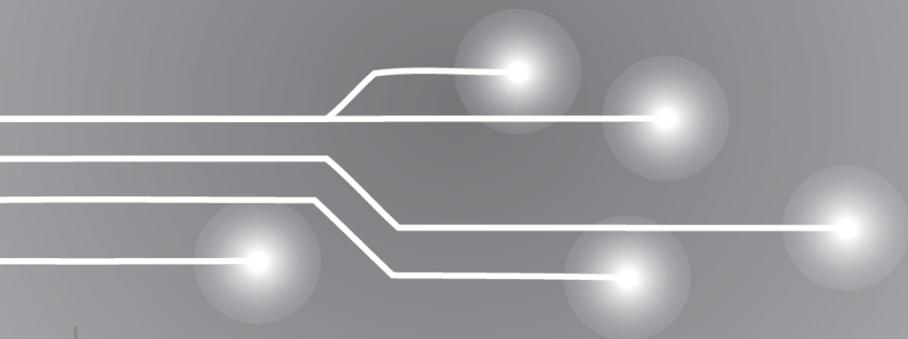


# UL

## UNDERWRITERS LABORATORIES



## TOPICS

### 1. WHAT IS UL?

- UL Standards
- UL Files for PFC Flexible Circuits

### 2. UL Tests for Flexible Circuit (FPC) boards

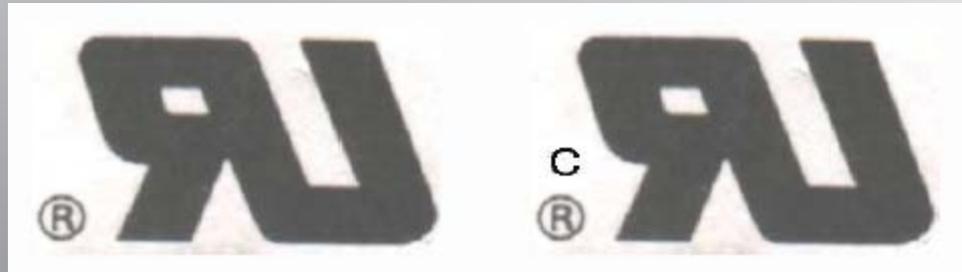
### 3. Summary of UL – Recognised types for PFC

### 4. Examples of UL – Recognised designation

## What is UL?

- UL stands for "Underwriters Laboratory"
- Independent and non-profit organization to tests electrical components and equipment for potential hazards
- When something is UL - listed, that means that the UL has tested the device, and it meets their requirements for safety
- UL has developed more than 1000 standards for safety

- UL – recognition means products which have been tested and approved by UL to use the UL recognition mark;



or whichever mark is registered with and approved by UL

- Necessary for consumer products in the US & Canada
- Optional elsewhere

- **UL Files for PFC Flexible Circuits E217146 [with Thermal Shock], Standard Component – Wiring, Printed – Flexible Material Constructions**
- **UL Standards**

<b>UL 796</b>	<b>Standard for Printed Wiring Board</b>
<b>UL 796F</b>	Standard for Printed Wiring Board includes special classification for flexible printed wiring
<b>UL 94</b>	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

- **For UL 796F standard, 2 categories of the safety test**
  - Flammability
  - Function
    - Adhesion
    - Bending / fatigue
    - Current / voltage limit

- **Flammability Test**

- UL 94 Standard

- These requirements cover tests for flammability of plastic materials used for parts in devices and appliances.

- There are 3 grades of flammability rating:

