

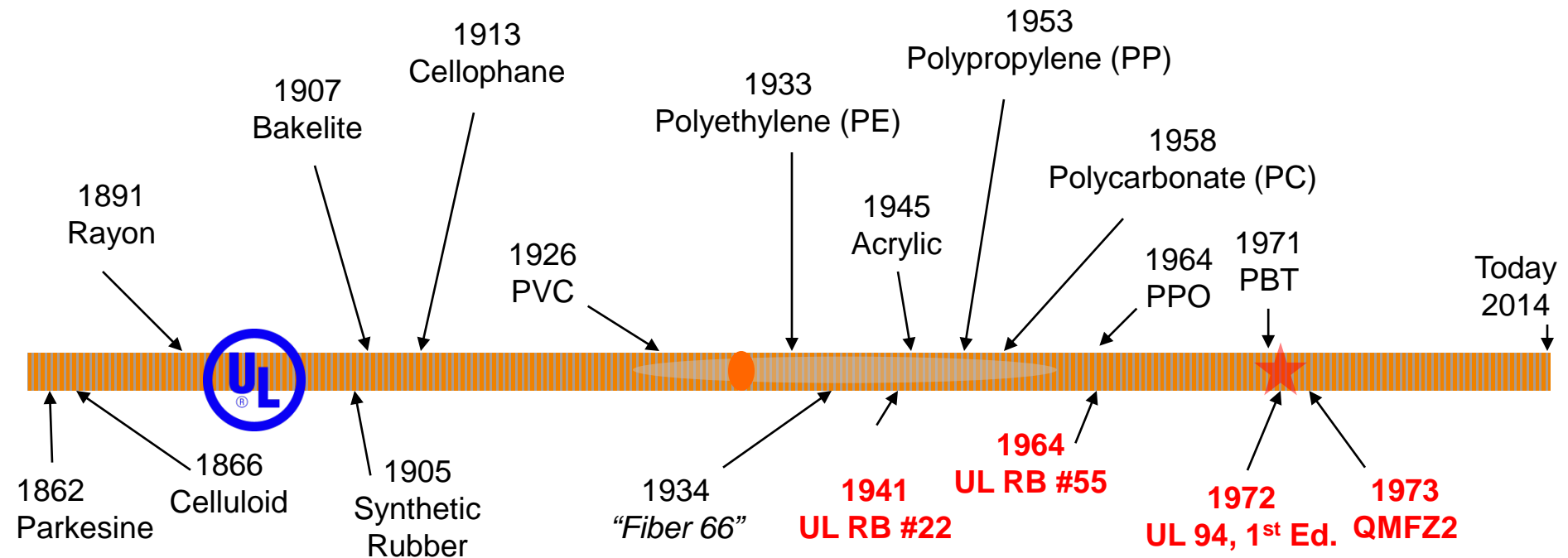
Criteri di Preselezione in Accordo ad UL 94 e Conformità del Prodotto Finito



