



# Test Procedures of the Behaviour of Cables in Case of Fire

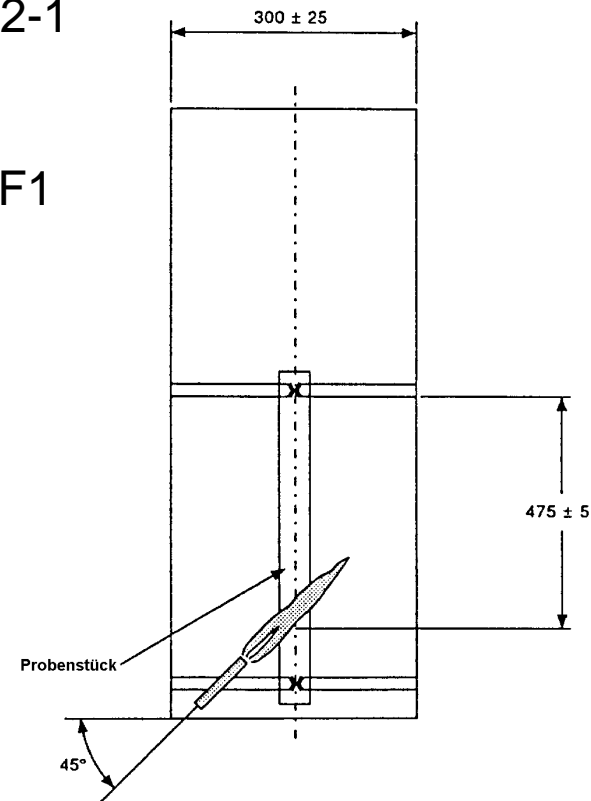


## Test of the fire behaviour on a single core or a single cable (Flame retardancy)

- comparable test procedures:**
- DIN VDE 0482-265-2-1
  - EN 50265-1
  - IEC 60332-1
  - NBN C 30-004 Kat. F1

Time for flame application:

Overall diameter of test piece (mm)	Time for flame application (s)
$D \leq 25$	60
$25 < D \leq 50$	120
$50 < D \leq 75$	240
$D > 75$	480



The wire or cable *shall pass the test*, if the distance between the lower edge of the top support and the onset of charring is greater than 50 mm. All soot is to be ignored. Softening or any deformation of the non-metallic is also to be ignored.

## Test of the fire behaviour on bunched cables (Reduced flame propagation)

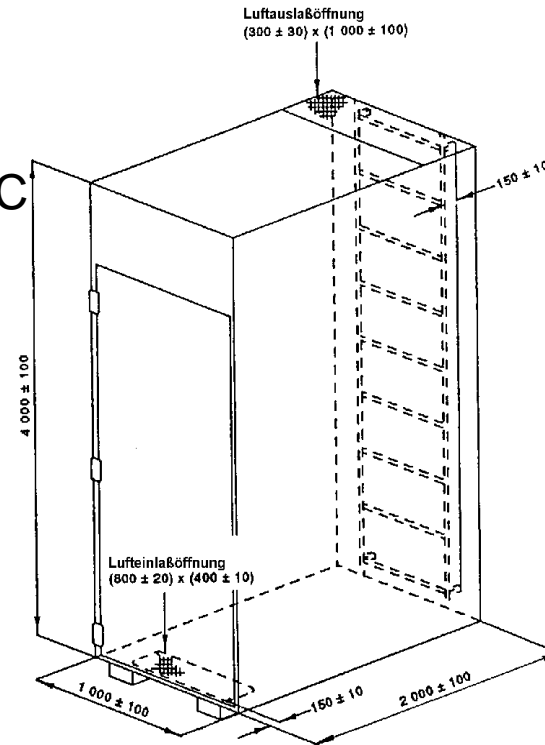
comparable  
test  
procedures:

- DIN VDE 0472-804, test procedure C
- prEN 50266
- IEEE 383 (approximate)
- IEC 60332-3 , cat. A, B or C
- NBN C 30-004 cat. F2

Samples / Time for flame application:  
No. of the samples (each 3.5 m long) is  
calculated as follows:

- cat. A: 7 l / m, Time > 40 Min.
- cat. B: 3.5 l / m, Time > 40 Min.
- cat. C: 1.5 l / m, Time > 20 Min.