- 1) Vertical Burning Test; V-0, V-1, or V-2

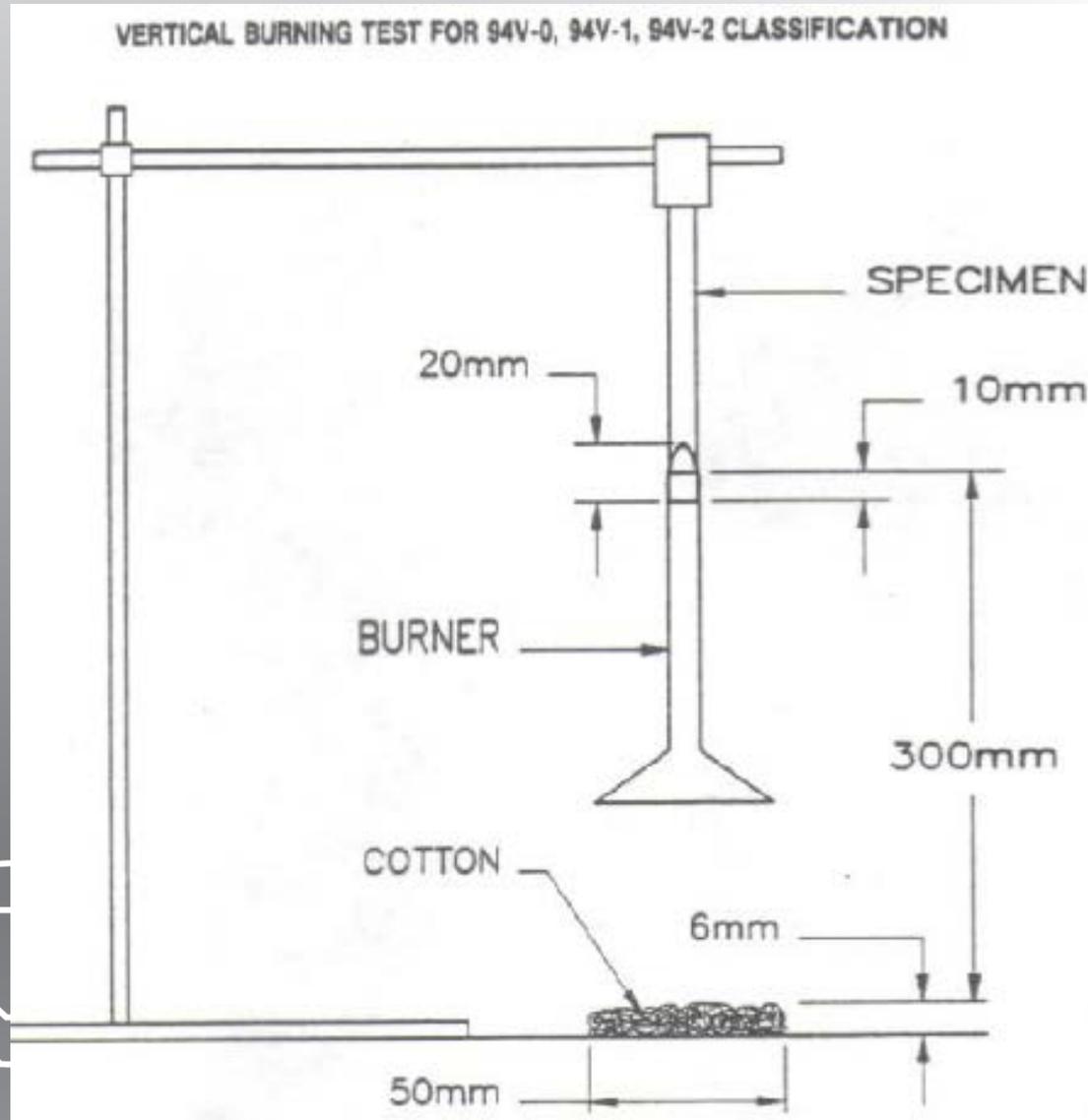
- 2) Thin Material Vertical Burning Test; VTM-0, VTM-1, or VTM-2

- 3) Horizontal Burning Test; HB

- **UL Tests for Flexible Printed Circuit Boards**  
**Vertical flammability, 94V**

- Test for flammability in which the test material is held vertically, governed by flame rating classification