**Matteo Paleari
Senior Project Engineer**

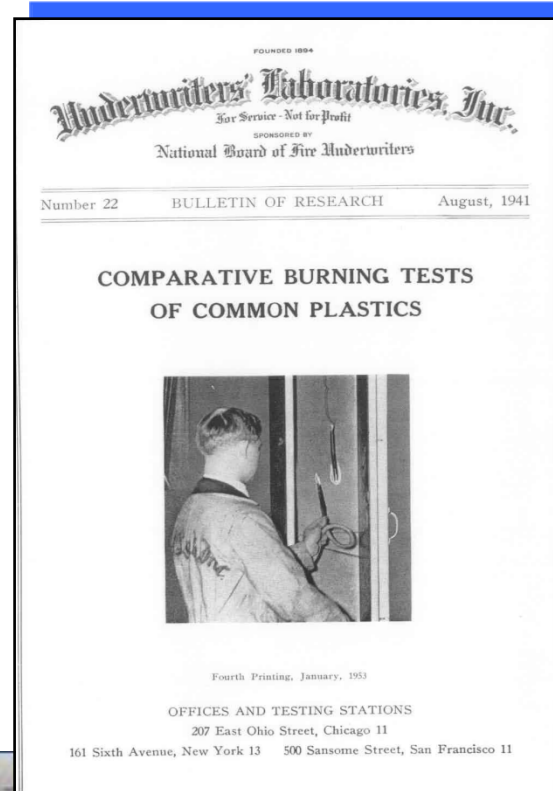
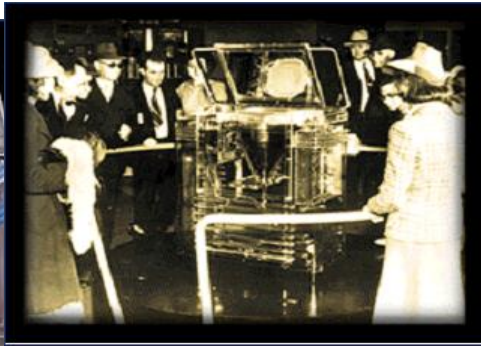
Who we are

- Underwriters Laboratories Inc (UL) is an independent safety testing and certification organization.
- Founded in 1894, UL has earned a reputation as a global leader in product safety standards development, testing and certification.



UL's "Path to Plastics"

- 1938 World's Fair –
 - a TV is exhibited for the public with plastics as the major insulating material.



Equipment and Method employed in comparative Tests of Plastics. (State Learning Service at New York)

- 1941: "Comparative burning tests of common plastics"
- UL Research Bulletin #22 by A. J. Perkins (1941)



Material Evaluation



**Performance
Of
Material
Alone**



**Performance Of
Material in
Finished Product**



UL 94 Flammability Classification

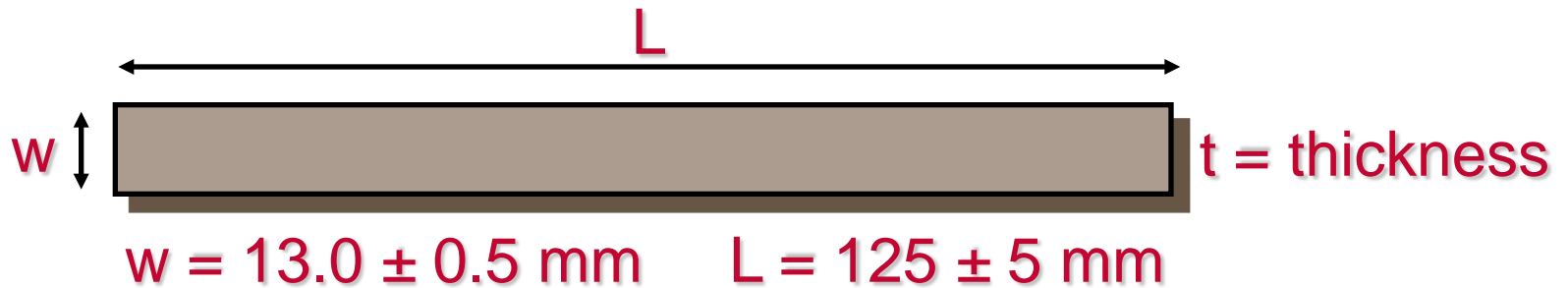


Flame Classification – Small Scale Tests

- HB
- V-0, V-1, V-2
- 5VA, 5VB
- HF-1, HF-2, HBF
- VTM-0, VTM-1, VTM-2
- Radiant Panel



Standardized Specimen



UL 94 “Flame Bar”

