



# UL 746C

## STANDARD FOR SAFETY

Polymeric Materials – Use in Electrical  
Equipment Evaluations

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UL Standard for Safety for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C  
Seventh Edition, Dated February 5, 2018

### **SUMMARY OF TOPICS**

***This revision of ANSI/UL 746C dated March 24, 2023 includes deformation resistance as an alternate test method for the tensile impact test described in paragraphs [25.3](#) and [26.1.3](#).***

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated June 24, 2022.

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## **UL 746C**

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#### **Seventh Edition**

**February 5, 2018**

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The Department of Defense (DoD) has adopted UL 746C on November 3, 1998. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in ULSE's Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover parts made of polymeric materials that are used in electrical equipment and describe the various test procedures and their use in the testing of such parts and equipment.

1.2 These requirements do not cover the specific insulating systems that are covered by the requirements contained in the Standard for Systems of Insulating Materials – General, UL 1446.

1.3 Test procedures are provided herein for the evaluation of polymeric materials in specific applications. These test procedures include references to data obtained from small-scale property tests conducted under standard conditions as well as other practical means of evaluation.

1.4 Unless otherwise indicated, parts made by Additive-Manufacturing (AM) Technology shall be evaluated by subjecting the end-product part or test specimens cut from the end-product part to the specified test. For preselection purposes, test specimens printed in the specified dimensions or cut to the specified dimensions from a printed part may represent the end product when the same production conditions are used.

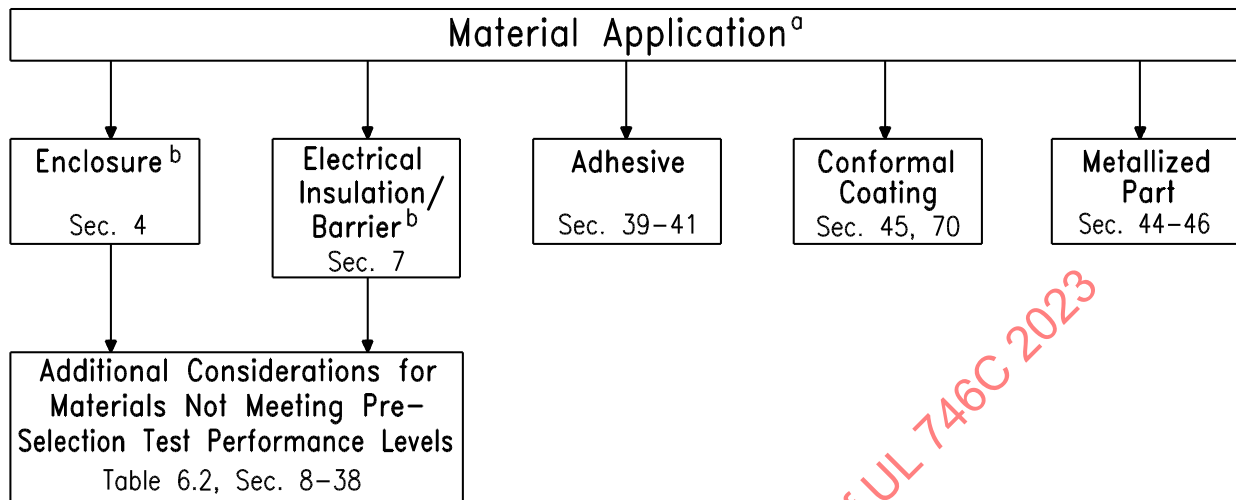
### 2 General

2.1 If a value for measurement is followed by a value in other units, the use of either value can be expected to provide equivalent results in the application of such requirements. Each of the requirements is stated in SI units as well as in U.S. customary units. Equivalent, although not necessarily exactly identical results, are to be expected from applying a requirement in SI units or U.S. customary units. Equipment calibrated in metric units is to be used when a requirement is applied in metric terms.

2.2 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.

2.3 For reference purposes, [Figure 2.1](#) describes the procedure to be followed in the evaluation of parts made of polymeric materials and covered by the requirements in this standard.

**Figure 2.1**  
**UL 746C guide for polymeric evaluations**



<sup>a</sup> More than one application may apply to the material under investigation.

<sup>b</sup> For alternate material substitution see Appendix A.

S4304B

2.4 The Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, covers flammability of polymeric materials used for parts in devices and appliances. 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. The Standard for Polymeric Materials – Fabricated Parts, UL 746D, contains requirements for traceability and performance of parts molded and fabricated from polymeric materials.

2.5 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 Glossary

3.1 For the purposes of this standard the following definitions apply:

3.2 ACCESSIBLE PART – A part so located that it can be contacted by a person, either directly or by means of a probe or a tool, or that is not recessed the required distance behind an opening.