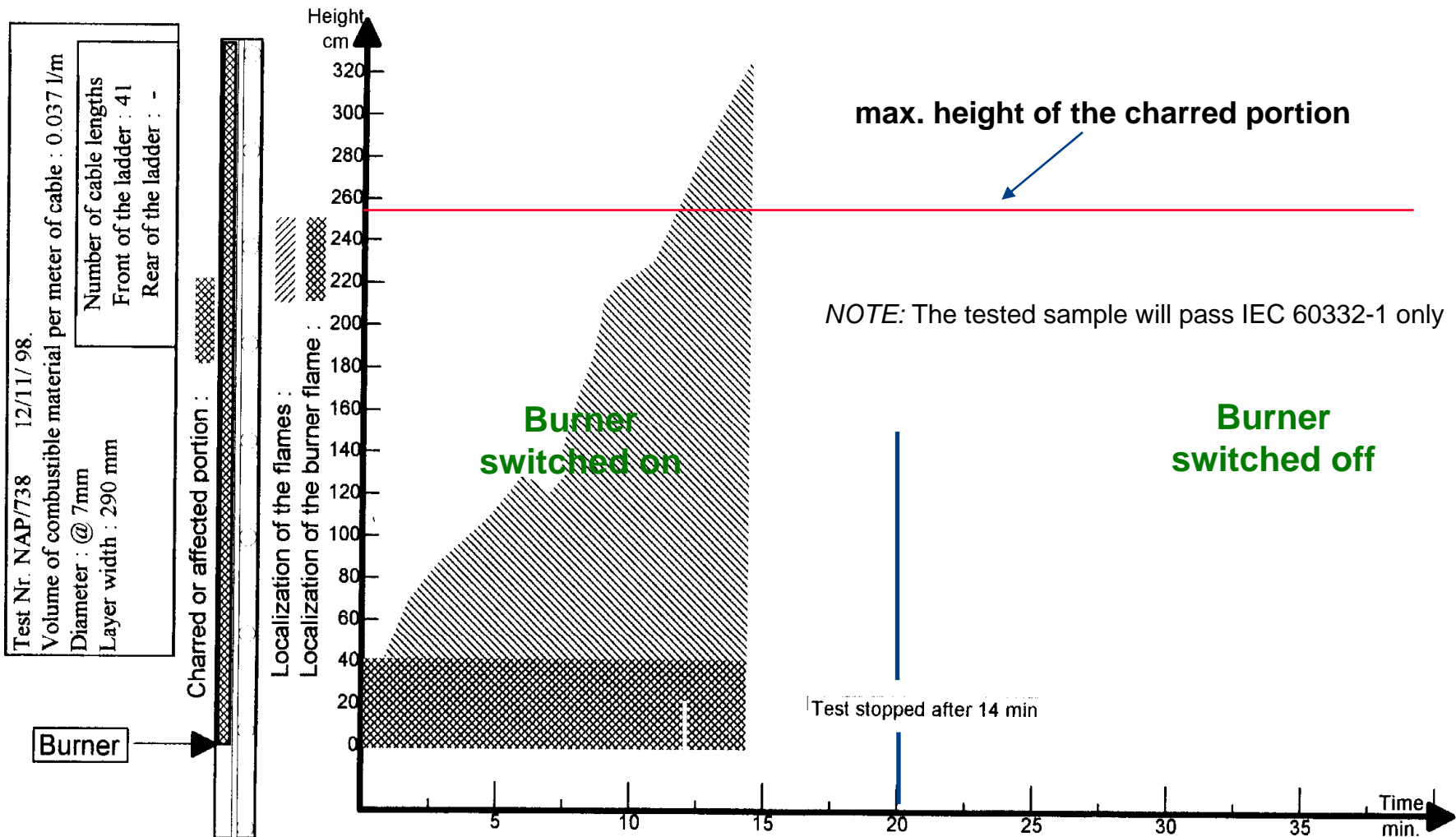
(Total volume of non-metal material in ...litre / meter)



The cable *shall pass the test*, if the created flames are self-extinguishing and the maximum extent of the charred portion measured on the sample shall not have reached a height exceeding 2.5 m above the bottom edge of the burner. All soot is to be ignored if, when wiped off, the original surface is undamaged. Softening or any deformation of the non-metallic is also to be ignored.