Used for HB, V-2, V-1V-0 and 5VB



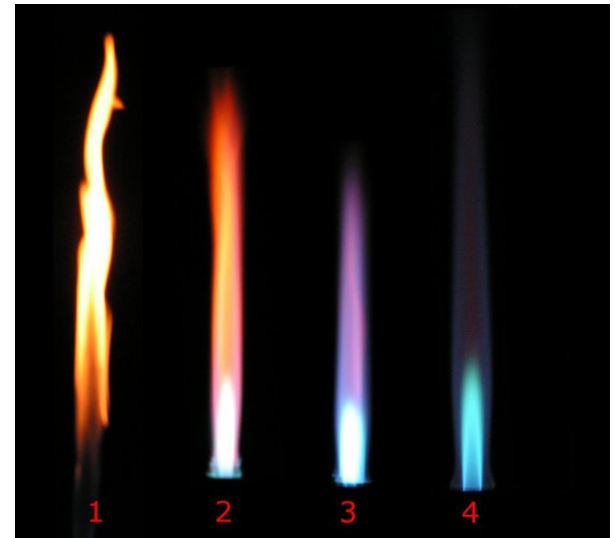
Burner

- ASTM D5025 / IEC 60695-11-3, -4



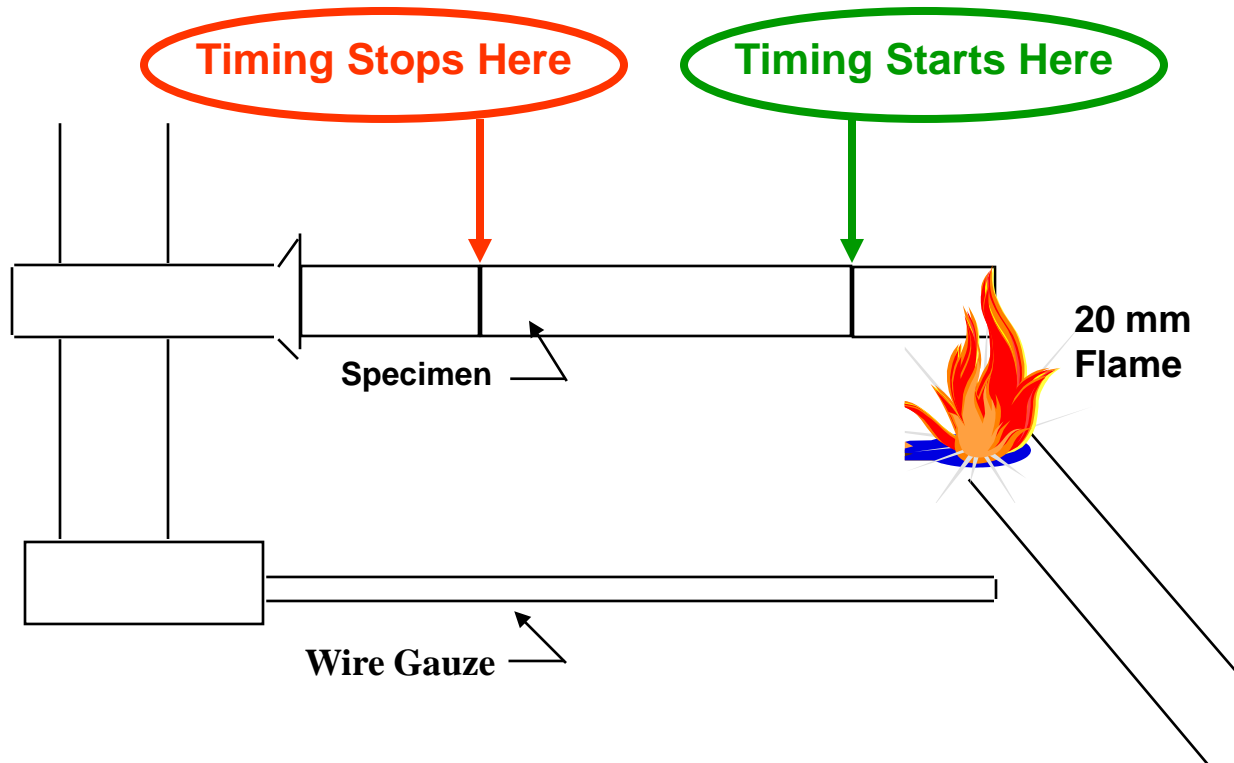
Confirmatory Test

- ASTM D5207 / IEC 60695-11-3, -4
- Verification flame/heat



Horizontal Burning Test – HB Flame Class

- Most Flammable
- Known As “Slow-Burning” Materials
- Generally Polymeric With No Flame-Retardant Added
- Test Measures Burning Rate



