

## 2. Test methods – Standards

### The glow wire test to IEC 60695-2, EN 60695-2, VDE 0471-2

The glow wire test to IEC 60695-2-11 is used to test electrical products, assemblies or individual components. The glow wire temperature (Fig. 2) is determined by the Electrical Equipment Committee as a function of the type of risk arising when the product is used. During the test, a note is made of the burning time  $t_b$  (s) after an application time of 30 s, and the dropping of burning or glowing particles of the specimen. The test is considered passed if a) the specimen does not constitute an ignition risk to the environment and b) any flames or glowing on the test specimen extinguish not later than 30 seconds after removal of the ignition source.

The glow wire test to IEC 60695-2-12 can also be used to test simple material specimens – e.g. discs. The test determines the glow wire flammability index (GWFI), this being the highest temperature at which flaming or glowing of the specimen extinguishes within 30 seconds of the removal of the glow wire coil, without burning or glowing particles dropping onto and igniting the material situated below the specimen. In another version of this test (the glow wire test to IEC 60695-2-13), the ignitability of different materials can be compared. The glow wire ignitability temperature (GWIT) determined here is 25 K higher than the highest temperature (glow wire temperature) that does not lead to ignition (flaming combustion time > 5 s) in three successive tests (Fig. 3).

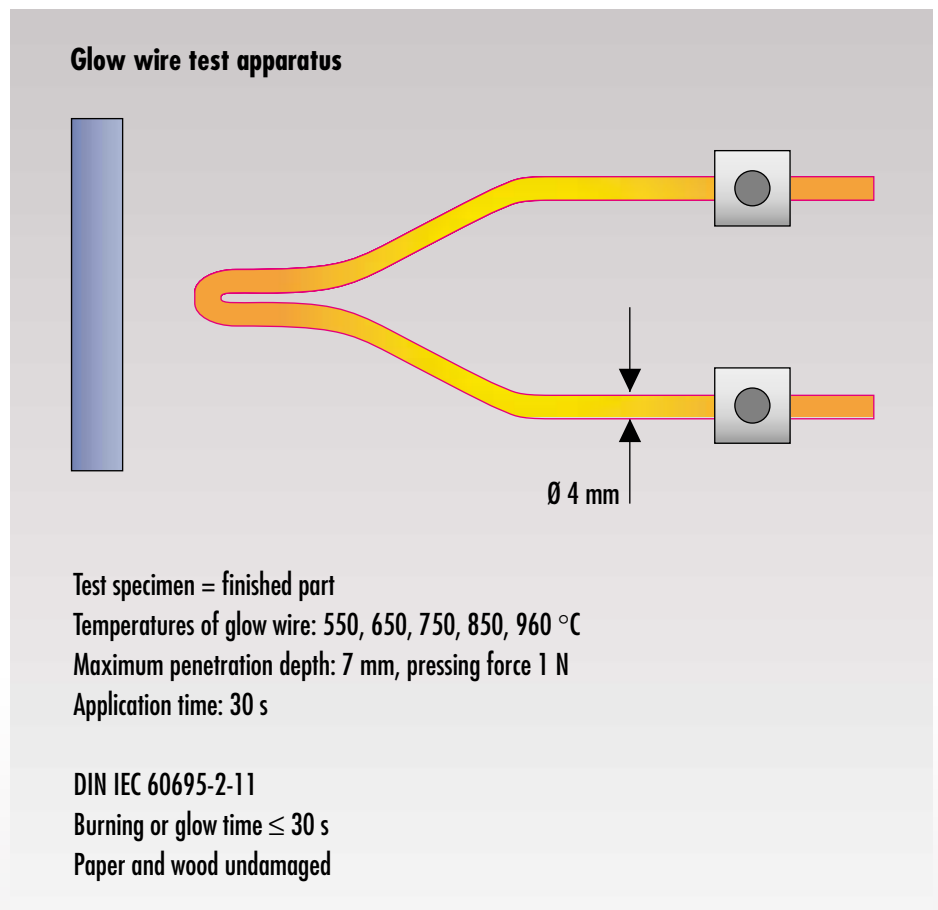


Fig. 2

### Fire safety tests using the glow wire test apparatus

	IEC 60695-2-11 glow wire test	IEC 60695-2-12 GWFI	IEC 60695-2-13 GWIT
