



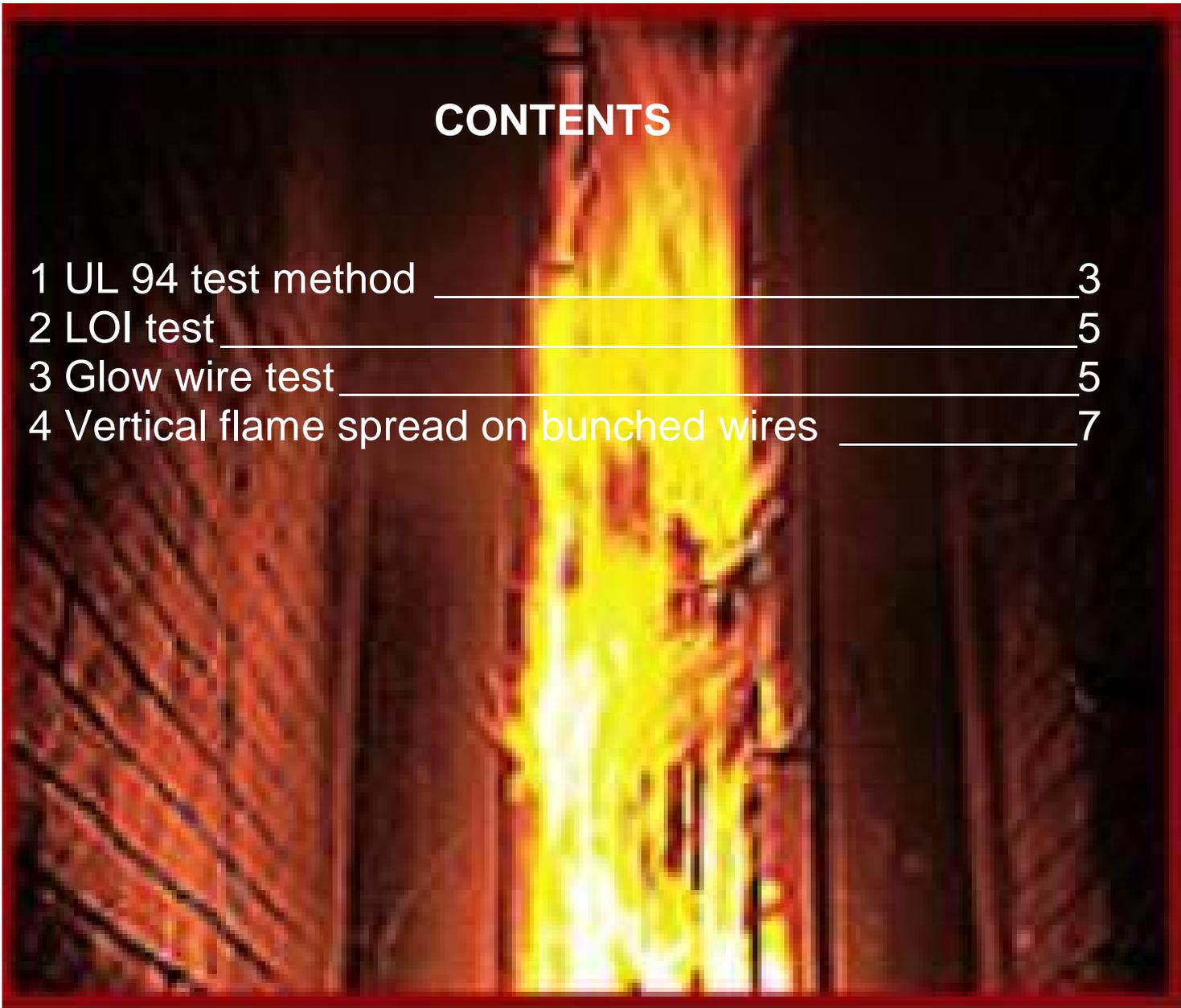
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# FIRE REGULATION FOR E&E EQUIPMENT