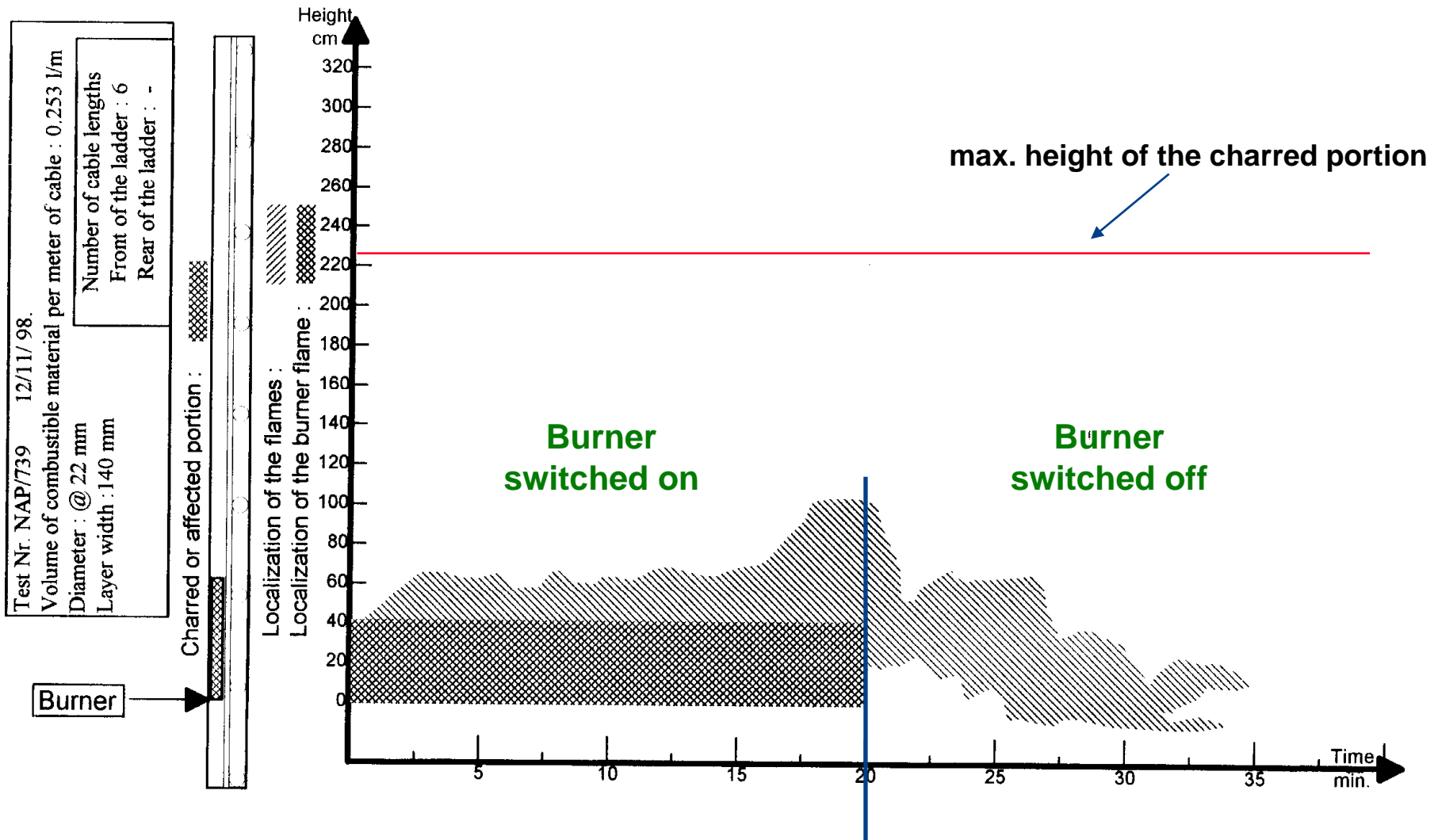
## Test diagram of an unsuccessful flame test