Specimen	Electrical product	Sheet Minimum dimensions: 60 mm x 60 mm Preferred thicknesses: 0.75, 1.5, 3.0 mm	
Conditioning	24 h 15 °C ≤ T ≤ 35 °C 45% ≤ RH ≤ 75%	48 h at 23 °C ± 2 °C 45% ≤ RH ≤ 75%	
Temperatures of glow wire (°C)	550, 650, 750, 850, 960	550, 600, 650, 700, 750, 800 850, 900, 960	
Pressing force	1.0 N ± 0.2 N	1.0 N ± 0.2 N	
Application time	30 s ± 0.1 s	30 s ± 0.1 s	
Rate of approach and withdrawal	10 mm/s ≤ v ≤ 25 mm/s	10 mm/s ≤ v ≤ 25 mm/s	
Number of specimens	1	3 in succession	

Fig. 3

**Needle flame test to IEC 60695-2-2, EN 60695-2-2, VDE 0471 Part 2-2**

The ignition source is a butane gas flame produced by a needle burner. The needle flame is used to simulate ignition sources that can occur on tracking paths as a result of electrical faults in insulating components. The flame is applied to the edge or surface of the specimen for 5, 10, 20, 30, 60 or 120 seconds, after which the burning length and the burning time (which must not exceed 30 seconds) are noted.

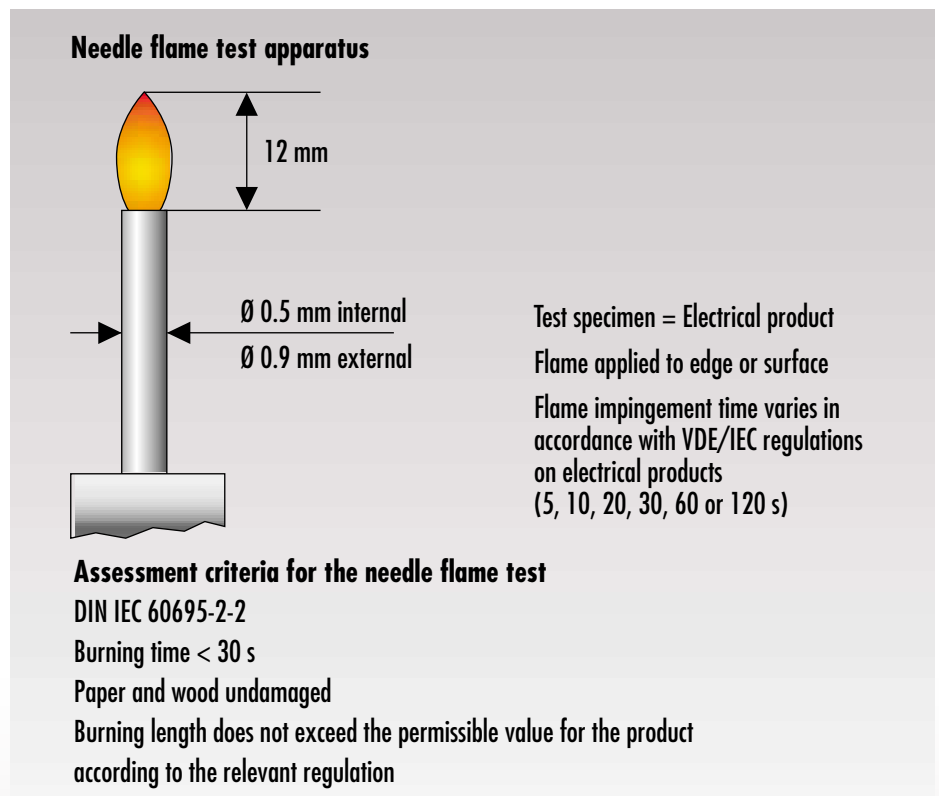


Fig. 4

**Test using larger flames in accordance with IEC 60695-11-10, Method A; EN 60695-11-10, Method A, VDE 0471 Part 11-10, Method A and UL 94 or CSA 22.2 No. 0.6 Part E Horizontal Burning Test**

The specimen is placed horizontally and exposed to a Bunsen burner flame ( $h = 20$  mm) for 30 seconds. Any ignition or burning is noted. In accordance with IEC 60695-11-10, EN 60695-11-10, and VDE 0471 Part 11-10 (Method A in each case), a classification is awarded on the basis of the burning rate of specimens up to 13 mm thick as follows:

HB 40: Burning must cease before the 100 mm mark is reached or  $v \leq 40$  mm/min

