UL 746E

STANDARD FOR SAFETY

Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used In Printed Wiring Boards

UL Standard for Safety for Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used In Printed Wiring Boards, UL 746E

Seventh Edition, Dated September 14, 2020

Summary of Topics:

This revision of ANSI/UL 746E dated January 27, 2022 includes the following changes:

Clarification of Conformal Coating in Figure 22.1; 22.2.1

Text that has been changed in any manner or impacted by UL'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 November 19, 2021.

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Standard for Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used In Printed Wiring Boards

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This ANSI/UL Standard for Safety consists of the Seventh Edition including revisions through January 27, 2022.

The most recent designation of ANSI/UL 746E as an American National Standard (ANSI) occurred on January 21, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page. Any other portions of this ANSI/UL standard that were not processed in accordance with ANSI/UL requirements are noted at the beginning of the impacted sections.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover test procedures to be used for the evaluation of industrial laminates, filament wound tubing, vulcanized fibre, and materials for use in fabricating printed wiring boards.

1.2 These requirements provide data with respect to the physical, electrical, flammability, thermal, and other properties of the materials, that are intended to provide guidance to the material manufacturer, the fabricator, the end product manufacturer, safety engineers and other interested parties.

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 ADHESIVE – A gelatinous substance such as glue or cement used to join, bond, or fasten materials or objects together.

2.3 ANISOTROPIC – A material having different values for properties, such as conductivity, depending on the direction or dimension within the material.

2.4 AS RECEIVED – Samples in an unconditioned state, prior to being subject to conditioning, or without a history of conditioning.

2.5 ASSEMBLY SOLDERING PROCESS – The process used for soldering components to a printed wiring board during the assembly process. The soldering process may include, but is not limited to, reflow, wave, selective soldering, or other equivalent soldering techniques.

2.6 BASE MATERIAL – An organic or inorganic insulating material used to support a pattern of conductor material. The base material may be rigid or flexible.

2.7 BASE MATERIAL THICKNESS – The thickness of the base dielectric material excluding conductive foil or material deposited on the surface of the base material. If an adhesive is used to adhere the conductor material to the base material, the adhesive thickness and application surfaces (base material sides) are indicated separately.

2.8 BIAS CUT – Samples cut crosswise to the surface of the material. See Figure 7.1.

2.9 BONDING LAYER – An adhesive layer used to bond discrete layers of multilayer laminate constructions. Also known as prepreg.

2.10 BUILD-UP THICKNESS – Overall thickness of a combination of materials. Unless otherwise indicated, the build-up thickness will refer to the overall thickness of a laminate construction where no internal or external conductor material resides.

2.11 CAP LAYER – A single sided copper clad laminate bonded to the external surface of the multilayer board with bonding layer material (prepreg or b-stage material).

2.12 CIRCUIT – Electrical devices and elements interconnected to perform a desired electrical function.

2.13 CIRCUITRY LAYER – Conductor layer or plane in or on a printed wiring board.

2.14 CLAD MATERIAL – See Metal Clad Base Material.

2.15 COATING – A non-metallic substance applied by some process, such as dipping, curtain coating, film laminating, screening, spraying, or melt-flow.

2.16 CONDITIONING – Exposure of test samples to an environment for a period of time, prior to or after testing and prior to evaluation.

2.17 CONDUCTIVE (ELECTRICAL) – The ability of a substance or material to conduct electricity.

2.18 CONDUCTIVE FOIL – A thin metal sheet intended for forming a conductor pattern on a base material.

2.19 CONDUCTOR – A trace or path for electricity to transmit in a conductor pattern.

2.20 CONDUCTOR ADHESIVE – Adhesive material used to attach conductor material to a base material.

2.21 CONDUCTOR AVERAGE TRACE WIDTH – The average width of a length of conductor trace.

2.22 CONDUCTOR BASE WIDTH – The width of a conductor at the interface of the conductor material as determined by microsection analysis. This width is used to determine bond strength/peel strength values.

2.23 CONDUCTOR LAYER – A single plane of a conductor material or pattern on a base material.

2.24 CONDUCTOR MATERIAL – An organic or inorganic substance capable of transmitting electricity, used for circuit conductors, including but not limited to copper, tin, nickel, gold, carbon paste, copper paste, silver paste, ruthenium oxide paste, etc.

2.25 CONDUCTOR PATTERN – The path, design, or configuration of conductor material on the base material, including but not limited to conductor traces, lands, through-holes, and vias.

2.26 CONDUCTOR THICKNESS – The thickness of the conductor and additional metallic platings or coatings, excluding non-conductive coatings.

2.27 CONDUCTOR TRACE – A linear conductor path of a conductor circuit.

2.28 CONDUCTOR WEIGHT – See Conductor Thickness.

2.29 CONDUCTOR WIDTH – The width of the conductor as viewed from a top view or at the plane of the surface of a base material, whichever is less. See Conductor Base Width.

2.30 CONFORMAL COATING – A protective covering applied on a printed wiring board capable of conforming to the configuration of objects coated, used to increase the dielectric voltage-withstand capability between conductors and/or to protect against environmental conditions.

2.31 CONTINUITY – An uninterrupted path for the flow of electrical current in a circuit.

2.32 CONSTRUCTION – A variation in laminate materials, including but not limited to base material, laminate, prepreg, dielectric materials, or other insulation materials. Variations include singlelayer, multilayer, and composite constructions.

2.33 CORE MATERIAL – The innermost material or base material which may be used to support a subsequent layer or layers of dielectric material and conductor pattern. Core material may be an organic or

inorganic material, with or without integral dielectric material. Core material may be referred to as substrate material.

2.34 COUPON – A test vehicle constructed to represent a production material to be used for testing. See Sample.

2.34A CURING AGENT – A component added at the A-Stage to facilitate or increase the rate of curing of a thermosetting resin. Commonly known as a crosslinking agent.

2.35 CURRENT – The flow or movement of electrons in a conductor as a result of voltage difference between the ends of the conductive path.

2.36 DECLAD – A dielectric material from which the foil or conductive material has been removed by etching or other means.

2.37 DELAMINATION – A planar separation of materials (i.e., separation between conductor and base material, prepreg, dielectric material, etc.).

2.38 DESICCATOR – A sealable vessel containing anhydrous calcium chloride, or other drying agent, maintained at a relative humidity not exceeding 20 percent at 23 ±2°C (73.4 ±3.6°F).

2.39 DIELECTRIC – A material capable of high resistance to the flow of electrical current and capable of being polarized by electric field.

2.40 DOUBLESIDED – A singlelayer board construction with conductor pattern on the two external sides of the base material only. Sometimes referred to as di-clad.

2.41 END PRODUCT – An individual part or assembly in its final completed state. See End-Use Product.

2.42 END-USE PRODUCT – A device or appliance in which a printed wiring board is installed as a component.

2.42A EPOXY – A class of thermosetting polymers derived from an epoxide resin.

2.43 ETCHANT – A chemically reactive solution used to remove portions or all material from a base material construction.

2.44 ETCHED – A laminate material in which the conductive layer has been removed by a chemical process.

2.45 ETCHING – The action of chemical, or chemical and electrolytic, removal of conductive or resistive material.

2.46 EXTERNAL LAYER – The conductor pattern on the external surface of the board construction.

2.47 FAMILY – Multiple grades of materials that have identical IR spectra and performance characteristics are UL Recognized for the manufacturer as a material family (alternate grades separated by a comma) of which one grade is representative of others in the family.

2.48 FILAMENT WOUND TUBING – A tube composed of continuous monofilaments or yarns with controlled orientation in a matrix of cured thermosetting resin.