## IEC 60332-3, Cat. C



## Test diagram of a successful flame test

## IEC 60332-3, Cat. C



## General

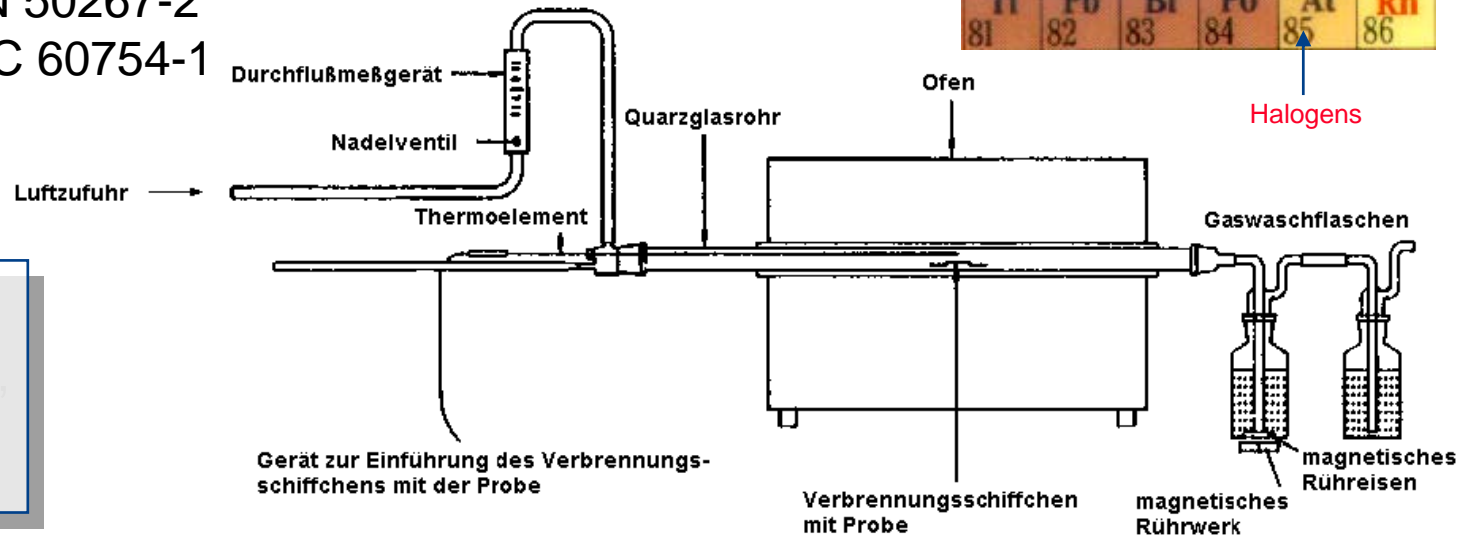
- In case of burning of conventional plastic-cables, e.g. with PVC insulation and sheath, huge quantities of corrosive and toxic gases will be generated.
- Considerable damage of persons (respiratory tract, poisoning) and real values (corrosion) is not to rule out.
- The object must be, to minimize the damage and the resulting costs of a fire.

## Determination of the amount of halogen acid gas (HCL-Emission)

- Halogen acid gas contains mainly following elements: fluorine, chlorine, bromine or iodine.
- Determination of the amount of halogen acid evolved during the combustion of each combustible material of a cable.
- For materials, which contain less than 5 mg/g (0,5 %) of halogen acid, the test procedure acc. to IEC 60754-2 is recommended.

Hauptgruppen					
III	IV	V	VI	VII	VIII
					4,0 He 2
10,8 B 5	12,0 C 6	14,0 N 7	16,0 O 8	19,0 F 9	20,2 Ne 10
27,0 Al 13	28,1 Si 14	31,0 P 15	32,1 S 16	35,5 Cl 17	39,9 Ar 18
69,7 Ga 31	72,6 Ge 32	74,9 As 33	79,0 Se 34	79,9 Br 35	83,8 Kr 36
114,8 In 49	118,7 Sn 50	121,8 Sb 51	127,6 Te 52	126,9 I 53	131,3 Xe 54
204,4 Tl 81	207,2 Pb 82	209,0 Bi 83	(209) Po 84	(210) At 85	(222) Rn 86