HB75:  $v \leq 75$  mm/min

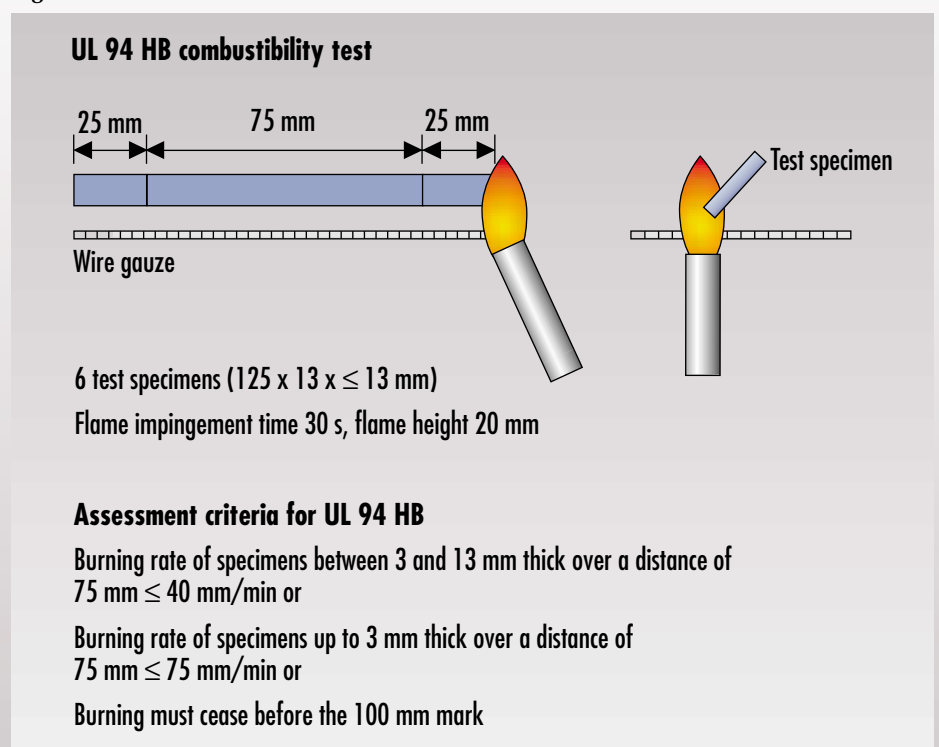


Fig. 5

**Test using larger flames in accordance with IEC 60695-11-10, Method B; EN 60695-11-10, Method B; VDE 0471 Part 11-10, Method B and UL 94 or CSA 22.2 Vertical Burning Test**

In this test the specimen is placed vertically and exposed to a Bunsen burner flame ( $h = 20 \pm 1$  mm) for two periods of 10 seconds. The assessment criteria are burning time, total burning time and the dropping of burning particles.

