

UL 746C

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Polymeric Materials – Use in Electrical Equipment Evaluations

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety
for
Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C

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A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The new and/or revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated November 13, 1998.

The revision dated July 7, 1999 includes a reprinted title page (page 1) for this Standard.

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As indicated on the title page (page 1), this UL Standard for Safety has been adopted by the Department of Defense.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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UL 746C

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December 27, 1995

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The Department of Defense (DoD) has adopted UL 746C on November 3, 1988. The publication of revised pages or a new edition of this standard will not invalidate the DoD adoption.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

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 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, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable 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 cannot be judged to comply with this Standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

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.

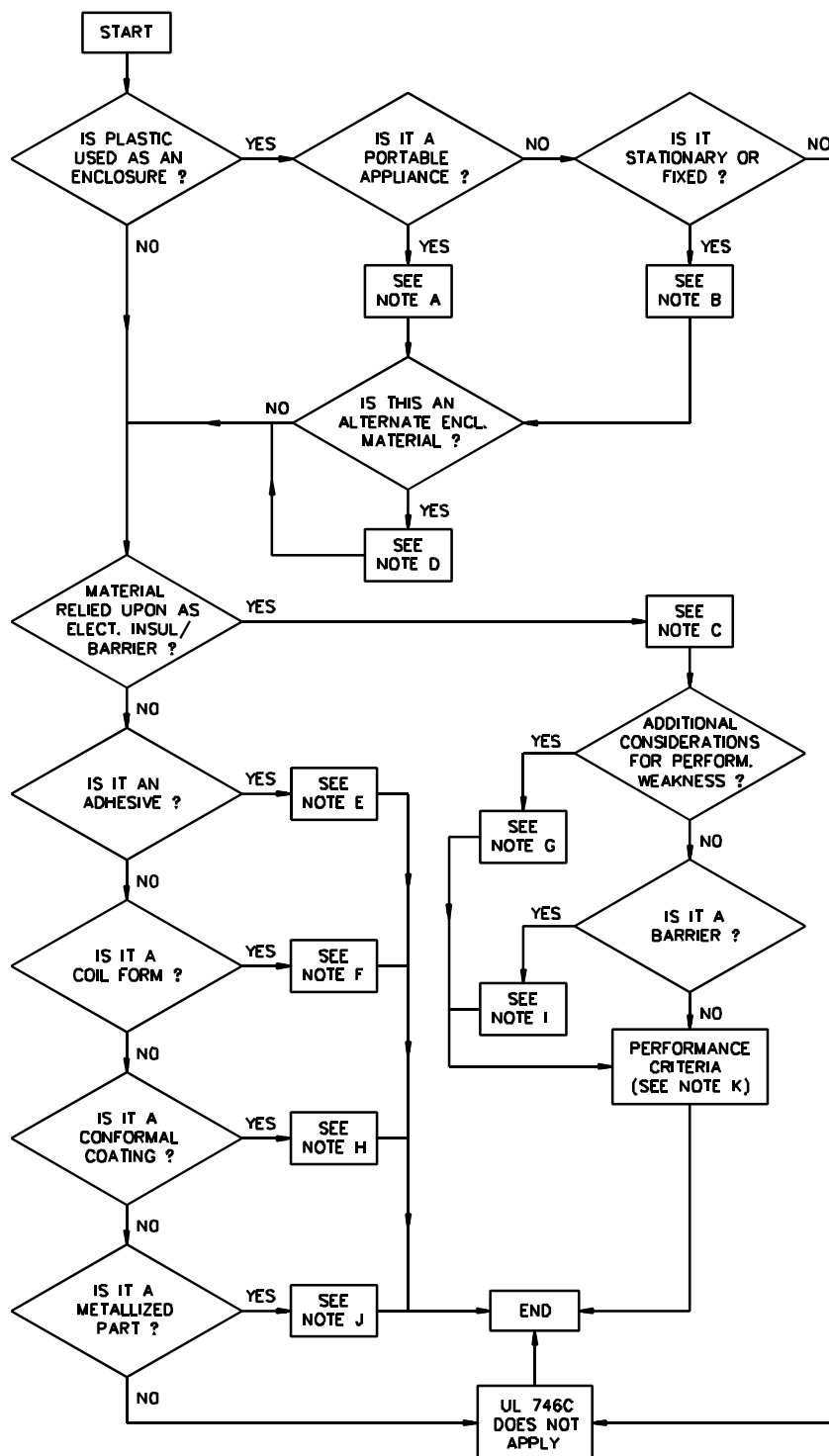
2.4 The requirements for tests for flammability of plastic materials for parts in devices and appliances, UL 94, covers flammability of polymeric materials used for parts in devices and appliances. The Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, contains short-term test 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.

2.4 added April 12, 1995

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.

2.5 added April 12, 1995

Figure 2.1
Flowchart of UL 746C procedures
to evaluate polymeric parts



- A. Section 5
- B. Section 6
- C. Sections 8, 9, Table 8.1
- D. Section 7
- E. Sections 40 – 42, 69
- F. Section 43
- G. Table 8.2
- H. Sections 44, 70
- I. Table 9.1
- J. Sections 45 – 47, 71
- K. Sections 10 – 39

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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 INTERMITTENT-DUTY HOUSEHOLD APPLIANCE – An appliance intended for infrequent and short-time use in residences and used only while attended, such as an electric knife, electric can opener, hair dryer and the like.

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 # TI	0
400 # TI < 600	1
250 # TI < 400	2
175 # TI < 250	3
100 # TI < 175	4
0 # 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 requirements for tests for flammability of plastic materials for parts in devices and appliances, UL 94.

