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UL Standard for Safety for Test for Flammability of Plastic Materials for Parts in Devices and Appliances,  
UL 94

Fifth Edition, Dated October 29, 1996

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

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**UL 94**

**Standard for Tests for Flammability of Plastic Materials for Parts in  
Devices and Appliances**

First Edition – September, 1972  
Second Edition – September, 1973  
Third Edition – January, 1980  
Fourth Edition – June, 1991

**Fifth Edition**

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover tests for flammability of plastic materials used for parts in devices and appliances. They are intended to serve as a preliminary indication of their acceptability with respect to flammability for a particular application.

1.2 The methods described in this Standard involve standard size specimens and are intended to be used solely to measure and describe the flammability properties of materials, used in devices and appliances, in response to heat and flame under controlled laboratory conditions. The actual response to heat and flame of materials depends upon the size and form, and also on the end-use of the product using the material. Assessment of other important characteristics in the end-use application includes, but is not limited to, factors such as ease of ignition, burning rate, flame spread, fuel contribution, intensity of burning, and products of combustion.

1.3 The final acceptance of the material is dependent upon its use in complete equipment that conforms with the standards applicable to such equipment. The flammability classification required of a material is dependent upon the equipment or device involved and the particular use of the material. The performance level of a material determined by these methods shall not be assumed to correlate with its performance in end-use application.

1.3 revised July 10, 1998

1.4 If found to be appropriate, the requirements are applied to other nonmetallic materials.

1.4 revised June 10, 1997

1.5 These requirements do not cover plastics when used as materials for building construction or finishing.

1.6 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.6 revised June 8, 2000

### 2 References

#### 2.1 General

2.1.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

## 2.2 Referenced standards in this text

2.2.1 If a designation for a test method is followed by an alternate or equivalent designation, in parenthesis, the latter method is considered technically equivalent, though not necessarily identical, and might yield somewhat different numerical test results than those obtained with the original test method.

ASTM D 618, Method for Conditioning Plastics and Electrical Insulating Materials for Testing (ISO 291 : Plastics – Standard Atmospheres for Conditioning and Testing)

ASTM D 789, Test Method for Determination of Relative Viscosity, Melting Point, and Moisture Content of Polyamide (PA)

ASTM E 162, Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source

ASTM D 3195, Practice of Rotameter Calibration

ASTM D 5025, Specification for a Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

ASTM D 5207, Standard Practice for Calibration of 20 mm and 125 mm Test Flames for Small-Scale Burning Tests on Plastic Materials

ASTM E 437, Specification for Industrial Wire Cloth and Screens (Square Opening Series), Appendix X3

HB: ASTM D 635, Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position (IEC 707, Methods of Test for the Determination of the Flammability of Solid Electrical Insulating Materials When Exposed to an Igniting Source, ISO 1210, Plastics – Determination of the Burning Behavior of Horizontal and Vertical Specimens in Contact with a Small Flame Ignition Source)

V: ASTM D 3801, Method for Measuring the Comparative Extinguishing Characteristics of Solid Plastics in a Vertical Position (IEC 707, ISO 1210)

VTM: ASTM D 4804, Test Method for Determining the Flammability Characteristics of Nonrigid Solid Plastics (ISO 9773, Plastics – Determination of Burning Behavior of Flexible Vertical Specimens in Contact with a Small Flame Ignition Source)

5V: ASTM D 5048, Standard Test Method for Measuring the Comparative Burning Characteristics and Resistance to Burn-Through of Solid Plastics Using a 125 mm Flame (ISO 10351, Plastics– Method of Test for the Determination of Combustibility of Specimens Using a 125 mm Flame Source)

HBF: ASTM D 4986, Standard Test Method for Horizontal Burning Characteristics of Cellular Polymeric Materials (ISO/DIS 9772.3, Cellular Plastics – Determination of Horizontal Burning Characteristics of Small Specimens Subjected to a Small Flame)

2.2.1 revised June 8, 2000

## 2.3 Related standards

2.3.1 The Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, contains short-term test procedures to be used for the evaluation of materials used for parts intended for specific applications in electrical end products. The Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, contains long-term test procedures to be used for the evaluation of materials used



for parts intended for specific applications in end products. Test procedures are provided in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, for the evaluation of polymeric materials in specific applications in end products. The test procedures include reference to the data obtained from the standard property tests in UL 746A, as well as other practical means of evaluation. The Standard for Polymeric Materials – Fabricated Parts, UL 746D, contains requirements for traceability and performance of parts molded and fabricated from polymeric materials.

2.3.2 Requirements for materials that have been modified to match the requirements of a specific application, including the use of recycled and regrind materials, the use of additives and colorants, and the blending of two or more materials, are described in the Standard for Polymeric Materials – Fabricated Parts, UL 746D.

### 3 Definitions

For the purpose of this Standard, the following definitions apply (See ISO/IEC Guide 52):

3.1 Afterflame – Persistence of flaming of a material, after the ignition source has been removed.

3.2 Afterflame Time – The length of time for which a material continues to flame, under specified conditions, after the ignition source has been removed.

3.3 Afterglow – Persistence of glowing of a material, after cessation of flaming or, if no flaming occurs, after removal of the ignition source.

3.4 Afterglow Time – The length of time for which a material continues to glow under specified test conditions, after the ignition source has been removed and/or cessation of flaming.

### 4 Significance of Tests

4.1 Tests conducted on a material under the conditions specified are intended to provide information when: comparing the relative burning characteristics of different materials, or assessing any change in burning characteristics prior to, or during, use. This method is not intended to provide correlation with performance under actual service conditions.