Horizontal Burning Test; HB



Horizontal Flame Class

<u>Thickness</u>	<u>Burning Rate</u>
< 3.0	≤ 75 mm/min max
≥ 3.0	≤ 40 mm/min max

- Flammability Extension: Testing at 3.0 mm may be extended down to 1.5 mm without further testing
- ***Not allowed for CAN/CSA C22.2 No. 0.17 (permitted under ISO/IEC)***
- IEC: HB, HB40 and HB75



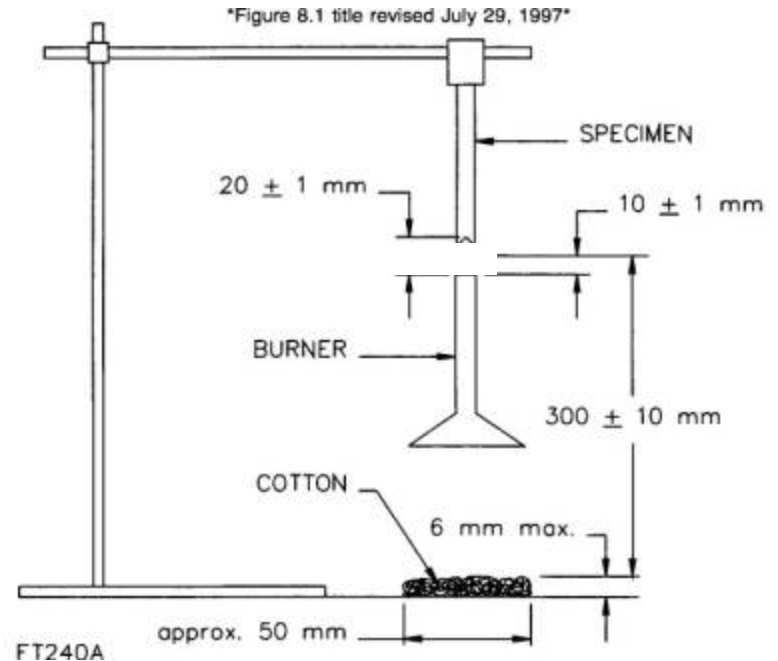
V FLAME CLASSES

- Vertical Burning
- Less Flammable
- Known As “Self-Extinguishing” Materials
- Generally Have Flame-Retardant Added
- A Measure of the Material’s Ability to Extinguish Itself Once Removed From the Source of Ignition



20mm Vertical Burning Test; V-0,V-1,V-2

- Same flame as HB
- Vertically oriented sample
- Cotton indicator @ 300 mm
- 2 - ten second flame applications
- Observe
 - flame/glow time
 - cotton indicator
 - extent of burn



Vertical Flame Classification

Applies to both:

- as-received ($23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ RH)
- oven conditioned ($70 \pm 2^\circ\text{C}$)

	V-0	V-1	V-2
Burning to the Holding Clamp	No	No	No
Indv. Flame Time (t_1 or t_2)	\leq 10 sec.	\leq 30 sec.	\leq 30 sec.
Total Flame Time (t_1 and t_2) Set of 5 Specimens	\leq 50 sec.	\leq 250 sec.	\leq 250 sec.
Glowing Time	\leq 30 sec.	\leq 60 sec.	\leq 60 sec.
Cotton Ignition	No	No	Yes

