

REGULATIONS AND STANDARDS
IN EUROPE

1.2 Federal Republic of Germany

In the Federal Republic of Germany the regulations relating to building inspection are derived from the Model Building Code (Musterbauordnung or MBO) which forms the basis of all the State Building Codes (Landesbauordnungen or LBO).

The building inspectorate is responsible for averting hazards which threaten the life, health and property of the individual. It is backed by a comprehensive range of legislation, directives and standards.

The classification of and the fire test methods for building materials summarised in Table 1 are described in the German Standard DIN 4102, which is divided in several parts.

Table 1. DIN 4102 classification and test methods for building materials

Building material class	Building inspection designation	Test method
A	non-combustible	
A1*		- furnace test 750 °C
A2		- Brandschacht
		- smoke density to ASTM D 2843-70 DIN E 53436/37
		- toxicity to DIN 53436
		- calorific potential to DIN 51900 Part 2 and heat release to DIN 4102 Part 8
		furnace test 750 °C
B	combustible	
B1**	low flammability	- Brandschacht and small burner test
		- special case of floor coverings, radiant panel test (NBSIR 75-950)
B2	moderately flammable	- small burner test
B3	highly flammable	- special case of floor coverings (DIN 54332)
		- no tests

* Class A2 requirements must also be satisfied.
** Class B2 requirements must also be satisfied.

1.0 BUILDING

1.1 Introduction

In Europe, regulations and fire tests are on their way to be harmonized by the European Community and the Nordic Countries. In the following, the regulations, materials classification and fire tests are summarized for the most important EEC countries Federal Republic of Germany (FRG), France and Great Britain as well as for the Nordic Countries.

The situation for the harmonization of building products fire safety in the EEC is dealt with in the Construction Products Directive and in CEN/TC 127 "Fire Safety in Buildings", the various proposals for fire testing and classification like the "Interim Period" (EGOLF Proposal), the "Harmonised System" (EUREFIC Proposal) and the "Robust Solution". It appears, that besides the existing national fire tests, the Cone Calorimeter and the Room/Corner Test for testing wall and ceiling linings are gaining in significance.

The Nordic Countries also aim to harmonize their national regulations within the Nordic Committee for building regulations NKB. The fire tests are already harmonized and are described in the Nordtest Methods NT Fire.

Due to the political changes in Eastern Europe, the COMECON Countries are very interested in the developments within the EEC. After German reunification, there is a strong interest from these countries in the German Small Burner (Kleinbrenner) and Brandschacht fire tests.

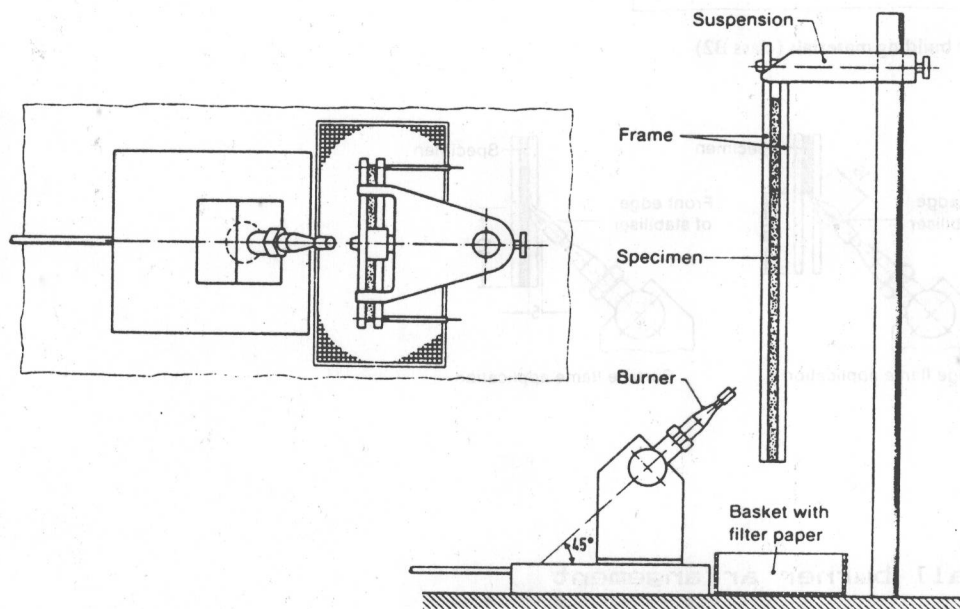
China has introduced the German building fire regulations and fire tests as part of the official Chinese Building Fire Design Regulation.