3.3 ATTENDED EQUIPMENT – Equipment intended for use where operator presence is required for the equipment to function but is not necessarily required for the equipment to operate. Operator absence is effectively limited to short durations due to one or more characteristics of the equipment such as

production of excessive noise or vibration. Examples may include hand-held drills, electric knives, can openers, hand-held hair dryers, blenders, and vacuum cleaners.

3.4 **BRANCH CIRCUIT** – A branch circuit is that portion of the building wiring system beyond the final overcurrent device on the power-distribution panel protecting the circuit to the field-wiring terminals of permanently connected equipment or to the receptacle outlet for cord-connected appliances.

3.5 **COMPARATIVE TRACKING INDEX** – Comparative tracking index (CTI) is determined by the method described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, Recommended Method for Determining the Comparative Tracking Index of Solid Insulating Materials Under Moist Conditions.

CTI range – tracking index (Volts)	Assigned PLC
$600 \leq TI$	0
$400 \leq TI < 600$	1
$250 \leq TI < 400$	2
$175 \leq TI < 250$	3
$100 \leq TI < 175$	4
$0 \leq TI < 100$	5

3.6 **CONFORMAL COATING** – A protective covering applied on a printed wiring board to increase the dielectric voltage-withstand capability between conductors and to protect against environmental conditions.

3.7 **CORD-CONNECTED UNIT** – An appliance or product intended for connection to the branch-circuit power line by means of a power supply cord.

3.8 **COUNTER-SUPPORTED APPLIANCE** – An appliance that is physically supported by a counter, table or bench during the performance of its intended function.

3.9 **DECORATIVE PART** – A part used for ornamental purposes only and not as an enclosure or insulation of electrically live parts.

3.10 **ENCLOSURE** – That part of the product that:

- a) Renders inaccessible all or any parts of the equipment that may otherwise present a risk of electric shock and/or
- b) Retards propagation of flame initiated by electrical disturbances occurring within.

3.11 **FIELD-WIRING TERMINAL** – Any terminal where a power supply or other wire can be connected by an installer in the field.

3.12 **FIXED EQUIPMENT** – Any equipment or appliance that is intended to be permanently connected electrically to the wiring system.

3.13 **FLAMMABILITY CLASSIFICATION** – The flammability classification of a material is determined by tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

3.14 GLOW WIRE RESISTANCE TO IGNITION – Glow wire resistance to ignition performance is expressed as the number of seconds required to ignite a specimen by an electrically heated bar operating at a specified temperature. This test is described in the Standard for Polymeric Materials– Short Term Property Evaluations, UL 746A.

3.15 GROUND – Earth ground, unless otherwise specified.

3.16 HAND-SUPPORTED APPLIANCE – An appliance that is physically supported by any part of the body of the user during the performance of its intended functions.

3.17 HIGH-CURRENT ARC RESISTANCE TO IGNITION – High-Current arc resistance to ignition (HAI) performance is expressed as the number of arc-rupture exposures (standardized as to electrode type and shape and electrical circuit) that are necessary to ignite a material when they are applied at a standard rate on the surface of the material. This test is described in the Standard for Polymeric Materials – Short Term Property Evaluation, UL 746A.

HAI range – mean number of arcs to cause ignition (NA)	Assigned PLC
$120 \leq NA$	0
$60 \leq NA < 120$	1
$30 \leq NA < 60$	2
$15 \leq NA < 30$	3
$0 \leq NA < 15$	4

3.18 HOT-WIRE RESISTANCE TO IGNITION – Hot-wire resistance to ignition (HWI) performance is expressed as the mean number of seconds needed to ignite standard specimens that are wrapped with resistance wire that dissipates a specified level of electrical energy. The test is described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

HWI range – mean ignition time (sec.)	Assigned PLC
$120 \leq IT <$	0
$60 \leq IT < 120$	1
$30 \leq IT < 60$	2
$15 \leq IT < 30$	3
$7 \leq IT < 15$	4
$0 \leq IT < 7$	5

3.19 HOUSEHOLD APPLIANCE – An appliance intended for use in the home.

3.20 IEC Glow Wire Ignition Temperature (GWIT) – in accordance with IEC 60695-2-13, is expressed as the temperature which is 25° C (30° C between 900° C and 960° C) higher than the maximum temperature of the tip of the glow wire which does not cause ignition of a test specimen of given thickness during three subsequent tests.

3.21 IEC Glow Wire Flammability Index (GWFI) – in accordance with IEC 60695-2-12, is expressed as the highest temperature, during three subsequent tests for a test specimen of a given thickness, at which one of the following conditions are fulfilled:

- a) flames or glowing of the test specimen extinguish within 30 seconds after removal of the glow wire and there is no ignition of the wrapping tissue placed underneath the test specimen;
- b) there is no ignition of the test specimen.