3.13 revised February 3, 1997

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 # NA	0
60 # NA < 120	1
30 # NA < 60	2
15 # NA < 30	3
0 # 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 # IT <	0
60 # IT < 120	1
30 # IT < 60	2
15 # IT < 30	3
7 # IT < 15	4
0 # IT < 7	5

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

3.20 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.

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

3.22 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.

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

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

3.25 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.

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

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

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

3.29 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.

3.30 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.

3.30 revised February 3, 1997

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

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

3.33 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.

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

3.35 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.

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

3.37 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 calendering, 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 The requirements for polymeric enclosures, or parts of enclosures of appliances and equipment are contained in Sections 5 – 7.

5 Portable Appliances

5.1 Portable appliances having an enclosure of polymeric material shall comply with the applicable requirements in Figure 5.1. The use of Figure 5.1 is explained in 5.7 – 5.11.

5.2 The requirements in Portable Appliances, Section 5, do not cover the additional considerations that must be given to enclosures employing large masses of polymeric materials. Whether or not such enclosures reduce the risk of electric shock or fire, or both, consideration should be given to the probability of ignition of the material by sources within the equipment or by external sources.

5.3 A polymeric material which can contact electrically live parts, or is within 0.79 mm (1/32 inch) of uninsulated live parts, shall comply with the requirements indicated in Table 8.1.

5.4 The requirements in Portable Appliances, Section 5, 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 Standard for Polymeric Materials – Short Term Property Evaluation, UL 746A.

5.5 The thermal endurance of a polymeric material shall be considered with respect to the requirements in Sections 33 – 38.

5.6 Polymeric material used to enclose a metal housing that encloses insulated or uninsulated live parts or as a decorative part, shall be classed either 5VA, 5VB, V-0, V-1, V-2, or HB by the burning tests described in the requirements for tests for flammability of plastic materials, UL 94.

Exception No. 1: 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.

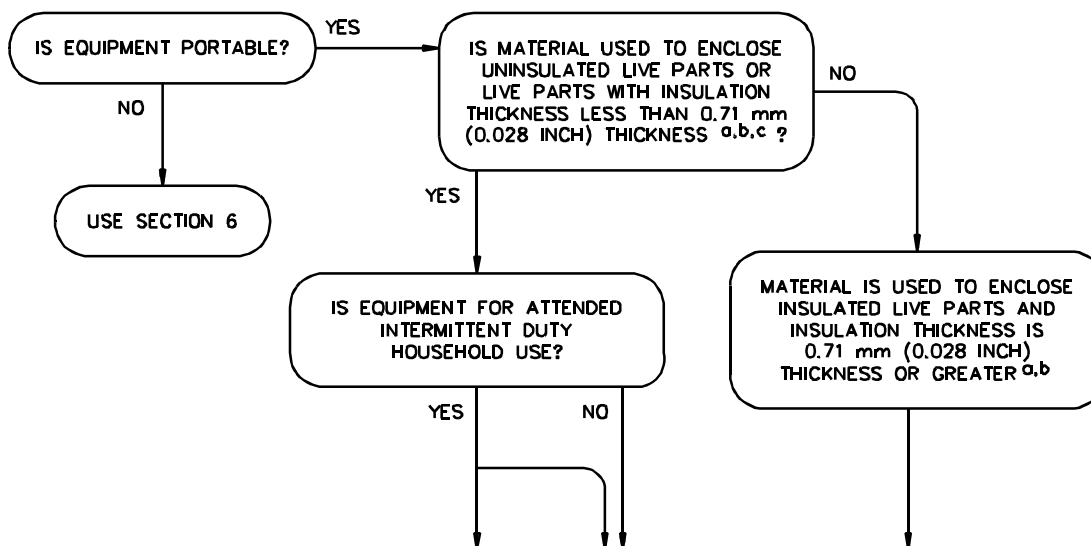
Exception No. 2: A material is to be considered equivalent if it complies with the requirements in 17.1, 51.1 – 51.5, 19.1, 53.1 – 53.5, when flame tested as used in the equipment. The use of a flame-retardant coating applied to the inside of a polymeric enclosure is not acceptable unless the coating/material interface is found to be acceptable by separate investigation (see Flame-Retardant Coatings, Section 22).

5.6 revised July 17, 1997

Figure 5.1
Enclosure requirements for portable appliances

Figure 5.1 revised July 15, 1998

Part 1 – Conditions of use



Part 2 – Applicable requirements

Minimum flammability rating	HB	V e.f	HB or V e.f
Electrical/Mechanical Properties per Table 8.1	Yes	Yes	Yes
Hot-Wire Ignition per Hot-Wire Ignition (HWI) – Abnormal Overload Test, Section 14	Max PLC of 4	Max PLC of 4 ^g	No
Impact Test per Resistance to Impact, Section 24	Yes	Yes	Yes
Abnormal Operation Test per 28.1	Yes	Yes	Yes
Severe Conditions Test per 29.1	Yes	No	No
Mold-Stress Relief Distortion per:			
A. 62.1	No	Yes	Yes
B. 62.2	Yes	No	No
Input after Mold-Stress Relief Distortion per 31.1	Yes	No	No
Creep per Section 24A ^h	Yes	Yes	Yes
Strain Relief Test per 32.1 ^d	Yes	Yes	Yes
Thermal Endurance per Sections 33 – 39	Yes	Yes	Yes
Volume Resistivity per Volume Resistivity, Section 16	Yes	Yes	No

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(Continued)

Figure 5.1 (Cont'd)

- ^a The insulation thickness of the component parts is considered to be equivalent to 0.71 mm (0.028 inch) if the component complies with the requirements for the component.
- ^b 0.71 mm (0.028 inch) thickness is generally required for internal insulation. However, if insulation or wire insulated with less than 0.71 mm (0.028 inch) insulation thickness (light duty) is provided that is restricted for use in chassis, channels or other internal areas where contact during user servicing or user operation of the equipment is unlikely, the insulation is considered to be equivalent to 0.71 mm (0.028 inch).
- ^c Enamel insulated magnet wire is to be considered as an uninsulated live part.
- ^d This test is required only if the strain-relief means is secured to the enclosure or is an integral part of the polymeric enclosure.
- ^e V = V-0, V-1, V-2 classed material, or enclosure material complies with the 12 mm end-product flame test described in Flammability – 12 mm Flame, Section 17.
- ^f As an alternative to the 12 mm end-product flame test, the 3/4 inch end-product flame test may be used.
- ^g The Hot-Wire Ignition criteria is applied only for materials used to enclose uninsulated live parts.
- ^h This test is only required if the equipment enclosure is subject to mechanical stresses from internal or external sources (such as bending, compression, or tensile loading) and the material used is not a rigid thermoset.