## WORLD OVERVIEW

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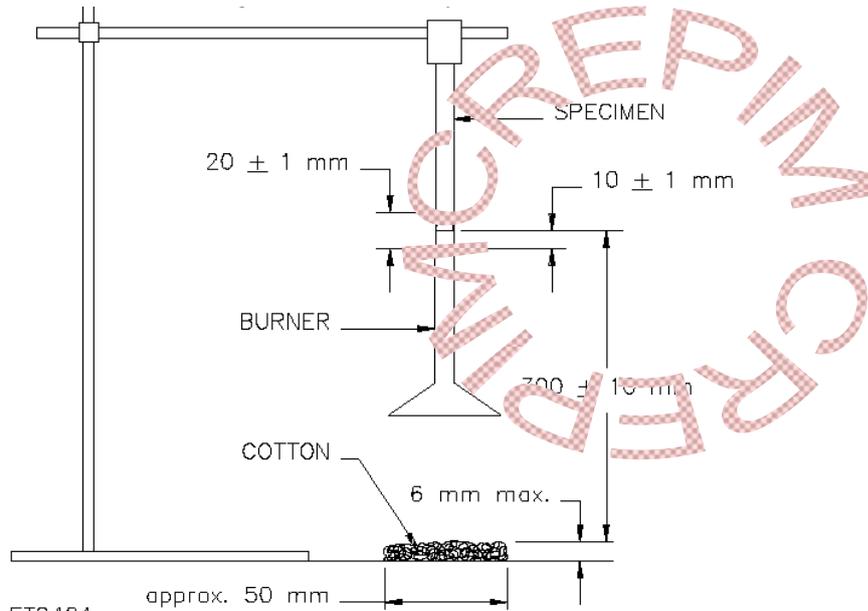
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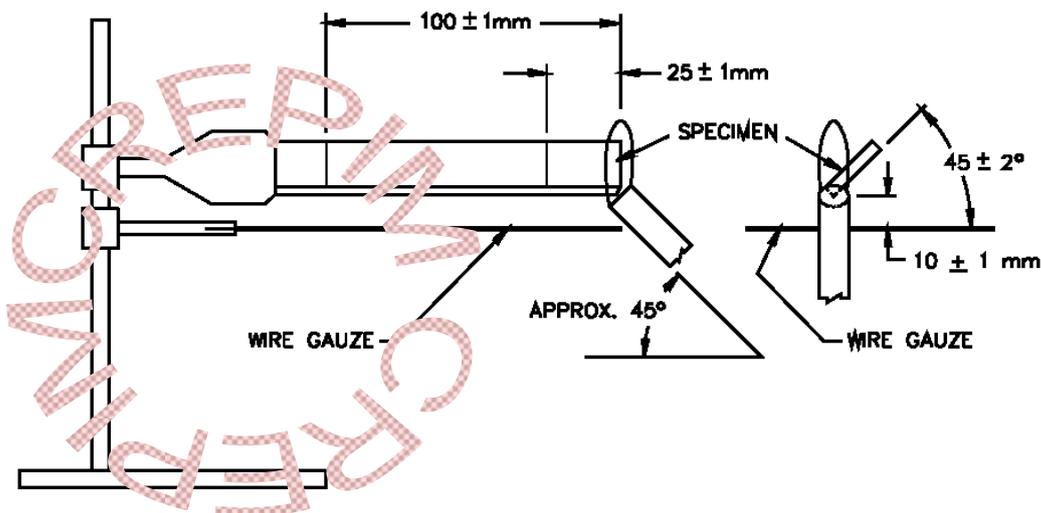
# 1 UL 94 test method

These requirements cover tests for flammability of plastic materials used for parts in devices and appliances. They are intended to serve as a preliminary indication of their acceptability with respect to flammability for a particular application. Assessment of important characteristics in the end-use application includes, but is not limited to, factors such as ease of ignition, burning rate, flame spread, fuel contribution, intensity of burning, and products of combustion. UL-94 test (according to the American National UL-94) is widely used for the determination of the relative flammability and for evaluating the dripping of plastics used in electrical engineering.