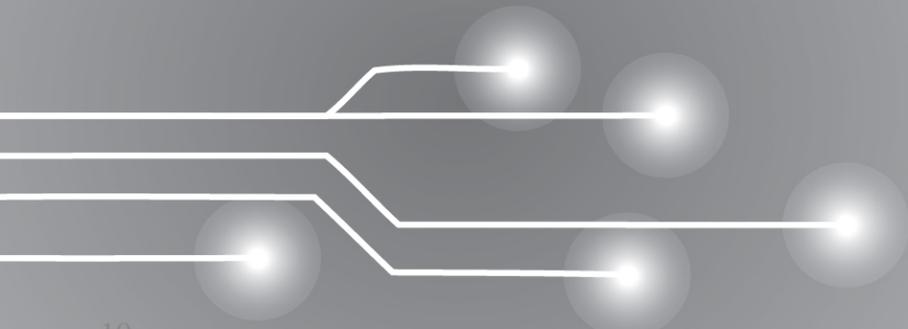
- 94V-0
- 94V-1
- 94V-2



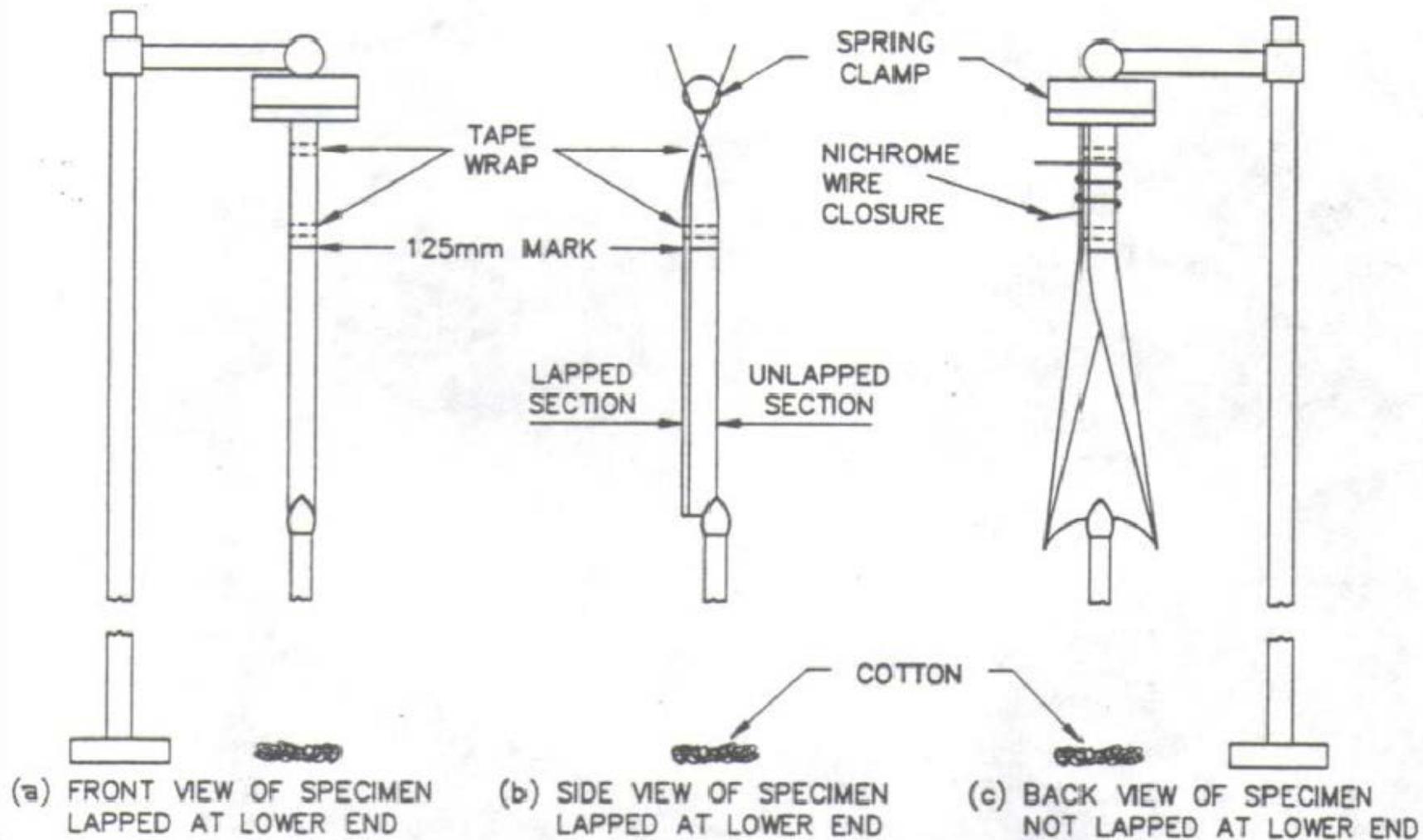
- **UL Tests for Flexible Printed Circuit Boards**  
**Vertical flammability, 94VTM**

- Test for flammability for thin materials in which the test material is held vertically, governed by flame rating classification