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5.7 The path shown on Part 1 of Figure 5.1 that matches the conditions of use for the polymeric material under consideration determines the requirements to be met.

5.8 Following the path in Part 1 of Figure 5.1 (selected using 5.7) leads to Part 2 and the applicable material requirements. It may be necessary to determine whether the equipment is of an attended, intermittent-duty, household-use type before the applicable material requirements can be selected.

5.9 Part 2 of Figure 5.1 indicates the required tests (marked with a "yes" and with a footnote reference if necessary) under the applicable path determined in Part 1 of Figure 5.1.

5.10 For example, a polymeric material used to enclose uninsulated live parts, such as a heating element, of an unattended household-use electric toaster, shall only be made from a V-rated material (second path from the left of Figure 5.1), specifically either V-0, V-1, V-2 or a material that complies with the requirements in 17.1, and 51.1 – 51.5.

5.10 revised July 17, 1997

5.11 Using this example, the material shall comply with the applicable requirements for:

- a) Hot-wire ignition per Section 14,
- b) Resistance to impact per 24.1 and 57.3,
- c) Mold stress-relief distortion per 62.1,
- d) Creep per Section 24A,
- e) Strain relief per 32.1,
- f) Abnormal operation per 28.1,
- g) Enclosure flammability per Section 17 or 18.
- h) Mechanical/electrical properties per Table 8.1, and
- i) Thermal endurance per Sections 33 – 39.

5.11 revised July 15, 1998

6 Fixed or Stationary Equipment

6.1 Electrical equipment that is fixed or stationary and not easily carried or conveyed by hand and that has an enclosure of polymeric material shall comply with the applicable requirements in Table 8.1 and Figure 6.1. The use of Figure 6.1 is explained in 6.7 – 6.11.

6.2 The requirements in Fixed or Stationary Equipment, Section 6, do not cover the additional considerations that must be given to enclosures employing large masses of polymeric materials. Whether or not such enclosures protect against electric shock and/or the likelihood of fire, consideration should be given to the probability of ignition of the material by sources within the equipment or by external sources. See 21.1 for large mass flammability considerations.

6.3 A polymeric material used for the support of electrically live parts, shall comply with the requirements indicated in Table 8.1.

6.4 The requirements in Fixed or Stationary Equipment, Section 6, do not cover the additional considerations that must be given to enclosure materials exposed to oils, acids, solvents, cleaning agents, and the like in production equipment. 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 Standard for Polymeric Materials – Short Term Property Evaluation, UL 746A.

6.5 See Sections 33 – 39 for considerations of thermal endurance and Mechanical/Electrical Property Considerations, Section 8, for additional considerations of the mechanical/electrical properties of enclosure materials.

6.6 Polymeric material used to enclose a metal housing that encloses insulated or uninsulated live parts or as a decorative part, shall be classed either 5VA, 5VB, V-0, V-1, V-2, or HB by the burning tests described in the requirements for tests for flammability of plastic materials, UL 94.

Exception No. 1: 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 4000 cubic millimeters (0.24 cubic inch), does not have any dimension greater than 60 mm (2.4 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.

Exception No. 2: A material is to be considered equivalent if it complies with the requirements in 17.1, 51.1 – 51.6 or 19.1, 53.1 – 53.5, when flame tested as used in the equipment. The use of a flame-retardant coating applied to the inside of a polymeric enclosure is not acceptable unless the coating/material interface is found to be acceptable by separate investigation (see Flame-Retardant Coatings, Section 22).

6.6 revised July 17, 1997

6.7 The path shown on Part 1 of Figure 6.1 that matches the conditions of use for the polymeric material under consideration determines the requirements to be met.

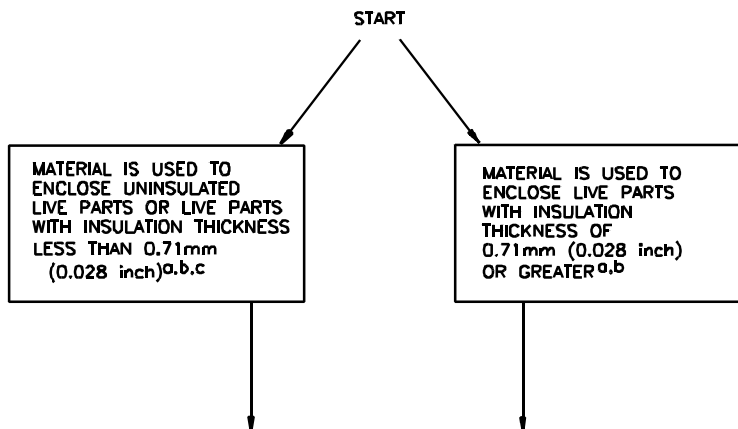
6.8 Following the path in Part 1 of Figure 6.1 (selected using 6.7) leads to the applicable requirements and the test considerations to be considered in Part 2 of Figure 6.1.

6.9 Part 2 of Figure 6.1 indicates the required tests (marked with a "yes" and with a footnote reference if necessary) under the applicable path determined in Part 1 of Figure 6.1.