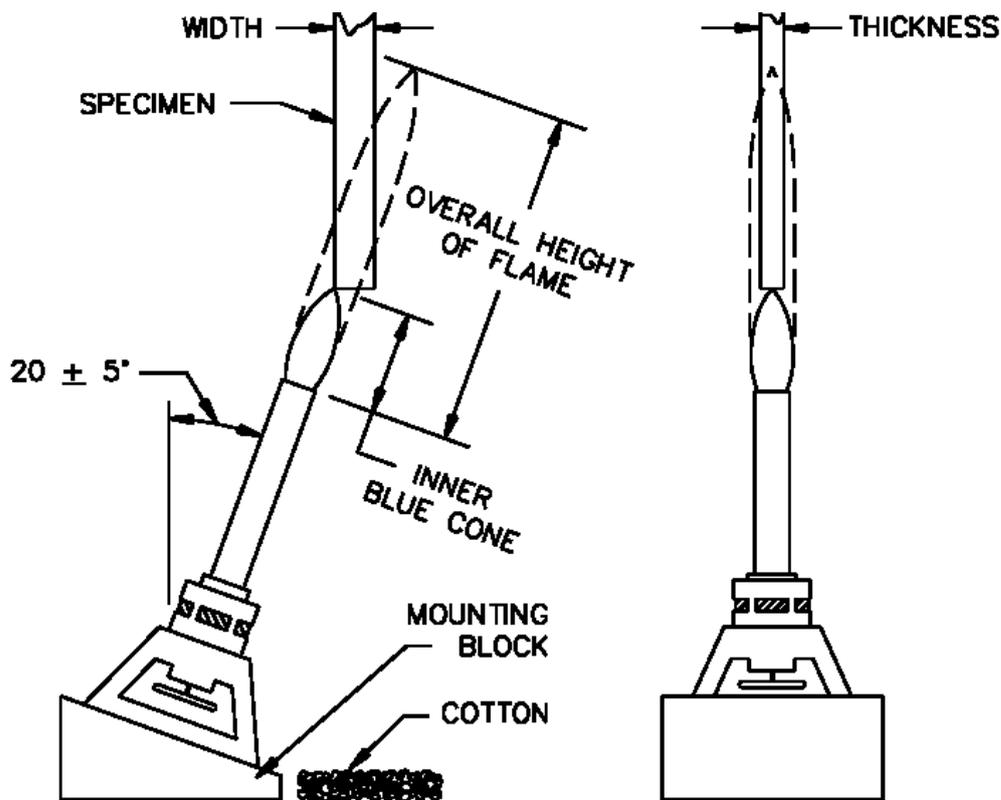
**Figure 1: UL94 Test for Flammability FOR V0, V1, V2 classification**



**Figure 2: Horizontal burning test for HB classification**



**Figure 3: Vertical burning test for 5VA, 5VB classification**



The following table shows the require conditions for each class. If a material does not comply with criteria of each class described in the table, it is non-classified.

**Table 1: UL94 criteria summary**

Criteria	V-2	V-1	V-0	HB	5VB	5VA
Number of ignitions	2	2	2	1	5	5
Maximum flaming time per specimen per flame application, sec	30	30	10	-		
Maximum total flaming time, 5 specimens, 2 ignitions, sec	250	250	50	-		
Specimen drips, ignites cotton	Yes	No	No	-	No	No
Maximum afterglow time, per specimen, sec	60	60	30	-		
Burn to holding clamp	No	No	No	-	No	No
Maximum flaming or glowing combustion time after 5th flame application, sec	-	-	-	-	60	60
Maximum burning rate for specimens from 3.0 mm to 13 mm thickness, mm/min	-	-	-	40	-	-
Maximum burning rate for specimens less than 3.0 mm thickness, mm/min	-	-	-	75	-	-
Plaque specimen exhibit burnthrough	-	-		-	Yes	No

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## 2 LOI test

Limiting Oxygen Index (LOI) is widely used for the determination of the relative flammability of polymeric materials.

**Figure 4: ISO 4589-2 LOI test appliance**



It measures the minimum concentration of oxygen in a nitrogen-oxygen mixture required to just support combustion of a test sample under specified test conditions (figure III-4) in a vertical position (the top of the test sample is inflamed with a burner). A material has fire retardant performances of interest if its LOI value is higher than 21% (vol./vol.) which represents the concentration of oxygen in the air. The higher this value is, the better the FR properties of the material are.

## 3 Glow wire test

Burning behaviour of compounded thermoplastics is not just a material characteristic. It's also dependent on the shape and wall thickness of the application. Components or parts may, under faulty conditions or overload conditions, attain a temperature such that they are unduly affected or such that they will ignite parts in the nearby area. The Glow Wire Test simulates thermal stresses that may be produced by such sources of heat or ignition, for example the glowing elements of overloaded resistors, in order to assess by simulation technique the fire hazard.