4.1 revised June 10, 1997

4.2 Assessment for risk of fire shall take into account such factors as fuel contribution, intensity of burning (rate of heat release), products of combustion and environmental factors such as the intensity of source, orientation of exposed material and ventilation conditions.

4.2 revised June 10, 1997

4.3 Burning characteristics, as measured by these test procedures, are affected by such factors as: density, color, any anisotropy of the material molding conditions and the thickness of the specimen.

4.4 When a specimen of a thin material shrinks from the flame without igniting, the test results shall be deemed invalid and additional specimens shall be tested. If all test specimens shrink from the applied flame without igniting, these materials cannot be evaluated by the test procedure and an alternate test procedure in this Standard shall be conducted.

4.4 revised June 10, 1997

## 5 Apparatus

5.1 Laboratory Fume Hood – having an inside volume of at least  $0.5 \text{ m}^3$ , is to be used when testing the specimens. The chamber is to permit observation and is to be draft free while permitting normal thermal circulation of air past the specimen during burning. For safety and convenience, it is desirable that this enclosure (which can be completely closed) be fitted with an evacuation device, such as an exhaust fan, to remove products of combustion which may be toxic. However, it is important to note that the device shall be turned off during the actual test and started again immediately after the test to remove the products of combustion.

Note: The amount of oxygen available to support combustion is important for the conduct of these flame tests. For tests conducted by this method when burning times are prolonged, chamber sizes less than  $1 \text{ m}^3$  do not consistently provide accurate results.

5.1 revised June 10, 1997

5.2 Laboratory Burner – A laboratory type burner having a tube with a length of  $100 \pm 10 \text{ mm}$  and an inside diameter of  $9.5 \pm 0.3 \text{ mm}$ . The barrel is not to be equipped with an end attachment, such as a stabilizer. The burner shall be in compliance with ASTM D5025.

5.3 Burner Wing Tip – A wing tip with dimensions of slit  $48 \pm 1 \text{ mm}$  in length by  $1.3 \pm 0.05 \text{ mm}$  in width, for the burner. (Used for the test procedure in Horizontal Burning Foamed Material Test; HBF, HF-1, or HF-2... Section 12 only.)

5.3 revised July 29, 1997

5.4 Burner Mounting Fixture – Capable of positioning the burner at an angle of 20 degrees from the vertical axis. (Used for the test procedure in 500w Vertical Burning Test; 5VA or 5VB Section 9 only.)

5.4 revised July 29, 1997

5.5 Ring Stands – Laboratory ring stands with clamps or the equivalent, for horizontal or vertical positioning of the specimen and/or the wire gauze. Laboratory ring stands with clamps adjustable to the desired angles and heights, or a support gauze holder constructed from aluminum or steel, or equivalent equipment.

5.6 Timing Devices – Accurate to 0.5 second.

5.7 Measuring Scale – Graduated in mm.

5.8 Gas Supply A supply of technical grade methane gas (min. 98 percent pure) with regulator and meter for uniform gas flow.

Note: Natural gas having a heat content of approximately  $37 \pm 1 \text{ MJ/m}^3$  has been found to provide similar results. However, technical grade methane shall be used in case of dispute.

5.8 revised April 30, 1997

5.9 Wire Gauze – Having approximately 20 openings per 25 mm, made with  $0.43 \pm 0.03 \text{ mm}$  diameter iron wire and cut to approximately 125 mm squares. (Used for the test procedure in Horizontal Burning Test; HB Section 7 only.)

5.9 revised July 29, 1997

5.10 Conditioning Room or Chamber – Capable of being maintained at  $23 \pm 2^{\circ}\text{C}$  and a relative humidity of  $50 \pm 5$  percent.

5.11 HB Support Fixture – A metal support fixture for testing specimens that are not self-supporting. See Figure 7.2 (Used for the test procedure in Horizontal Burning Test; HB Section 7 only.)

5.11 revised July 29, 1997

5.12 Micrometer – Capable of being read to  $0.01$  mm.

5.13 Cotton – A supply of absorbent 100 percent cotton.

SA6.1.4 A thermogram of the material is to be obtained by means of a thermal analyzer with a DSC (Differential Scanning Calorimetry) module in accordance with the methods described in Differential Scanning Calorimetry, Section 47 of UL746A, Polymeric Materials – Short Term Property Evaluations. Instrument settings used in obtaining the thermogram shall be identical to those used in the original thermogram of the material referenced in this procedure. The thermogram obtained shall indicate the same general thermal response over the programmed temperature range as that recorded in the thermogram obtained under the original investigation.

SA6.2 Upon completion of follow-up testing, the Certification organization shall report the results to the manufacturer.

## **SUPPLEMENT SB - GUIDANCE FOR ACCEPTING ALTERNATE MANUFACTURING LOCATIONS**

Supplement SB added June 8, 2000

### **INTRODUCTION**

#### **SB1 Scope**

SB1.1 The following guidelines have been developed by UL to assist manufacturers in understanding what additional testing is necessary when a manufacturer wants to change or add to the existing production sites.

#### **SB2 Guidelines**

SB2.1 A UL Recognized product may be produced at alternate manufacturing locations without additional testing if:

1. The new location (manufacturer) of the product is accountable to and initially audited by the UL Applicant.
2. The same raw material specifications are used.
3. The same product formulation is followed.
4. The same product name and product specifications are used.
5. Verification of the product is determined by UL Follow-Up testing.

SB2.2 These products may be produced at the same company, affiliate and/or contractor locations as long as the above requirements are met. The published ratings must be identical in all cases.

SB2.3 The applicant must provide a summary to UL of the initial audit with all relevant test data demonstrating that the new manufacturing location produces an identical product.

SB2.4 If any of the above requirements are not met, an appropriate test program would be conducted by UL.