Figure 6.1
Enclosure requirements for fixed or stationary equipment

Figure 6.1 revised July 15, 1998

Part 1 – Conditions of use



Part 2 – Applicable requirements

Minimum flammability rating	5V ⁱ	5V ⁱ
ELECTRICAL/MECHANICAL PROP. PER TABLE 8.1	YES	YES
DIELECTRIC WITHSTAND PER 12.1	YES	NO
LARGE MASS FLAMMABILITY PER SECTION 21	YES	YES
CRUSHING RESISTANCE PER 23.1	YES	NO
RESISTANCE TO IMPACT PER SECTION 24	YES	YES
UV RESISTANCE PER 26.1	YES ^f	YES ^f
WATER EXPOSURE AND IMMERSION		
A. PROPERTIES PER 27.1	YES ^f	YES ^f
B. DIMENSION PER 27.2	YES	NO
ABNORMAL OPERATION PER 28.1	YES	YES
SEVERE CONDITIONS PER 29.1	YES	YES ^g
MOLD STRESS–RELIEF DISTORTION PER 62.1	YES	YES ^d
INPUT AFTER MOLD STRESS–RELIEF DISTORTION PER 31.1	YES	YES ^g
CREEP PER SECTION 24A	YES ^j	YES ^j
CONDUIT CONNECTIONS	YES ^h	YES ^h
STRAIN RELIEF PER 32.1	YES ^e	YES ^e
THERMAL ENDURANCE PER SECTIONS 33 – 39	YES	YES
VOLUME RESISTIVITY PER SECTION 16	YES	NO

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(Continued)

Figure 6.1 (Cont'd)

- a The insulation thickness of the component parts is considered to be equivalent to 0.71 mm (0.028 inch) if the component complies with the requirements for the component.
- b 0.71 mm (0.028 inch) thickness is generally required for internal insulation. However, if insulation or wire insulated with less than 0.71 mm (0.028 inch) insulation thickness (light duty) is provided that is restricted for use in chassis, channels or other internal areas where contact during user servicing or user operation of the equipment is unlikely, the insulation is considered to be equivalent to 0.71 mm (0.028 inch).
- c Enamel insulated magnet wire is to be considered as an uninsulated live part.
- d This test is required only if failure of the material causes a stress on the junction between a lead and a terminal of a component. If the strain-relief test is acceptably performed for components with integral leads either as a separate test or as part of the regular test procedure for the component, it shall be considered that the material does not cause a stress on the junction between the lead and a terminal of the component.
- e This test is required only if the strain-relief means is mounted to the enclosure or is a polymeric part of the enclosure.
- f This test is required only if the equipment may be exposed to outdoor weather conditions.
- g This test is required only if the equipment may be used unattended.
- h 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, 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.
- i 5V = 5VA or enclosure material complies with the 5 inch End-Product Flame Test described in Flammability – 127 mm (5 inch) Flame, Section 19.
- j This test is only required if the equipment enclosure is subject to mechanical stresses from internal or external sources (such as bending, compression, or tensile loading) and the material used is not a rigid thermoset.

S3467E

6.10 For example, a polymeric material used to enclose uninsulated live parts (such as the motor windings) of a permanently wired, indoor-use ceiling fan shall be made from a 5VA classed material or a material that complies with the requirements in 19.1, 53.1 – 53.5.

6.10 revised July 17, 1997

6.11 Using the above example, the material shall also comply with the applicable requirements for:

- a) Electrical/mechanical properties per Table 8.1,
- b) Dielectric strength per 12.1,
- c) Flammability testing per Flammability – 127 mm (5 inch) Flame, Section 19 and Enclosure Flammability – Large Mass Considerations, Section 21,
- d) Crushing resistance per 23.1,
- e) Resistance to impact per 24.1 and 24.3,
- f) Dimensional change per 27.3,
- g) Abnormal operation per 28.1,
- h) Severe conditions per 29.1,
- i) Mold stress-relief distortion per 62.1,
- j) Input after mold stress-relief distortion per 31.1,
- k) Creep per Section 24A.
- l) Conduit connections per footnote h of Figure 6.1, and
- m) Thermal endurance per Sections 33 – 39.

6.11 revised July 15, 1998

7 Alternate Enclosure Material Considerations

7.1 From time-to-time, it may be necessary to select alternative or substitute materials for use as an enclosure. These considerations apply only to alternate materials for a given part. Changes in part dimensions and, in particular, reductions in material thickness, generally require an evaluation using all the end-product tests.

7.2 It may not be necessary that a complete series of end-product tests be required, provided that equivalent or better material properties can be demonstrated by standardized small-scale tests on the candidate material when compared to the properties of a material having acceptable application performance.

Exception: A candidate material that does not provide equivalent material properties to the properties of a material having acceptable application performance, may be acceptable providing that the candidate material possesses the minimum performance level required in Figure 5.1 or 6.1 for the application.

7.3 Table 7.1 indicates general guidelines that can be used to evaluate alternate or substitute materials if small-scale test data is available. It should be noted that these guidelines apply to substitutions within the same class of materials (thermoplastic to thermoplastic and thermoset to thermoset).

7.4 Except as indicated in Table 7.1, if the originally tested material was considered acceptable based upon special tests (for example, determining the resistance of the material to ultraviolet light for an outdoor application or tests required by the end-product standard such as resistance to creep, endurance, and overload), these tests are to be conducted on the candidate material to determine acceptability.

7.5 In Table 7.1, the material property parameters are tabulated in column 1. Acceptance guidelines for those situations where the candidate material properties are equivalent to or better than the characteristics of the original material are tabulated in column 2.

7.6 Column 3 of Table 7.1 indicates the required end-product tests if the candidate material properties are not equivalent to the original material properties.