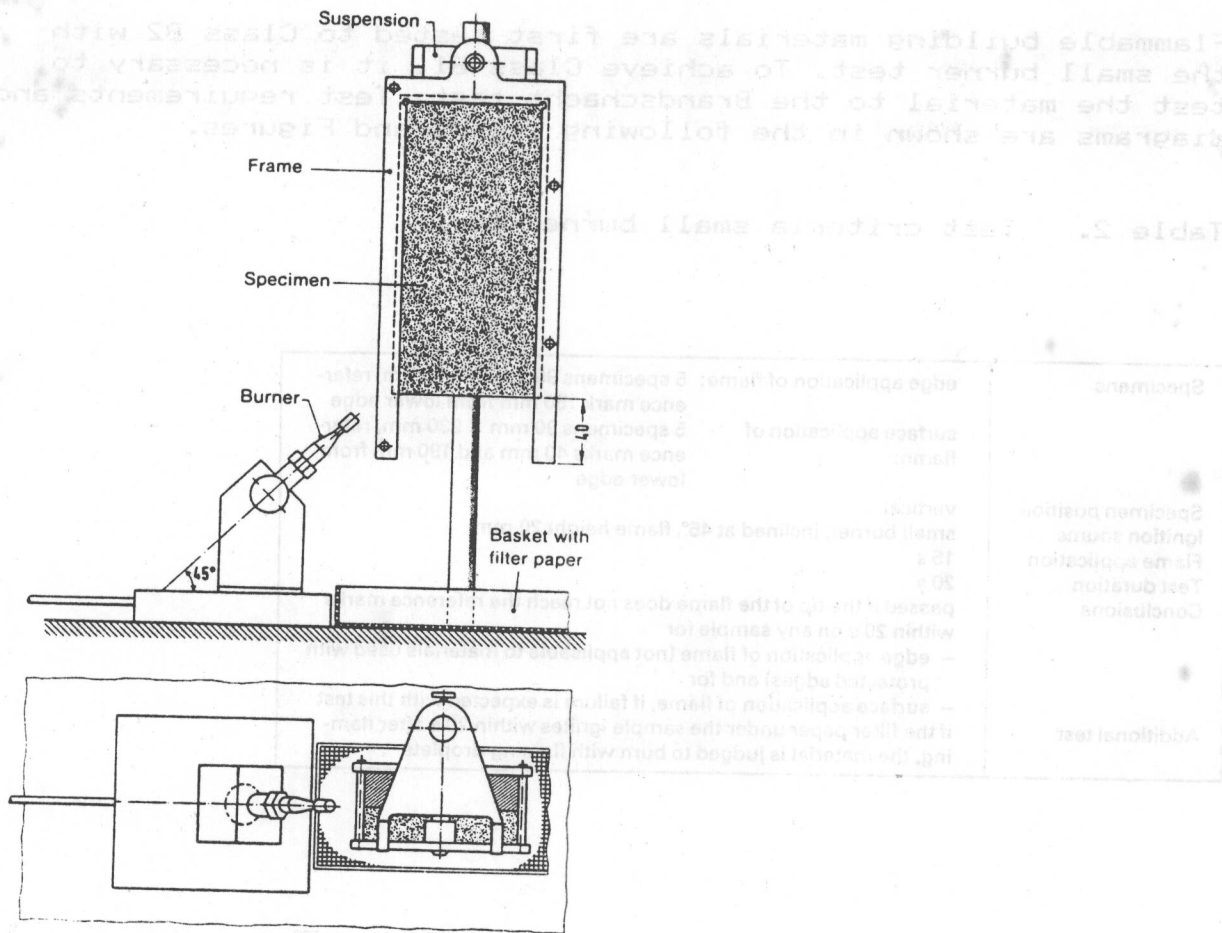
Small Burner and Brandschacht Tests appear therefore to become very important fire tests world-wide and will certainly play a relevant role for building products development in future.