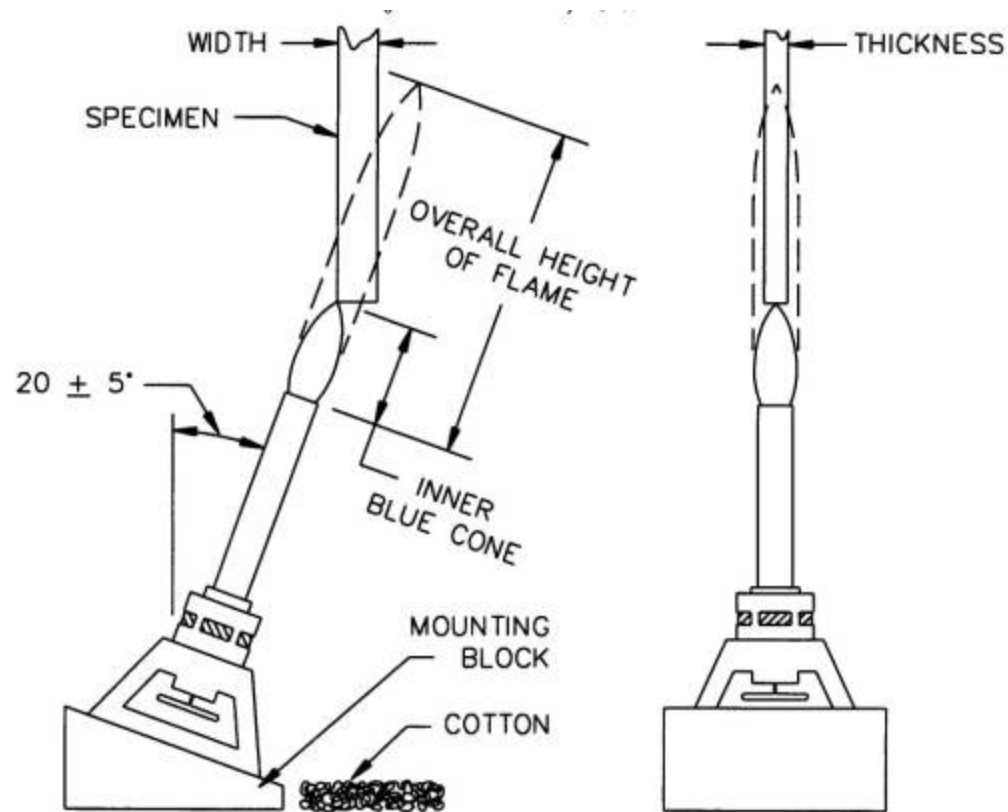


20 mm Vertical Flame



125 mm Vertical Burning Test; 5VA, 5VB

- 5 flame applications (5 on, 5 off)
- Observe flame/glow and cotton indicator

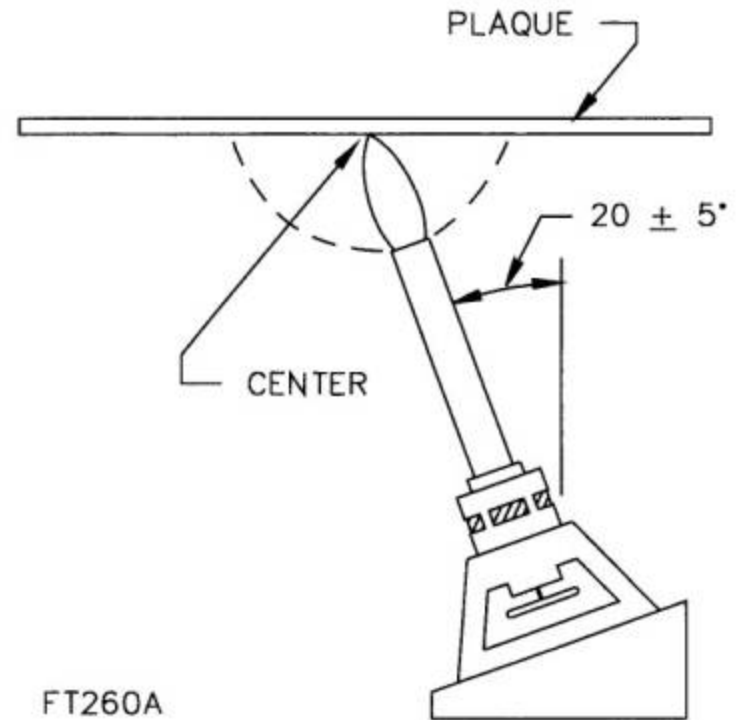


125 mm Vertical Burning



125mm Vertical Burning Test: plaques

- 150 (± 5) x 150 (± 5) mm x minimum thickness plaques
- 5 flame applications (5 on, 5 off)
- Observe hole formation