7.7 As an example, if the original enclosure material was a Type 66 nylon (PA66) and the candidate material is a polycarbonate (PC), then for each property parameter tabulated in column 1, the end-product test in column 3 would be required if the candidate material properties are not equivalent to the original material properties.

Table 7.1
Alternative enclosure material consideration

Table 7.1 revised July 15, 1998

Material property parameters (Column 1)	Candidate material characteristics, equivalent or better than characteristics of the original material considered acceptable for the application (Column 2)	Candidate material characteristics not equivalent to original material characteristics ^a (Column 3)
FLAMMABILITY UL 94 flammability classification at use thickness and color	Candidate Material Considered Acceptable	Conduct flame test on part or enclosure (See Flammability – 12 mm Flame, Section 17, Flammability – 127 mm (5 inch) Flame, Section 19, Enclosure Flammability – Large Mass Considerations, Section 21)
ELECTRIC STRENGTH (1) Volume resistivity, and (2) Dielectric Strength	Candidate Material Considered Acceptable	Conduct end-product: (1) leakage current tests or insulation resistance (2) See 12.1
TRACKING RESISTANCE Comparative tracking resistance under moist conditions, or Inclined Plane Tracking	Candidate Material Considered Acceptable	Increase spacings
PERMANENCE (outdoor equipment only) Dimensional change after water exposure. Also see 7.4	Candidate Material Considered Acceptable	Conduct rain/humidity/immersion tests on end-product
RESISTANCE TO ELECTRICAL IGNITION (1) Hot- wire ignition, and (2) High current arc resistance	Candidate Material Considered Acceptable	Conduct end-product: Abnormal Overload Test (See Hot-Wire Ignition (HWI) – Abnormal Overload Test, Section 14) Arc-Resistance Test (See 13.3 – 13.5)

(Continued)

Table 7.1 (Cont'd)
Alternative enclosure material consideration

MECHANICAL Tensile or Flexural Strength and Tensile Strength and Tensile or Izod Impact	See note b below for candidate material of same basic composition as original material. For candidate material of different composition from original material, conduct end-product impact, strain relief, and loading tests such as crush resistance – see Crushing Resistance, Section 23.	Conduct end-product impact, strain-relief and loading tests such as crush resistance – see Crushing Resistance, Section 23.
MOLD STRESS-RELIEF	All alternative or substitute materials are to be subjected to end-product mold stress-relief tests (see Mold Stress-Relief Distortion, Section 30), unless; a) The candidate material is of the same basic composition, b) The candidate material has equivalent or higher small scale heat-deflection, vicat softening, or ball pressure temperature. Mold stress-relief tests are not required for thermosets.	
CREEP	All alternative or substitute materials are to be subjected to end product creep tests (see Section 24A) unless: a) The candidate material is of the same basic composition b) The candidate has equivalent or higher small scale heat deflection, vicat softening, or ball pressure temperature indexes. c) The candidate has equivalent creepage characteristics based on tests and/or test data (Note – the test results being compared must have the same test parameters). Creep evaluations are not required for rigid thermoset materials.	
MAXIMUM-USE TEMPERATURE	Refer to Sections 33 – 39	
SPECIAL END-USE CONSIDERATIONS^c	If indicated by the applicable path in Figure 5.1 or 6.1, all alternative or substitute materials are to be subjected to the abnormal operation (28.1) and severe conditions tests (29.1), unless the candidate material is of the same basic composition.	
^a See the Exception to 7.2.		
^b All alternative or substitute materials are to be subjected to end-product impact tests (see Resistance to Impact, Section 24) unless: a) The candidate material is of the same basic composition as defined in 3.31, and b) The candidate material has equivalent or higher small-scale tensile-impact or Izod-impact strength.		
^c See 7.4		

ELECTRICAL INSULATION

8 Mechanical/Electrical Property Considerations

8.1 General

8.1.1 Mechanical and electrical properties of materials are to be judged with respect to the particular "end use" application. The requirements in Mechanical/Electrical Property Considerations, Section 8, are intended to establish general minimum acceptable requirements for those applications where the polymeric material is relied upon to reduce the risks of fire and electric shock. In the case where the material's characteristics do not meet the minimum performance levels specified, recommended engineering considerations will be made.

8.1.2 These requirements do not cover the additional considerations that must be given to applications employing large masses of polymeric materials. Whether or not such materials protect against electric shock or injury to persons, consideration is to be given to the likelihood of ignition of the material by sources inside the product or by sources outside the product. See 21.1 for large mass flammability considerations.

8.1.3 These requirements alone do not cover enclosures that provide mechanical support of electrically live parts. For evaluation of such enclosures, Figure 5.1 or 6.1 is to be used in addition to the requirements in Mechanical/Electrical Property Considerations, Section 8.

8.1.4 Using Figure 8.1 as a guide, the figurative examples that match the application of the material under consideration determine the applicable properties tabulated in Table 8.1. A material shall provide acceptable levels of performance for each of these applicable properties tabulated in Table 8.1.

Exception: End product tests may be used to determine if the material is acceptable in the application, as indicated in Table 8.2.

8.1.5 For example, a polymeric material used in an application that most closely matches figurative example No. 6 of Figure 8.1, would be evaluated with respect to the distortion under load and mold-stress relief, creep, and maximum-use temperature properties indicated in Table 8.1.

8.1.5 revised July 15, 1998

8.1.6 To determine a polymeric material's performance profile, certain tests are to be performed according to the methods contained in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A and the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B. These tests, general engineering considerations, and minimum performance levels are tabulated in Table 8.1. Specific applications may require different limits than are shown in the general case. Refer to 8.2.1 and 8.2.2 for considerations to be used in determining the acceptability of an insulating material that does not meet with the requirements tabulated in Table 8.1.