- comparable test procedures:**
- DIN VDE 0482-267-2-1
  - EN 50267-2
  - IEC 60754-1



**Note:**  
This test doesn't show, whether a material is zero halogen or not.

## Determination of degree of acidity of gases (zero halogen)

- Halogen acid gas contains mainly following elements: fluorine, chlorine, bromine or iodine.
- Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring the pH-value and conductivity

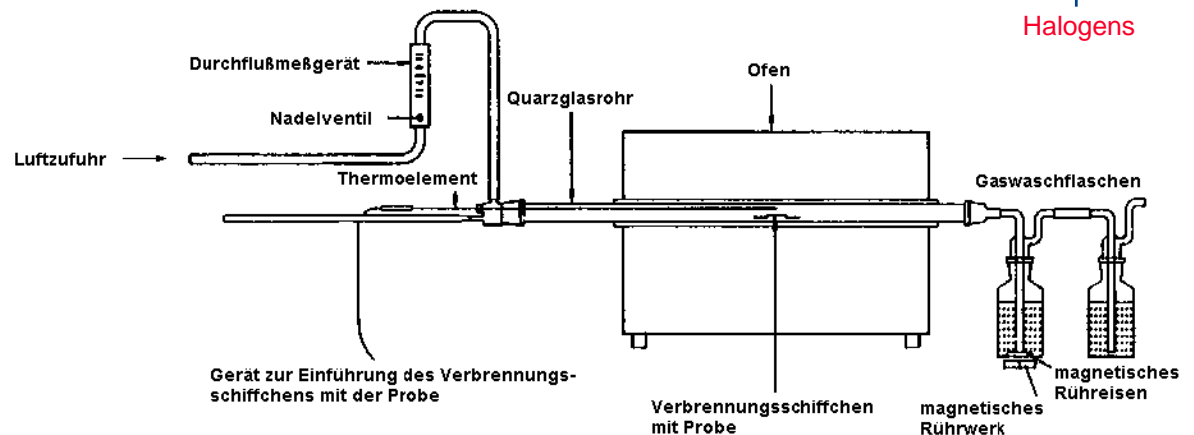
- Limit values (depending on standards):

	pH-value
DIN VDE 0276-604:	$\geq 4.3$
IEC 60754-2 (recommended):	$\geq 4.3$

	conductivity
	$\leq 100 \mu\text{S/cm}$
	$\leq 100 \mu\text{S/cm}$

		Hauptgruppen				
III	IV	V	VI	VII	VIII	
					4,0 He	
10,8 B	12,0 C	14,0 N	16,0 O	19,0 F	20,2 Ne	
5	6	7	8	9	10	
27,0 Al	28,1 Si	31,0 P	32,1 S	35,5 Cl	39,9 Ar	
13	14	15	16	17	18	
69,7 Ga	72,6 Ge	74,9 As	79,0 Se	79,9 Br	83,8 Kr	
31	32	33	34	35	36	
114,8 In	118,7 Sn	121,8 Sb	127,6 Te	126,9 I	131,3 Xe	
49	50	51	52	53	54	
204,4 Tl	207,2 Pb	209,0 Bi	(209) Po	(210) At	(222) Rn	
81	82	83	84	85	86	