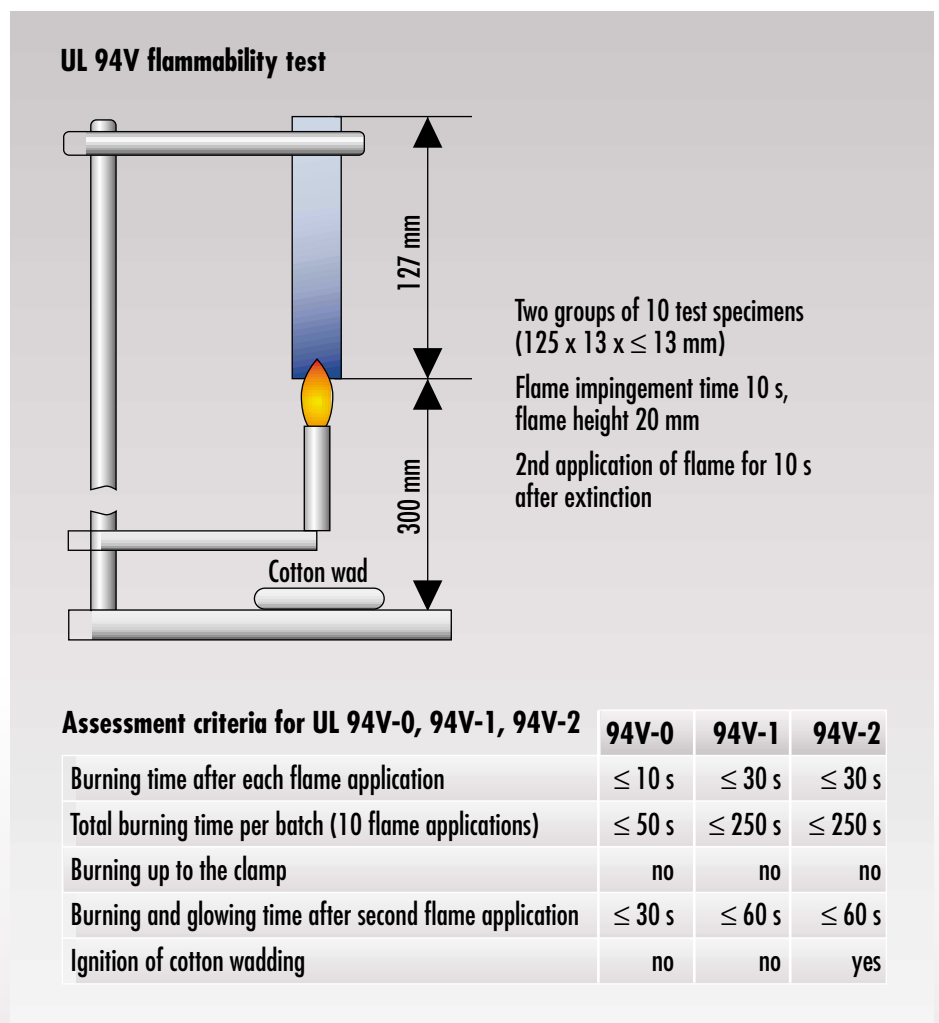


Fig. 6

**Example:**

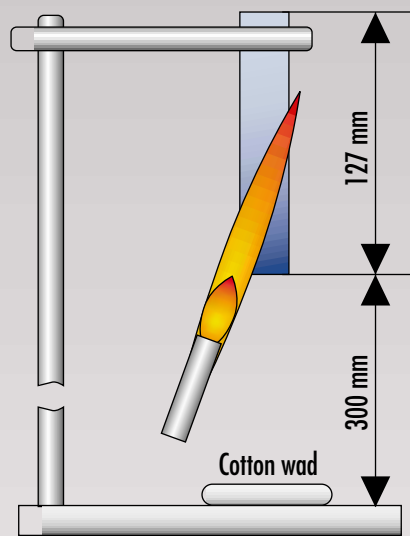
**Fire behavior of Makrolon® according to UL:**

Basic grades of Makrolon® comply with the requirements of UL (Underwriters Laboratories Inc., USA) Subj. 94V-2 (depending on wall thickness). Certain flame-retarded grades achieve V-0 at 0.8 and 1.6 mm thickness. Glass fiber reinforced products achieve V-1, or V-0 if flame-retarded. Flame-retarded grades of Makrolon® present no problems during processing.

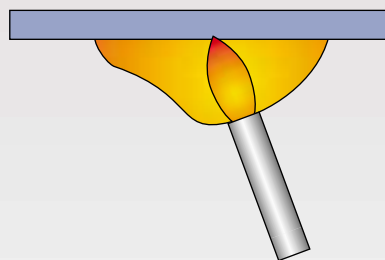
**Test using larger flames in accordance with IEC 60695-11-20; EN 60695-11-20; VDE 0471 Part 11-20, UL 94, Test Method 94-5 V and CSA 22.2 No. 0.6 Test c – Vertical Burning Test**

The specimen is positioned vertically and a Bunsen burner flame (125 mm/40 mm) is applied to its bottom edge five times for 5 seconds with 5 second intervals between each application. In a variant of this method, plaques are tested in a horizontal position, with the flame being applied to the underside of the specimens. A note is made of whether the specimens continue to burn and whether there is any dripping of burning particles. Burning time must not exceed 60 seconds, and there must be no dripping from the specimen after the ignition source is removed for the fifth time. The specimen must not burn away completely.

**UL 94-5V flammability test**



Flame applied to **bars**  
at an angle of 20°  
20 bars (125 x 13 x ≤ 13 mm)  
Flame height 125 mm  
5 applications of 5 seconds duration  
with 5-second intervals



Flame applied to **plaques**  
at an angle of 20°  
12 plaques (150 x 150 x ≤ 13 mm)  
Flame height 125 mm  
5 applications of 5 seconds duration  
with 5-second intervals

**Assessment criteria for UL 94-5VA, 94-5VB**

	94-5VA	94-5VB
Burning and glowing time after 5th flame application (bar)	≤ 60 s	≤ 60 s
Ignition of cotton wadding	no	no
Specimen (plaque) exhibits burn-through (hole)	no	yes

Fig. 7