8.1.7 In establishing acceptable performance levels, consideration has been given to the service experience and to property values of presently available materials. Minimum performance characteristics have been grouped into four distinct levels based upon a material's flammability classification. The basis for the grouping is a relationship developed between resistance to ignition and persistence or rate of burning.

8.1.8 Nonrigid foamed materials – having a tensile or flexural modulus less than 0.69 gigapascals (100,000 lbf/in²), and a density less than 0.5 gram per cubic centimeter (31.3 lb/ft³) – are generally not considered acceptable for the direct or indirect support of live parts.

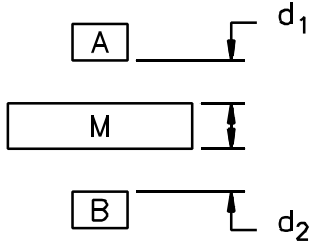
8.2 Performance weaknesses

8.2.1 Some materials may have performance characteristics that are less than those tabulated in Table 8.1. In such cases, the application must be considered or special tests conducted to determine if the reduced value can be accepted without increasing the likelihood of risk for the particular end-product.

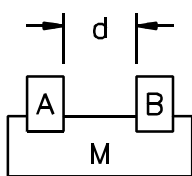
8.2.2 Table 8.2 is intended to be used as a guide in determining the acceptability of a material where performance is less than the anticipated level.

Figure 8.1
Figurative examples for Table 8.1

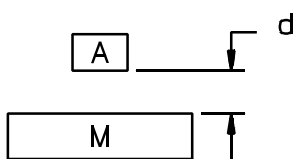
Figure 8.1 revised July 15, 1998

1. 

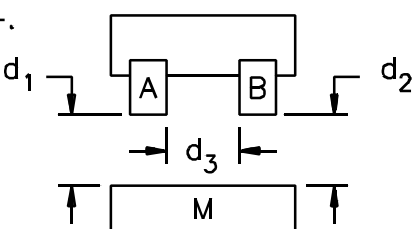
$$d_1 + d_2 < S_a$$

WHERE d_1, d_2 = THROUGH AIR SPACING
 S_a = APPLICABLE THROUGH AIR SPACING REQUIREMENT
2. 

$$d < 12.7\text{mm}$$

WHERE d = OVER SURFACE SPACING
3. 

$$0 \leq d < 0.8\text{mm}$$

WHERE d = THROUGH AIR SPACING
4. 

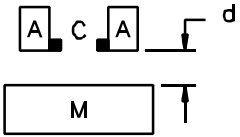
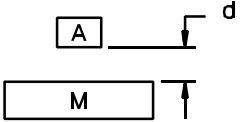
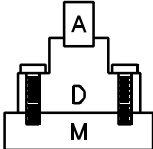
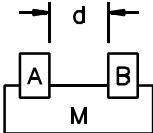
$$d_1, d_2 < 0.8\text{mm}$$

$$d_3 < 12.7\text{mm}$$

WHERE d_1, d_2 = THROUGH AIR SPACINGS
 d_3 = OVER SURFACE SPACING

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Figure 8.1 (Cont'd)
Figurative examples for Table 8.1

5.  $d < 12.7\text{mm}$
 WHERE d = THROUGH AIR SPACING
 C = ELECTRICAL CONTACTS, e.g.
 SWITCH CONTACTS,
 RELAY CONTACTS,
 BRUSH/COMMUTATOR CONTACTS
6.  $0.8\text{mm} \leq d < 12.7\text{mm}$
 WHERE d = THROUGH AIR SPACING
7.  D = ACCEPTABLE INSULATING MATERIAL
 IN CONTACT WITH "A" AND MOUNTED
 ON "M" BY SCREWS
8.  $d \geq 12.7\text{mm}$

A = UNINSULATED LIVE PART

B = (1) UNINSULATED LIVE PART HAVING DIFFERENCE IN POTENTIAL FROM A, OR
 (2) DEAD METAL PART THAT MAY BE GROUNDED IN SERVICE OR IS EXPOSED TO CONTACT.

M = POLYMERIC MATERIAL UNDER CONSIDERATION

Note: (1) ALL SPACINGS ASSUMED TO BE RELIABLY MAINTAINED.
 (2) UNLESS SHOWN IN CONTACT WITH "M", ALL LIVE PARTS ARE SUPPORTED BY STRUCTURES NOT DEPENDENT ON "M".

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Table 8.1
Mechanical/electrical property considerations

Table 8.1 revised July 15, 1998

Property	Test	Method	Units or PLC	Recommended levels related to flammability classification ^a				Applications ^b	Figurative examples from Fig. 8.1	Exceptions based upon engineering considerations
				V-0 VTM-0	V-1 VTM-1	V-2 VTM-2	HB			
ELECTRIC STRENGTH	Volume - resistivity	UL 746A	Min Ohm-cm (dry)	50×10^6	50×10^6	50×10^6	50×10^6	Material serves as insulation between uninsulated live parts of opposite polarity or between uninsulated live parts and (1) dead metal parts that may be grounded in service or (2) any surface exposed to contact	(1), (2), (3), (8)	See Sec. 16
			Min Ohm-cm (after 90% humidity)	10×10^6	10×10^6	10×10^6	10×10^6			
	Dielectric strength	UL 746A	Min V (rms) (both dry & after 90% humidity)	5000	5000	5000	5000	Same as above	(1), (2), (3), (8)	See Sec. 12
TRACKING RESISTANCE	Comparative tracking index (CTI)	UL 746A	Max. PLC	^c				Material surface is in contact with or in close proximity (less than 1/32 inch (0.8 mm)) to (a) uninsulated live parts of opposite polarity, or (b) uninsulated live parts and either (1) dead metal parts that may be grounded in service, or (2) any surface exposed to contact	(2), (3), (4)	See Sec. 11
				4	4	4	4	Higher CTI values are required where a greater degree of contamination is involved, as follows:		
				3	3	3	3	Indoor equipment exposed to relatively clean environment Outdoor and indoor equipment exposed to moderate contaminate environments		