Flammable building materials are first tested to Class B2 with the small burner test. To achieve Class B1, it is necessary to test the material to the Brandschacht test. Test requirements and diagrams are shown in the following Tables and Figures.

Table 2. Test criteria small burner test

Specimens	edge application of flame: 5 specimens 90 mm × 190 mm, reference mark 150 mm from lower edge surface application of flame: 5 specimens 90 mm × 230 mm, reference marks 40 mm and 190 mm from lower edge
Specimen position	vertical
Ignition source	small burner, inclined at 45°, flame height 20 mm
Flame application	15 s
Test duration	20 s
Conclusions	passed if the tip of the flame does not reach the reference marks within 20 s on any sample for – edge application of flame (not applicable to materials used with protected edges) and for – surface application of flame, if failure is expected with this test
Additional test	if the filter paper under the sample ignites within 20 s after flaming, the material is judged to burn with flaming droplets





Set up for testing multilayer building materials (class B2)

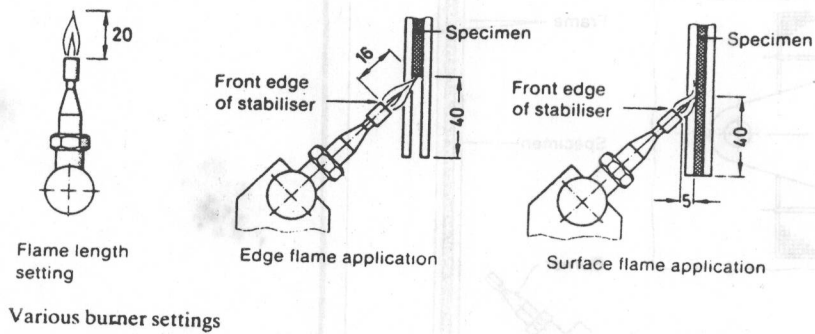


Figure 1. Small burner arrangement

Table 3. Test criteria Brandschacht

Specimens	4 specimens 190 mm × 1000 mm × original thickness (max. 80 mm)
Specimen position	vertical, samples at right angles to one another
Ignition source	ring burner
Test duration	10 min
Conclusions	<p>passed if</p> <ul style="list-style-type: none"> - mean value of residual length is at least 150 mm; residual length must not be 0 mm for any specimen - mean smoke gas temperature should not exceed 200 °C - no other reservations exist