125 mm Vertical Flame



5V Flame Classification (Bars)

Max. Flame Time (after 5th flame application)	60 Seconds
Max. Glow Time (after 5th flame application)	60 Seconds
Cotton Ignition	No

Material Must be V-1 or V-0



5V Flame Classification (Plaques)

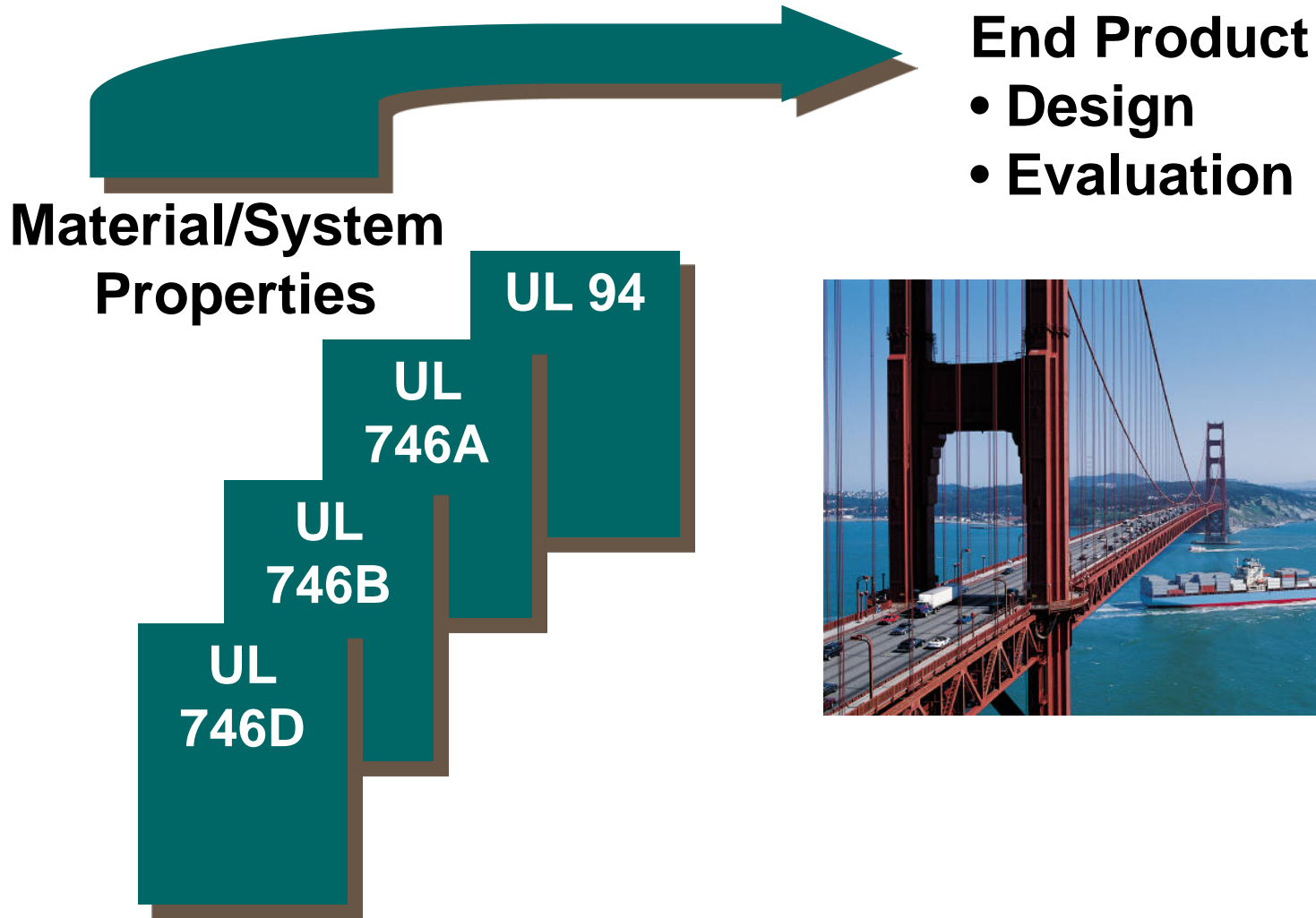
- 5VA - No holes with diameter greater than 3 mm in plaque
- 5VB - Hole opened in plaque