(Continued)



Table 8.1 (Cont'd)
Mechanical/electrical property considerations

Property	Test	Method	Units or PLC	Recommended levels related to flammability classification ^a					HB	Applications ^b	Figurative examples from Fig. 8.1	Exceptions based upon engineering considerations
				V-0 VTM-0	V-1 VTM-1	V-2 VTM-2	2	2 ^c				
TRACKING RESISTANCE (Cont'd)	CTI	UL 746A	Max PLC	2	2	2	2	2	2	Outdoor and indoor equipment exposed to severe contaminate environments		
	Inclined-plane tracking	UL 746A	Min time (min) to track 25.4 mm at 2.5 kV excitation	60	60	60	60	60	60	Same as above for CTI except that the application voltage range is 601 V-5 kV	(2), (3), (4), (8)	See Sec. 15
	(See Sec. 15)			300	300	300	300	300	300	Same as above for CTI except that application voltage range is 5,001 V-35 kV	(2), (3), (4), (8)	See Sec. 15
PERMANENCE	Dimensional change after water exposure	UL 746A	Max percent change	2	2	2	2	2	2	Same as Volume Resistivity above but also includes applications where the material maintains the relative positioning of live parts and the parts could be subjected to high humidity or moisture	(1), (2), (3), (4), (7), (8)	See 27.2.1
DISTORTION UNDER LOAD	Heat deflection temperature under load or	UL 746A	Min EC at 66 psi	10EC (18EF) not less than 90EC	10EC (18EF) not less than 90EC	10EC (18EF) not less than 90EC	10EC (18EF) not less than 90EC	10EC (18EF) not less than 90EC	10EC (18EF) not less than 90EC	All applications except decorative parts	(1), (2), (3), (4) (5), (6), (7), (8)	See Sec. 30
	Vicat softening point or			25EC greater than the use temperature but not less than 105EC (221EF)	25EC greater than the use temperature but not less than 105EC (221EF)	25EC greater than the use temperature but not less than 105EC (221EF)	25EC greater than the use temperature but not less than 105EC (221EF)	25EC greater than the use temperature but not less than 105EC (221EF)	25EC greater than the use temperature but not less than 105EC (221EF)			
	Ball pressure temperature			Greater than the use temperature by the difference between 40EC and the ambient, but not less than 95EC	Greater than the use temperature by the difference between 40EC and the ambient, but not less than 95EC	Greater than the use temperature by the difference between 40EC and the ambient, but not less than 95EC	Greater than the use temperature by the difference between 40EC and the ambient, but not less than 95EC	Greater than the use temperature by the difference between 40EC and the ambient, but not less than 95EC	Greater than the use temperature by the difference between 40EC and the ambient, but not less than 95EC			

(Continued)



Table 8.1 (Cont'd)
Mechanical/electrical property considerations

Property	Test	Method	Units or PLC	Recommended levels related to flammability classification ^a				HB	Applications ^b	Figurative examples from Fig. 8.1	Exceptions based upon engineering considerations
DIMENSIONAL CHANGE DUE TO EXTERNAL STRESSES	Resistance to Creep	UL 746C		V-0 VTM-0	V-1 VTM-1	V-2 VTM-2			Resistance to creep should be evaluated in the specific application	All applications with mechanical stresses due to external sources	See Sec. 24A
RESISTANCE TO ELECTRICAL IGNITION SOURCES	High current arc resistance to ignition (HAI)	UL 746A	Max ^d PLC	3	2	2	1		Material is in contact with or in close proximity to uninsulated live parts 0.8 mm (1/32 inch) for nonarcing parts or 12.7 mm (1/2 inch) for arcing parts	(1), (2) (3), (4) (5), (8)	See Sec. 13
	Hot wire ignition HWI	UL 746A	Max ^e PLC	4	3	2	2		Material is in contact with or close proximity to uninsulated live parts [less than 0.8 mm (1/32 inch)]	(2), (3), (4), (8)	See Sec. 14
MECHANICAL	Tensile or flexural strength; tensile, Izod, or Charpy impact	UL 746A	MPa ₂ KJ/m ² or J/m notch	Mechanical strength is judged in the application					Material maintains the relative positioning of live parts or encloses live parts	(2), (4) (7), (8)	See Sec. 24
MAXIMUM USE TEMPERATURE	Relative thermal index (RTI)	UL 746A	Minimum EC	The maximum operating temperature of the part shall not exceed materials' temperature limit determined by the method indicated in Table 33.1 (See Sections 33 – 39)					All applications except decorative parts	(1), (2), (3), (4), (5), (6), (7), (8)	See Sections 37 – 39

(Continued)

Table 8.1 (Cont'd)

a	Materials classed as 5VA and 5VB only by the Vertical Burning Test described in the requirements for tests for flammability of plastic materials for parts in devices and appliances, UL 94, or a material when flame tested as used in the equipment, complies with the requirements in Flammability – 12 mm flame, Section 17, Flammability – 3/4-inch flame, Section 18, or Flammability – 127 mm (5 inch) flame, Section 19, shall be considered with respect to the recommended performance levels of a material classed as V-1.	
		Assigned PLC
b	Materials located in nonhazardous-energy circuitry, as defined in the appropriate end-product standard, shall only be considered with respect to their flammability, distortion under load and mold stress relief, mechanical and maximum use temperature properties except their resistance to electrical ignition sources property may also be considered if the material is located less than 12.7 (1/2 inch) from arcing parts or sources of ignition.	
		Assigned PLC
c	CTI Range – Tracking Index (Volts)	
	600 # TI	0
	400 # TI < 600	1
	250 # TI < 400	2
	175 # TI < 250	3
	100 # TI < 175	4
	0 # TI < 100	5
d	During the HAI test, the electrodes are to be positioned as indicated in 13.2	
		Assigned PLC
e	HAI Range – mean number of arcs to cause ignition	
	120 # NA	0
	60 # NA < 120	1
	30 # NA < 60	2
	15 # NA < 30	3
	0 # NA < 15	4
	HWI Range – mean ignition time	
		Assigned PLC
	120 # IT	0
	60 # IT < 120	1
	30 # IT < 60	2
	15 # IT < 30	3
	7 # IT < 15	4
	0 # IT < 7	5