↑  
Halogens



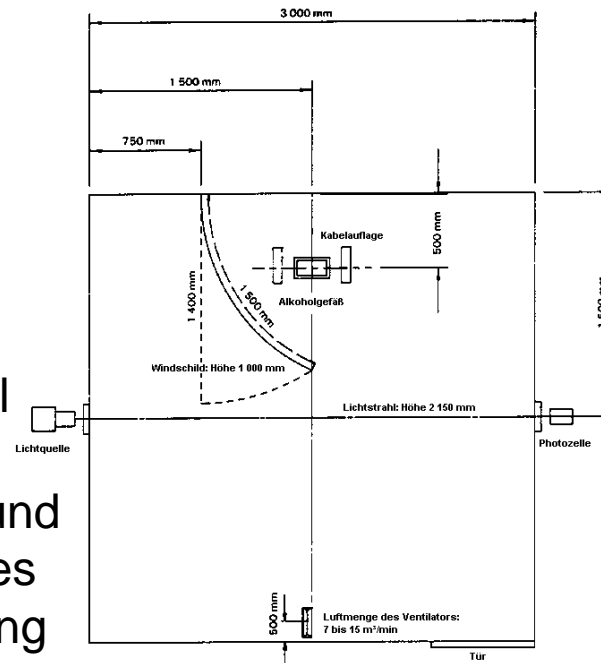


## Measurement of smoke density of cables burning under defined conditions (smoke density)

### comparable test procedures:

- DIN VDE 0482-286-1 und -2
- prEN 50268-1 und -2
- IEC 61034-1 und -2

The tray containing the alcohol shall be supported above the ground surface to permit air circulation around and beneath the tray. The test pieces (cables or bundles) shall be laid touching in a horizontal position and centred above the tray. The air circulation will be started and the alcohol (1 litre) will be ignited. The light intensity will be measured between the light source and the photocell. The test is considered as ended when there is no decrease in light transmittance for 5 minutes after the fire source has extinguished or when the test duration reaches 40 minutes. *The test will be passed, if the recorded light transmittance is min. 60% that means the smoke density has a value of max. 40%.*

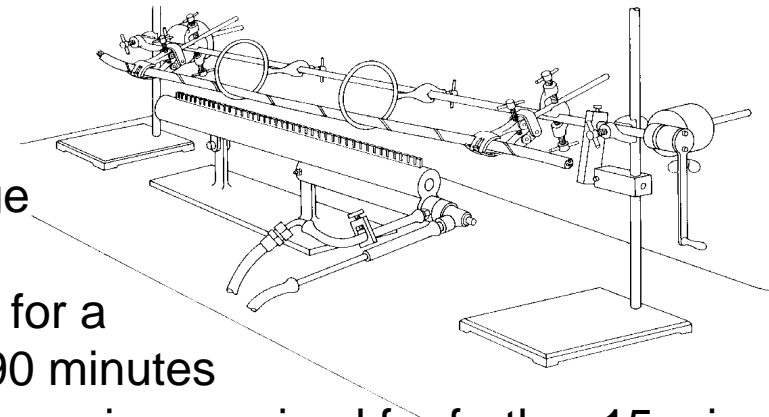


## Tests for electric cables under fire conditions - Circuit integrity

comparable test procedures / test duration / test temperature / additional influences

- DIN VDE 0472-814: 1.5 h, 750 °C
- DIN 4102-12: 30 / 60 / 90 min., var. (ETK)
- NBN C 30-004, "F3" 1.5 h, 850 - 950 °C
- IEC 60331-21: 1.5 h, 750 °C

BS 6387:	Test Temp.	only Fire for (..hours)	with Water	with mech. Shock
	650 °C	(3 hours) A	W	X
	750 °C	(3 hours) B	W	Y
	950 °C	(3 hours) C	W	Z
	950 °C	(20 min.) S	W	Z



Conductors are connected to a separate phase of a transformer output with a 2 A fuse with the nominal voltage  $U_0/U$ . Where metallic sheath, armour or screen acts as a neutral or protective conductor, it shall be connected as for a neutral or protective conductor. After the test duration of 90 minutes the burner will be switched off but the cable sample shall remain energised for further 15 min. The total test duration shall be the flame application time together with the 15 min cooling period. The **test will be passed** if during the course of the test no fuse fails and a conductor does not rupture, i.e. the lamp is not extinguished.

## Measurement of smoke density of cables burning under defined conditions

### (Flammability Temperature)

#### **Definition:**

The flammability temperature (FT) is the temperature at which combustion of a material / plastic / compound is just supported in air under specified test conditions.

## Measuring the minimum oxygen concentration to support candle-like combustion of plastics

### (Oxygen Index (LOI) )

#### Definition:

The oxygen index describes the minimum concentration of oxygen, expressed as volume percentage, in a mixture of oxygen and nitrogen that will just support combustion of a material / plastic / compound initially at room temperature under specified test conditions.

**For information:** LOI  $\leq$  23 combustible  
24....28 conditional flame retardant  
29....35 flame retardant  
 $\geq$  36 „extra“ flame retardant