End Product – Flammability



The UL 746C Bridge



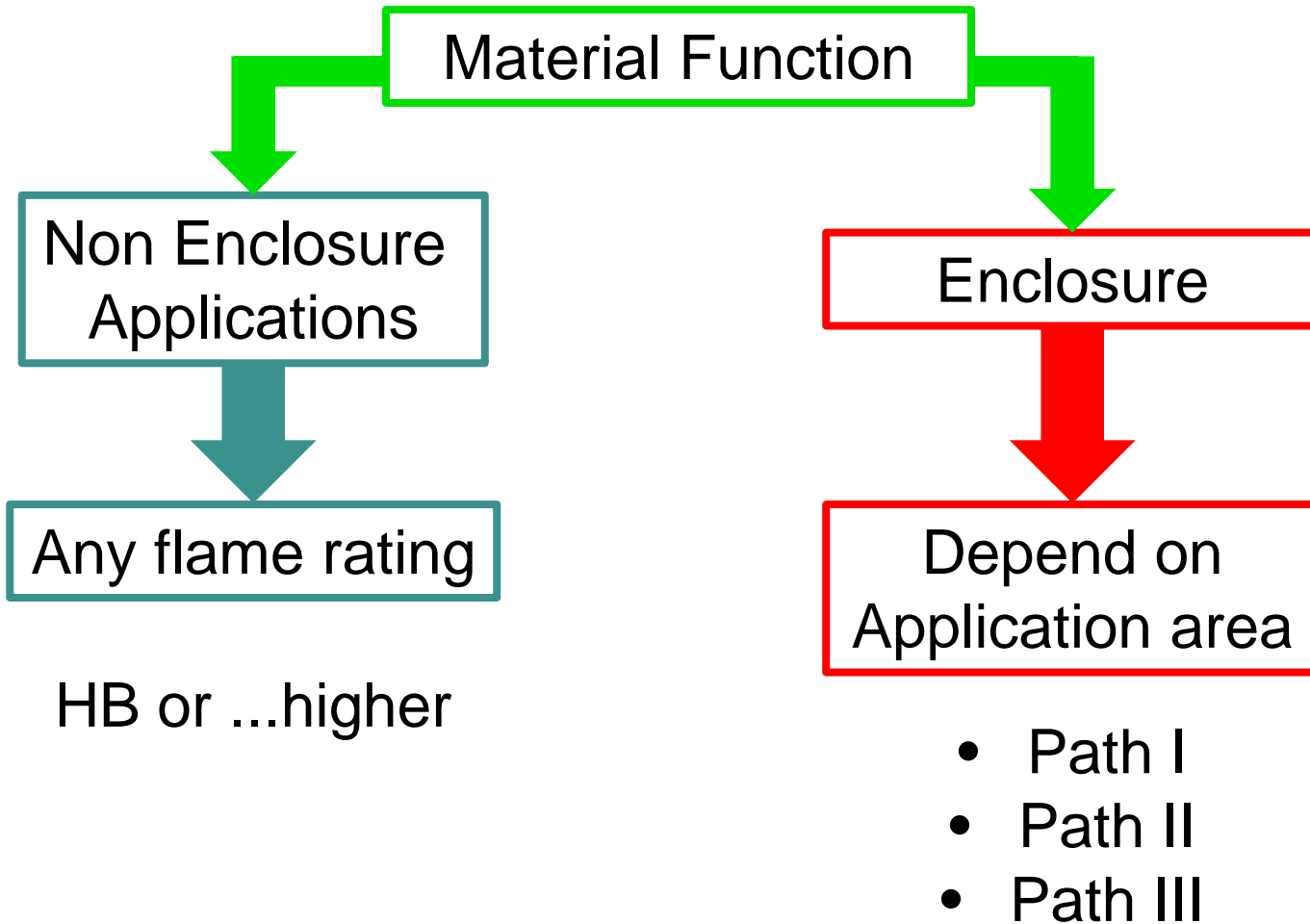
Definition – Risk of Fire (UL 746C Par 3.34)