Temperatures of glow wire test are: 550, 650, 750 850 or 960 °C (depending on the relevant specification):

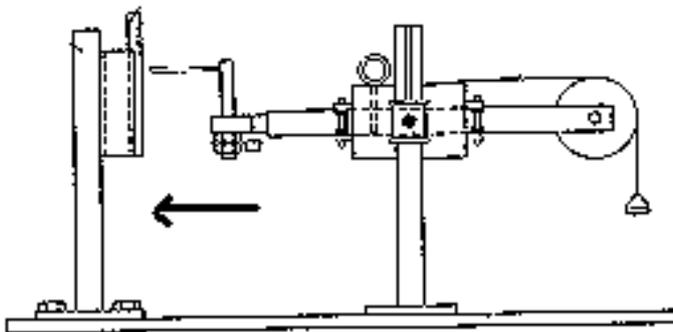
- ✓ The specimen is considered to have withstood the Glow Wire Test if one of the following applies: here is no flame and no glowing on the sample,

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- ✓ Flames or glowing of the sample extinguish within 30 seconds after removal of the glow wire, and if the cotton or the paper underlay doesn't ignite or burn.

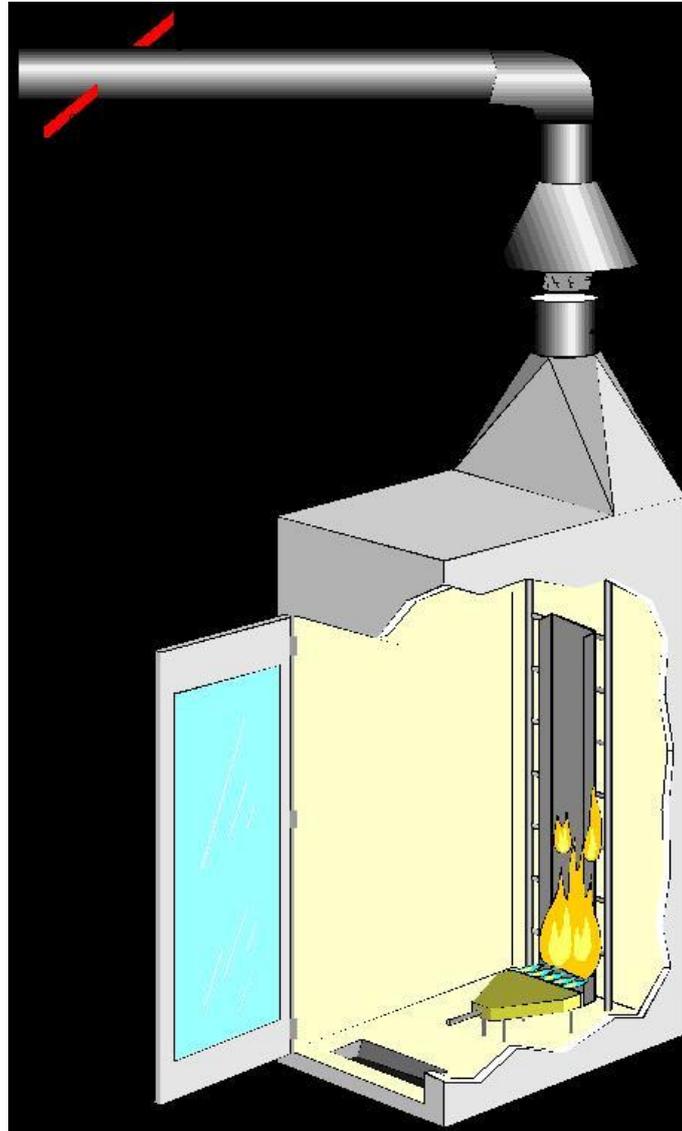
**Figure 5: the NF EN 60695-2-10/-11/-12 glow wire test method**



## 4 Vertical flame spread on bunched wires

European EN 50399 protocol simulates a fire starting under well-ventilated conditions in a vertical cable tray/shaft. A test according to this method provides data for the early stage of a cable fire from ignition of cables mounted vertically on a ladder until flames have propagated the entire height of a normal room.

**Figure 6: EN 50399 test method**



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