

Plastic Requirements for Product Safety Compliance

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The usage of plastics in the product manufacturing process has become so commonplace that it has essentially eliminated the usage of many other traditional manufacturing materials. Today, everything from your laptop to your coffee maker to your home stereo are made with extensive use of various types of durable and moderately inexpensive plastics. However, when manufacturers begin to plan for compliance with their applicable Product Safety requirements, there are a number of factors that need to be taken into consideration with regard to the usage of plastics.

There are three categories of plastic materials that are considered in the safety standards. The definition of these categories follows:

1. Enclosures: The plastic materials used in enclosures must meet the flammability, electrical and/or mechanical requirements.
2. Internal Components: The plastic materials used inside the enclosure, such as, but not exclusively, are connectors, ducting, printed wiring boards, card guides and tubing. The plastic materials used in these components only have to meet the flammability requirements for use inside the enclosure. There may be also mechanical and electrical requirements depending on the use.
3. Decorative parts: These parts are usually rated at the minimum flammability requirements and are located outside the fire enclosure. They normally cannot be used as enclosures or in contact with electrically live parts (i.e. connectors) without additional testing.

Plastic Flammability Classification:

The plastic materials are classified according to their flammability rating. Starting from the most flammable to the least – 94HB, 94V-2, 94V-1, 94V-0, 94-VA and 94-5VB.

The first two numbers are in reference to UL standard 94. H is in reference to orientation of the sample during the classification testing, in this case horizontal. V stands for vertical orientation. Both of these orientations use the 20 mm (3/4 in.) long flame. The designation 5V refers to the more severe 125mm (5 in.) long flame length for 94-5V requirements. For European compliance they drop the 94 reference and use the shorten designation for documentation purposes. We will use the European designation for describing the flame rating for the rest of this discussion.

Other plastic flammability classifications are VTM and HF. VTM refers to Vertical Thin Material, or materials due to their thickness could not be tested like the thicker material. HF refers to Horizontal Foam materials.

Material Characteristics:

To determine the characteristics, requesting the material specification directly from the manufacturer is the best method. However, they may not contain all of the agency certification information required for the application. UL is the biggest and most recognized agency for testing plastics. They have an online directory for all of the plastics tested under their program. The link is <http://database.ul.com/cgi-bin/XYV/template/LISEXT/IFRAME/index.htm>.

Other material considerations that are covered under the UL certification.

Thermal Endurance

The temperature below which a class of critical property will not be unacceptably compromised through chemical thermal degradation, over the reasonable life of an electrical product (relative to a reference material having a confirmed, acceptable corresponding performance) is defined as the Relative Thermal Index (RTI). More than one RTI may be appropriate for a

given material depending on the property requirements for a given application. In certain cases, higher temperatures are permitted if so specified by the end-use product standard.

RTI Elec — Electrical RTI, associated with critical insulating properties.

RTI Mech Imp — Mechanical Impact RTI, associated with critical impact resistance, toughness, elongation and flexibility properties.

RTI Mech Str — Mechanical Strength (Mechanical without Impact) RTI, associated with critical mechanical strength and structural integrity where impact resistance, resilience and flexibility may not be essential.

Resistance to Ignition and Tracking Properties

Performance may be investigated with respect to electrical track resistance, ability to resist ignition from electrical sources, and other electrical properties.

Hot-Wire Ignition (HWI; ASTM D3874, IEC 60695-2-20) — Performance is expressed as the mean number of seconds needed to either ignite standard specimens or to burn through the specimens without ignition.

High- Current Arc Ignition (HAI; ANSI/UL 746A) — Performance is expressed as the number of arc rupture exposures (standardized as to electrode type and shape and electric circuit) that are necessary to ignite a material when they are applied at a standard rate on the surface of the material.

High-Voltage Arc Tracking Rate (HVTR; ANSI/UL 746A) — Denoted as the rate, in mm/min, that a tracking path can be produced on the surface of the material under standardized test conditions.

High-Voltage, Low-Current Arc Resistance (D495; ASTM D495) — Expressed as the number of seconds that a material resists the formation of a surface conducting path when subjected to an intermittently occurring arc of high voltage, low current characteristics.

Comparative Tracking Index (CTI; ASTM D3638)

Expressed as that voltage which causes tracking after 50 drops of 0.1 percent ammonium chloride solution have fallen on the material.

How each of the considerations applies is dependent on the use and standard requirements of the product category. We will explain a few of the uses of plastics can be used in product and how the above considerations apply.

Enclosures:

The enclosure can provide one or more of the following functions described below –

Fire enclosure – Fire enclosure is intended to minimize the spread of flames from the interior of the unit.

Mechanical enclosure – Mechanical enclosure is intended to prevent or limit access to mechanical or other physical hazards that may injure.