- A risk of fire is considered to exist at any two points in a circuit where:
 - 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
- A power of more than 15 watts can be delivered into an external resistor connected between the two points.

NOTE: UL 746 C should be considered a guideline where actual end use conditions are considered



End product flammability requirements UL 746C



Enclosure Minimum Flame Rating: UL 746C table 4.1

Path	I	II	III
Application Area	Portable Attended Household Equipment	All other Portable Equipment ^k	All other Equipment
Applicable requirements shown below			
Minimum Flammability Rating	HB ^{a,d}	V ^{b,d}	5VA ^{c,d}

^a HB or has a GWIT as described in 3.20 of at least 575°C or a GWFI as described in 3.21 of at least 550°C, or the enclosure complies with the 12 mm or 20 mm end-product flame tests as described in Section 15 and 16 respectively.

^b V=V-0, V-1 or V-2 classed materials, or the enclosure complies with the 12 mm or 20 mm end-product flame tests as described in Section 15 and 16 respectively. Exception: A polymeric enclosure material classified HB may be used in portable unattended household equipment that complies with the criteria specified in Section 5.

^c 5VA or the enclosure complies with the 127 mm end-product flame tests as described in Section 17.

^d May require flame spread per Section 19.



Enclosure Minimum Flame Rating: UL 746C table 4.1

Path	I	II	III
Application Area	Portable Attended Household Equipment	All other Portable Equipment ^k	All other Equipment
Applicable requirements shown below			
Minimum Flammability Rating	HB ^{a,d}	V ^{b,d}	5VA ^{c,d}

End product:
12 or 20 mm
flame test



Enclosure Minimum Flame Rating: UL 746C table 4.1

Path	I	II	III
Application Area	Portable Attended Household Equipment	All other Portable Equipment ^k	All other Equipment
Applicable requirements shown below			
Minimum Flammability Rating	HB ^{a,d}	V ^{b,d}	5VA ^{c,d}



End product:
12 or 20 mm
flame test



Enclosure Minimum Flame Rating: UL 746C table 4.1

Path	I	II	III
Application Area	Portable Attended Household Equipment	All other Portable Equipment ^k	All other Equipment
Applicable requirements shown below			
Minimum Flammability Rating	HB ^{a,d}	V ^{b,d}	5VA ^{c,d}



End product:
125 mm
flame test

NOTE: large areas may
require also Radiant Panel



Path I and II end product flame

20 mm (3/4 inch)

vs

12 mm Flame

- Methane Based Flame
 - Same flame as HB and V
- Butane Based “Needle” Flame (IEC 60695-11-5)
 - Heat Content of Butane is three times that of Methane
 - Smaller flame but heat source is concentrated
 - Flame resembles burning of a small component in the proximity of the material
- Flame is applied to area most likely to become in contact with a fire
 - Two 30 second flame applications
 - Observe flame time (< 60 seconds)



Flammability - 127 mm (5 inch) –Flame (Par 17)



- Methane Based Flame (same as 500 W)
- Flame is applied to area most likely to become in contact with a fire
- Test is less severe on end-product sample than on bar specimen

Thank you for your attention.