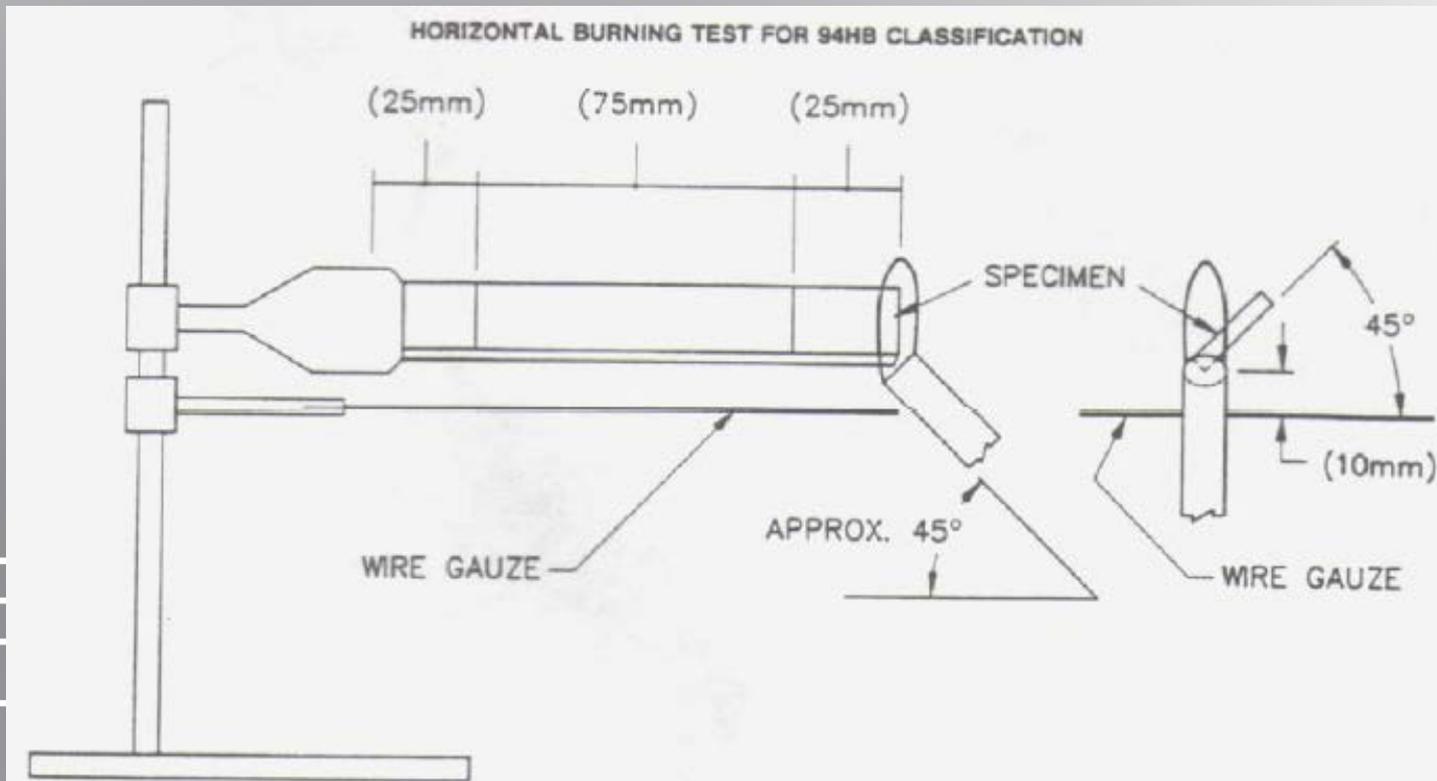
- 94VTM-0
- 94VTM-1
- 94VTM-2



## SPECIMEN ORIENTATION



- **UL Tests for Flexible Printed Circuit Boards**  
**Horizontal flammability, 94HB**
  - Test for flammability in which the test material is held horizontally governed by flame rating classification



- Standard Vertical Flammability Rating**

<b>Flame Rating Classification</b>			
<b>Criteria Condition</b>	<b>94V-0</b>	<b>94V-1</b>	<b>94V-2</b>
After flame time for each individual specimen t1 or t2	<10s	<30s	<30s
Total after flame time for any condition set (t1 + t2 for the 5 specimens)	<50s	<250s	<250s
After flame + Afterglow time for each individual specimen after the second flame application (t2 + t3)	<30s	<60s	<60s
After flame or Afterglow of any specimen up to the holding clamp	No	No	No
Cotton indicator ignited by flaming particles or drops	No	No	Yes

- Vertical Flammability Rating – *Thin Materials***

<b>Flame Rating Classification</b>			
<b>Criteria Condition</b>	<b>94VTM-0</b>	<b>94VTM-1</b>	<b>94VTM-2</b>
After flame time for each individual specimen t1 or t2	<10s	<30s	<30s
Total after flame time for any condition set (t1 + t2 for the 5 specimens)	<50s	<250s	<250s
After flame + Afterglow time for each individual specimen after the second flame application (t2 + t3)	<30s	<60s	<60s
After flame or Afterglow of any specimen up to the holding clamp	No	No	No
Cotton indicator ignited by flaming particles or drops	No	No	Yes

- **Horizontal Flammability Rating**  
Flame rating classification – 94HB

Must meet the following criteria:

1	Materials with thickness range $3.0 < t < 13$ mm	Burning rate $< 40$ mm/min over a distance of 75 mm
2	Materials with thickness $< 3.0$ mm	Burning rate $< 75$ mm/min over a distance of 75 mm
3	Stop burning before flame covers a distance of 100 mm	