Electrical enclosure – Electrical enclosure is to limit access to hazardous voltages, energy levels and/or TNV (Telecom Network Voltages).

Flammability requirements for enclosures:

The following requirements are for 60950-1, Information Technology Equipment – Safety – Part 1: General Requirements.

The enclosure requirements for units that are movable and have a mass not exceeding 18kg (39.6 lbs) must have a minimum flammability rating of V-1. For movable units exceeding 18kg and stationary units the minimum rating is 5VB.

If the plastic material that does not meet the minimum flammability ratings, it can be used if the material can pass the test of clause A.2 for V-1 and A.1 for 5VB requirements. Note – if this path is used, there will be an on going follow-up testing on the materials for the duration of the unit's manufacturing life.

Flammability Requirements for Barriers and Internal Components:

Barriers and other materials inside a fire enclosure must meet the minimum flammability requirement of V-2 or meet the requirements of clause A.2. This includes PWBs, connectors, card guides and all other polymeric parts.

Note: IC's, opto-coupler packages, capacitors and other small components mounted on a material of flammability class V-1 or better are exempt from this requirement.

Flammability Requirements for External Components:

Polymeric materials located outside the fire enclosure must meet the minimum flammability requirements of HB75 (<3 mm thick) HB40 (≥3 mm thick) or HBF. Connectors are not considered external components and are subjected to the internal component requirements.

Components that are not Required to Meet Flammability requirements:

Electrical components which do not present a fire hazard under abnormal operating conditions.

Materials that are enclosed within a metal enclosure of 0.06 m³ or less volume and without vents.

Summary of material flammability requirements (EN 61010-1)

Part	Requirement
Fire Enclosures (9.2.1)	<ul style="list-style-type: none"> • V-1 • HF-2
Connectors or components and parts, including mechanical and electrical enclosures, inside fire enclosures supporting components (9.2.1)	<ul style="list-style-type: none"> • V-2 • HF-2 • Component standard
Air filter assemblies (9.2.1)	<ul style="list-style-type: none"> • V-2 • HF-2
High Voltage components (9.2.1)	<ul style="list-style-type: none"> • V-2 • HF-2

Meter cases.

Components meeting their relevant component standards.

Any small components, such as integrated circuits and opto-couplers and other small components that are mounted on V-1 material, supplied from a power source ≤ 15 VA.

Wiring, cables and connectors insulated with PVC, TFE, PTFE, FEP, neoprene or polyimide.

Individual clamps (not including helical wraps or other continuous types), lacing tape, twine and cable ties.

Gears, cams, belts, bearings and other like small parts.

Replaceable supplies, consumable materials, media and recording materials.

Parts that are required to have particular properties in order to perform intended functions, such as rubber rollers and ink tubes.

Materials for Air filters:

Air filters are required to be constructed of materials with a flammability of V-2 or HF-2.

Summary of material flammability requirements (Table 4D in EN 60950-1)

Part		Requirement
Fire Enclosures (4.7.3.2)	Movable Equipment > 18 kg and Stationary Equipment	<ul style="list-style-type: none"> • 5VB • Test A.1 • Hot wire test of IEC 60695-2-20
	Movable Equipment ≤ 18 kg	<ul style="list-style-type: none"> • V-1 • Test A.2 • Hot wire test of IEC 60695-2-20
	Parts which fill an opening	<ul style="list-style-type: none"> • V-1 • Test A.2 • Component standard
Components and parts, including mechanical and electrical enclosures, outside fire enclosures (4.7.3.1 and 4.7.3.3)		<ul style="list-style-type: none"> • HB40 for thickness ≥ 3 mm • HB75 for thickness < 3 mm • HBF • Glow-wire test 550 °C of IEC 60695-2-11
Components and parts, including mechanical and electrical enclosures, inside fire enclosures (4.7.3.4)		<ul style="list-style-type: none"> • V-2 • HF-2 • Test A.2 • Component standard
Air filter assemblies (4.7.3.5)		<ul style="list-style-type: none"> • V-2 • HF-2 • Test A.2
High Voltage (> 4 kV) components (4.7.3.6)		<ul style="list-style-type: none"> • V-2 • HF-2 • Test of IEC 60065, 14.4 • Needle flame test of IEC 60695-2-2

Summary of material flammability requirements (EN 60601-1)

Part		Requirement
Fire Enclosures (4.7.3.2)	Mobile and Portable Equipment	<ul style="list-style-type: none"> • V-2 • 60695-11-10 (Ed 3.0)
	Fixed and Stationary Equipment	<ul style="list-style-type: none"> • V-0 (V-1 Ed 3.0) • 60695-11-10 (Ed 3.0)
Connectors or components and parts, including mechanical and electrical enclosures, inside fire enclosures supporting components (9.2.1)		<ul style="list-style-type: none"> • V-2 • HF-2

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