	Yes	No	No	No
Flaming Drips Ignite Cotton Below	Yes	Yes	No	No	No	No
Other	Burning rate < 76 mm/min for thickness < 3 mm or burning stops before 100 mm	N/A	No afterglow on bar persists for more than 60 sec	No afterglow on bar persists for more than 30 sec	Plaque may develop a burn through hole	Plaque may not develop a burn through hole

INCREASING RESISTANCE TO FLAMMABILITY

FIGURE 1. EXAMPLE OF A UL YELLOW CARD FOR ENTEC POLYMERS HYLEX POLYCARBONATE



Component - Plastics
File Number: E141008

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HYLEX P1010FR, HYLEX P1310FR

Polycarbonate (PC), pellets, powder
Note - Material designation may be followed by an alpha numeric color designation

Flammability	Value	Test Method
Flame Rating		UL 94 IEC 60695-11-10, -20
1.5 mm, CL	V-2	
1.5 mm, AO	V-0	
3.0 mm, ALL	V-0	
6.0 mm, ALL	V-0	
Electrical	**Value**	**Test Method**
Hot-wire Ignition (HWI)		UL 746
1.5 mm	PLC 0	
3.0 mm	PLC 0	
6.0 mm	PLC 0	
High Amp Arc Ignition (HAI)		UL 746
1.5 mm	PLC 1	
3.0 mm	PLC 0	
6.0 mm	PLC 0	
Comparative Tracking Index (CTI)	PLC 3	UL 746
High Voltage Arc Tracking Rate (HVTR)	PLC 4	UL 746
Arc Resistance	PLC 7	ASTM D495
Thermal	**Value**	**Test Method**
RTI Elec		UL 746
1.5 mm	80.0 °C	
3.0 mm	80.0 °C	
6.0 mm	80.0 °C	
RTI Imp		UL 746
1.5 mm	80.0 °C	
3.0 mm	80.0 °C	
6.0 mm	80.0 °C	
RTI Str		UL 746
1.5 mm	80.0 °C	
3.0 mm	80.0 °C	
6.0 mm	80.0 °C	

There are also a number of different flammability tests besides the UL 94 test. These include:

- ✓ Automotive - FMVSS 302
- ✓ Aerospace - FAR 25.853
- ✓ Flame spread - ASTM E 162
- ✓ Heat release - ASTM E 1354
- ✓ Limiting Oxygen Index - ASTM D 2863 or ISO 4589
- ✓ Fire Test for Heat and Visible Smoke - UL 2043
- ✓ Surface Burning Characteristics - UL 723
- ✓ Smoke density - ASTM E 662