Table 8.2
Additional considerations for performance weaknesses

Table 8.2 revised July 15, 1998

Test		Additional end product considerations
1.	Volume resistivity	Conduct end product leakage current test – see 16.1
2.	Dielectric strength	Use thicker material section – see 12.1
3.	Comparative tracking index (CTI)	Increase spacings
4.	Inclined Plane tracking	Increase spacings
5.	Permanence	Conduct end product conditioning test – see 27.3
6.	Distortion under load	Conduct end product mold stress-relief distortion test where stress is internal (i.e, results from molding or fabrication process) – see 30.1 Conduct end-product creep test where stress is due to externally applied forces – see Section 24A
7.	High current arc ignition (HAI)	Conduct end product arc resistance test – see 13.3 and 13.4
8.	Hot wire ignition (HWI)	Conduct end product abnormal overload test, or end-product Glow-Wire Test – see Hot-Wire Ignition (HWI)) – Abnormal Overload Test, Section 14
9.	Maximum Use Temperature	Conduct end product thermal aging test – see Relative Thermal Index, Section 36, Relative Thermal Capability, Section 37, and Temperature Excursions Beyond the Maximum Use Temperature, Section 39

9 Internal Barriers

9.1 A vulcanized fiber barrier or liner having a minimum 0.71 mm (0.028 inch) thickness may be an acceptable alternative to maintaining electrical spacing between live parts of opposite polarity or between uninsulated live parts and accessible metal parts where the maximum temperature does not exceed 90EC (194EF).

Exception No. 1: 0.33 mm (0.013 inch) thick vulcanized fiber is acceptable if used in conjunction with an air space of at least one-half of the required spacing.

9.2 A barrier or liner of other than vulcanized fiber, employed where spacings are unacceptable between uninsulated live parts of opposite polarity or between uninsulated live parts and accessible metal parts, shall comply with all of the following:

- a) The barrier or liner shall be of insulating material that complies with Table 9.1.
- b) The minimum thickness of the barrier or liner shall be at least 0.71 mm (0.028 inch), except that 0.33 mm (0.013 inch) is acceptable where used in conjunction with an air space of at least one-half of the required spacing.

Exception: The thickness of the barrier may be less than that specified in 9.1 providing that the results of a separate investigation indicate acceptable performance. For example, 0.18 mm (0.007 inch) thick polyethylene terephthalate (PETP) film is considered equivalent to 0.71 mm (0.028 inch) thick vulcanized fiber. Resin bonded mica 0.15 mm (0.006 inch) thick is considered electrically equivalent to 0.71 mm (0.028 inch) thick vulcanized fiber; however, its use is limited to applications where it is protected from mechanical abuse or movement.

- c) The barrier or liner shall be equivalent to vulcanized fiber in mechanical strength (tensile strength, tear resistance, puncture strength, creep, and the like) if likely to be subject to mechanical damage. See Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials used in Printed Wiring Boards, UL 746E, Vulcanized Fibre, Section 9, for specific performance indexing data on vulcanized fiber.
- d) The maximum use temperature shall not exceed either the Functional-Use Temperature Indices, Section 34, Generic Thermal Indices, Section 35, or the Relative Thermal Index, Section 36, of the barrier material, unless an end-product relative thermal capability evaluation is conducted using the requirements of Relative Thermal Capability, Section 37.

9.2 revised July 15, 1998

Table 9.1
Material requirements for internal barriers

Table 9.1 revised July 15, 1998

Application	Properties				
	Resistance to ignition from		Flammability classification ^d	Comparative tracking index (CTI) max. PLC ^e	Other criteria ^f
	Hot-wire (HWI) max. PLC ^b	High-current arc (HA) max. PLC ^c			
Used instead of spacings	4 or g	3	V-0 or VTM-0	e, o	i, j, k, l, m, n
in contact with live parts	3 or g	2	V-1 or VTM-1	e, o	i, j, k, l, m, n
	2 or g	2	V-2 or VTM-2	e, o	i, j, k, l, m, n
Used instead of spacings	4 or g	3 ^h	V-0 or VTM-0	4	i, k
in conjunction with an	3 or g	2 ^h	V-1 or VTM-1	4	i, k
air space	2 or g	2 ^h	V-2 or VTM-2	4	i, k
	2 or g	1 ^h	HB	4	i, k
Used as a	–	–	V-0 or VTM-0 or	–	k
physical			V-1 or VTM-1 or		
barrier			V-2 or VTM-2 or		
only	2 or g	1 ^h	HB	–	k
^a Deleted. ^b Hot-Wire Resistance to Ignition – See 3.18. ^c High-Current Arc Resistance to Ignition – See 3.17. ^d Flammability Classification – See 3.13. ^e Comparative Tracking Index – See 3.5 and Comparative Tracking Index (CTI), Section 11. ^f Other criteria; mechanical strength is to be judged in the application. Special consideration is to be given to cold flow or creep characteristics if the barrier material is subjected to any type of long-time mechanical loading (for example, bending, compressive, or tensile loading). See section 24A. ^g Abnormal Overload Test or End-Product Glow-wire Test described in Section 14.					

(Continued)