3.22 INSULATED LIVE PART – An electrically live part that is provided with complete protection against electric shock and does not rely upon other parts for insulation.

3.23 INSULATION, FUNCTIONAL – The insulation necessary for the proper functioning of the product and for basic protection against electric shock.

3.24 INTERMITTENT OPERATION EQUIPMENT – Operation in a series of specified cycles each composed of a period of operation under NORMAL LOAD, followed by a rest period with the equipment switched off or running idle.

3.25 LEVEL OF ATTENDANCE – The level of operator attendance is determined by whether or not operator presence is normally required or essential in order for the equipment to perform its intended task or purpose. Consideration should be given to whether the equipment has to be kept switched on by hand or foot, or equipment, which is continuously loaded by hand under normal use. The end-product standard should be referenced when determining the applicable level.

3.26 LIVE PARTS – Denotes metal or other conductive parts that, during intended use, has an electrical potential difference with respect to earth ground or any other conductive part.

3.27 NON-HAZARDOUS ENERGY CIRCUIT – A circuit that is not considered to have a risk of electric shock or fire.

3.28 PERFORMANCE LEVEL CATEGORY – An integer that defines a range of test values for a given electrical/mechanical property test.

3.29 PORTABLE APPLIANCE – An appliance that is easily carried or conveyed by hand, and is provided with a power-supply cord for connection to the supply circuit.

3.30 POWER-SUPPLY CORD – The flexible electrically insulated cord provided to connect the product to the supply circuit.

3.31 PRIMARY CIRCUITS – The wiring and components that are conductively connected to the supply circuit.

3.32 PRINTED-WIRING BOARD – The finished combination of a pattern of conductive paths either on or within multilayer sheets of insulating material.

3.33 RISK OF ELECTRIC SHOCK – A risk of electric shock is considered to exist at any part if,

- a) The potential between the part and earth ground or any other accessible part is more than 42.4 V peak, and
- b) The continuous current flow through a 1500 ohm resistor connected across the potential exceeds 0.5 mA.

3.34 RISK OF FIRE – A risk of fire is considered to exist at any two points in a circuit where;

- a) The open circuit voltage is more than 42.4 V peak and the energy available to the circuit under any condition of load including short circuit, results in a current of 8 A or more after 1 minute of operation, or
- b) A power of more than 15 watts can be delivered into an external resistor connected between the two points.

3.35 SAME BASIC COMPOSITION – Materials that are of the identical generic material type having equivalent percentage and type of fillers, additives, resins and reinforcements.

3.36 SECONDARY CIRCUIT – A secondary circuit is a circuit supplied from a secondary winding of an isolating transformer.

3.37 STATIONARY EQUIPMENT – Any equipment or appliance that is intended to be fastened in place or located in a dedicated space, and is provided with a power-supply cord for connection to the supply circuit.

3.38 SUPPLY CIRCUIT – The branch circuit supplying electrical energy to the product.

3.39 UNINSULATED LIVE PART – A part involving the risks of fire or electric shock that is bare or has insulation that is not acceptable for the operating conditions (electrical potential, temperature, and the like) involved.

3.40 USER SERVICING – The replacing, cleaning, or adjusting done by the user.

3.41 VULCANIZED FIBER – A term used in this standard to denote a material normally used as electrical insulation. Vulcanized fiber is made by combining layers of chemically gelled paper. The zinc chloride used in gelling the paper is subsequently removed by a water leaching treatment, and the resultant product, after being dried and finished by calendaring, is a dense material of partially regenerated cellulose where the fibrous structure is retained in varying degrees, depending upon the grade of fiber. Cellulose fiberboard, pressboard, fullerboard, or cardboard are not acceptable as the equivalent of fiber. Fishpaper is a designation commonly used in the trade to refer to thin sheets of electrical grade vulcanized fiber.

## ENCLOSURES

### 4 General

4.1 Equipment having an enclosure, or parts of the enclosure, comprised of polymeric material shall comply with the applicable requirements in [Table 4.1](#).

**Table 4.1**  
**Enclosure requirements**

Path	I	II	III
Application area	Portable attended household equipment	All other portable equipment <sup>k</sup>	All other equipment
Applicable requirements shown below			
Minimum Flammability Rating	HB <sup>a,d</sup>	V <sup>b,d</sup>	5VA <sup>c,d</sup>
Material Properties per <a href="#">Table 6.1</a>	Yes	Yes	Yes
Impact Test per Section <a href="#">22</a>	Yes	Yes	Yes
Crush Resistance per <a href="#">21.1</a>	No	No	Yes
Abnormal Operations Test per <a href="#">27.1</a>	Yes	Yes	Yes
Severe Conditions Test per <a href="#">28.1</a>	Yes <sup>l</sup>	No <sup>j</sup>	Yes
Mold-Stress Relief Distortion per Section <a href="#">29.1</a>	Yes <sup>e</sup>	Yes <sup>e</sup>	Yes <sup>e</sup>

Table 4.1 Continued on Next Page

Table 4.1 Continued

Path	I	II	III
Application area	Portable attended household equipment	All other portable equipment <sup>k</sup>	All other equipment
<b>Applicable requirements shown below</b>			
<b>Minimum Flammability Rating</b>	<b>HB<sup>a,d</sup></b>	<b>V<sup>b,d</sup></b>	<b>5VA<sup>c,d</sup></b>
Input after Mold-Stress Relief per <a href="#">30.1</a>	Yes	No <sup>j</sup>	Yes
Strain Relief Test per <a href="#">31.1</a>	Yes <sup>f</sup>	Yes <sup>f</sup>	Yes <sup>f</sup>
UV Resistance per <a href="#">25.1</a>	Yes <sup>g</sup>	Yes <sup>g</sup>	Yes <sup>g</sup>
Water Exposure and Immersion per Sec. <a href="#">26</a>	Yes <sup>h</sup>	Yes <sup>h</sup>	Yes <sup>h</sup>
Dimensional Stability per <a href="#">26.2</a>	Yes	Yes	Yes
Conduit Connections	No	No	Yes <sup>i</sup>
<p><sup>a</sup> HB or has a GWIT as described in 3.20 of at least 575°C or a GWFI as described in 3.21 of at least 550°C, or the enclosure complies with the 12 mm or 20 mm end-product flame tests as described in Section <a href="#">15</a> and <a href="#">16</a> respectively.</p> <p><sup>b</sup> V=V-0, V-1 or V-2 classed materials, or the enclosure complies with the 12 mm or 20 mm end-product flame tests as described in Section <a href="#">15</a> and <a href="#">16</a> respectively. Exception: A polymeric enclosure material classified HB may be used in portable unattended household equipment that complies with the criteria specified in Section <a href="#">5</a>.</p> <p><sup>c</sup> 5VA or the enclosure complies with the 127 mm end-product flame tests as described in Section <a href="#">17</a>.</p> <p><sup>d</sup> May require flame spread per Section <a href="#">19</a>.</p> <p><sup>e</sup> Mold-Stress Relief. For HB enclosures use <a href="#">61.2</a>. For V, 5VA or enclosures that comply with the 12 mm or 20 mm end-product flame tests as described in Section <a href="#">15</a> and <a href="#">16</a> respectively use <a href="#">61.1</a>.</p> <p><sup>f</sup> This test is only required if the strain-relief means is secured to the enclosure or is an integral part of the polymeric enclosure.</p> <p><sup>g</sup> This test is only required if the equipment is intended for outdoor use and is constructed such that the enclosure's degradation from exposure to outdoor weather conditions or UV radiation could increase the risk of fire, electrical shock, or injury to persons.</p> <p><sup>h</sup> This test is only required if the equipment is intended for outdoor use and is constructed such that the enclosure's degradation from exposure to water could increase the risk of fire, electrical shock, or injury to persons.</p> <p><sup>i</sup> This test is required only if the equipment is permanently connected electrically to the wiring system. The continuity of the conduit system shall be a metal-to-metal contact. If the integrity of the polymeric enclosure is relied upon to provide for bonding between the parts of the conduit system at any location where conduit may be connected, the bonding shall be evaluated by the requirements contained in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50. If the polymeric enclosure is intended for connection to a rigid conduit system, it shall acceptably perform when tested using the pullout, torque and bending tests as described in the Standard for Industrial Control Equipment, UL 508.</p> <p><sup>j</sup> This test is only required for materials that are rated HB.</p> <p><sup>k</sup> Path II includes portable attended and unattended commercial equipment, and portable unattended household equipment.</p>			

4.2 The requirements in this section, do not cover the additional considerations that must be given to enclosure materials exposed to oils, acids, solvents, cleaning agents, and the like in use. The performance of the material shall not be adversely affected by such environments (if encountered in the end-use application) as determined by applicable tests as detailed in the end-product standard or the Standard for Polymeric Materials – Short Term Property Evaluation, UL 746A.

4.3 If a metal sub-enclosure houses all insulated or uninsulated live parts that involve a risk of fire, then the overall polymeric outer enclosure may be classed either 5VA, 5VB, V-O, V-1, V-2, or HB.

*Exception: A V-0 material may be substituted for the metal sub-enclosure for portable equipment described in Path II of [Table 4.1](#).*

4.4 Decorative parts are not required to be made of a material classed 5VA, 5VB, V-0, V-1, V-2, or HB, providing the part does not occupy a volume greater than 2 cubic centimeters (0.122 cubic inch), does not have any dimension greater than 3 cm (1.18 inch), and is located so it cannot propagate flame from one area to another or bridge between a possible source of ignition and other ignitable parts.