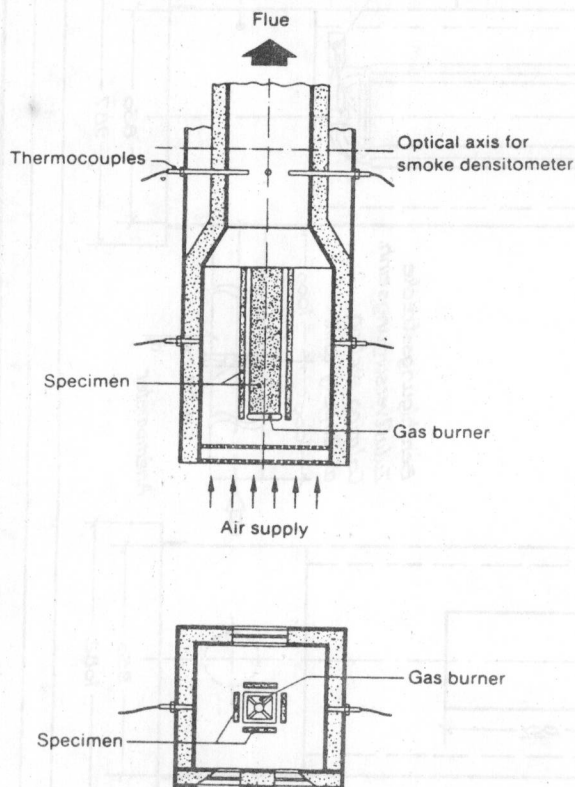
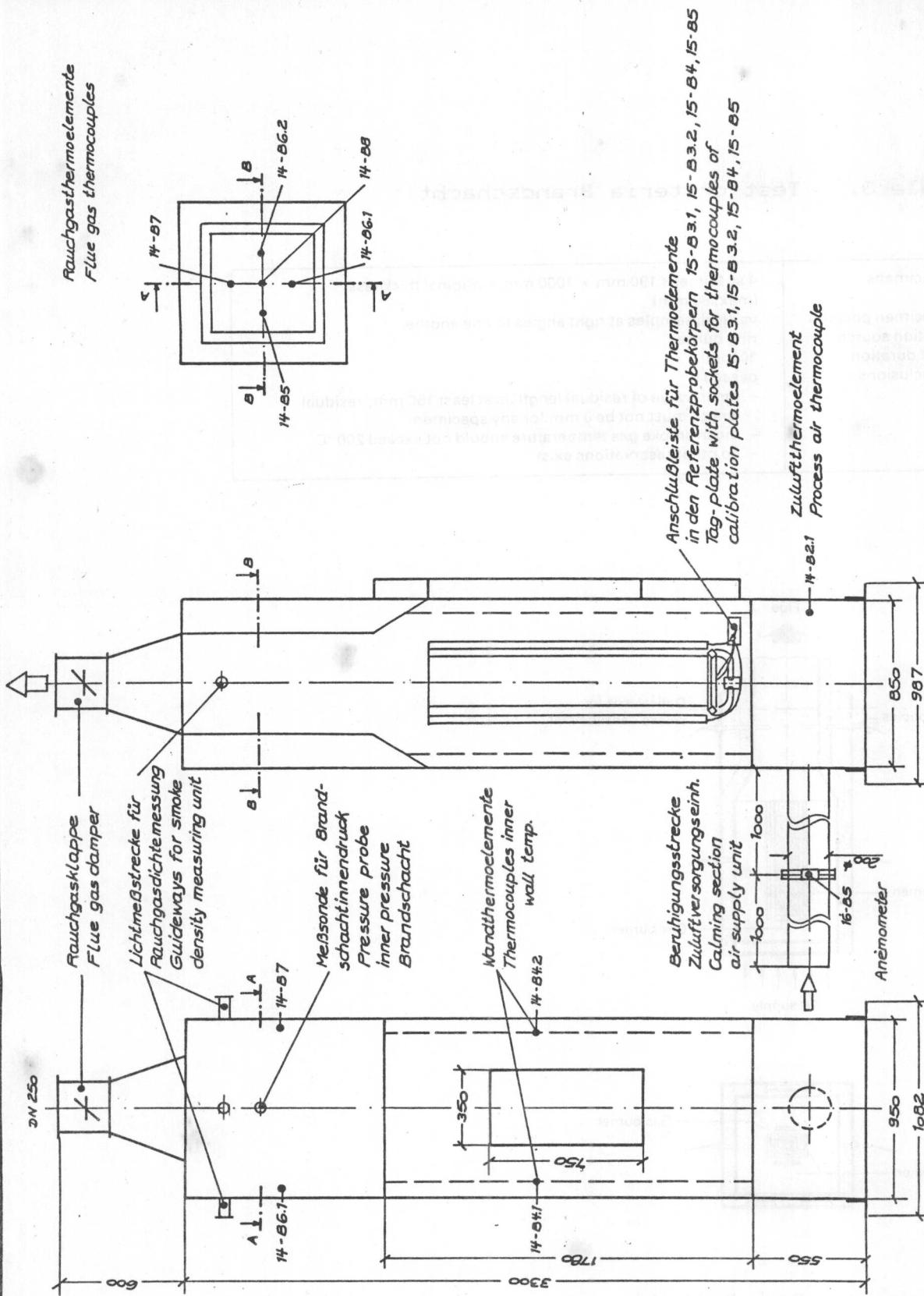


Figure 2. Brandschacht



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Floor-coverings are testing to the American "Flooring-radiant-panel-test" to ASTM E 648. This test was introduced in Germany as DIN 4102 Part 14. A smoke measuring device was added. Floor coverings now only fulfill B1 classification, if they do not exceed a defined smoke density (max. 300 % x min as integral of surface under the smoke density/time curve)*.

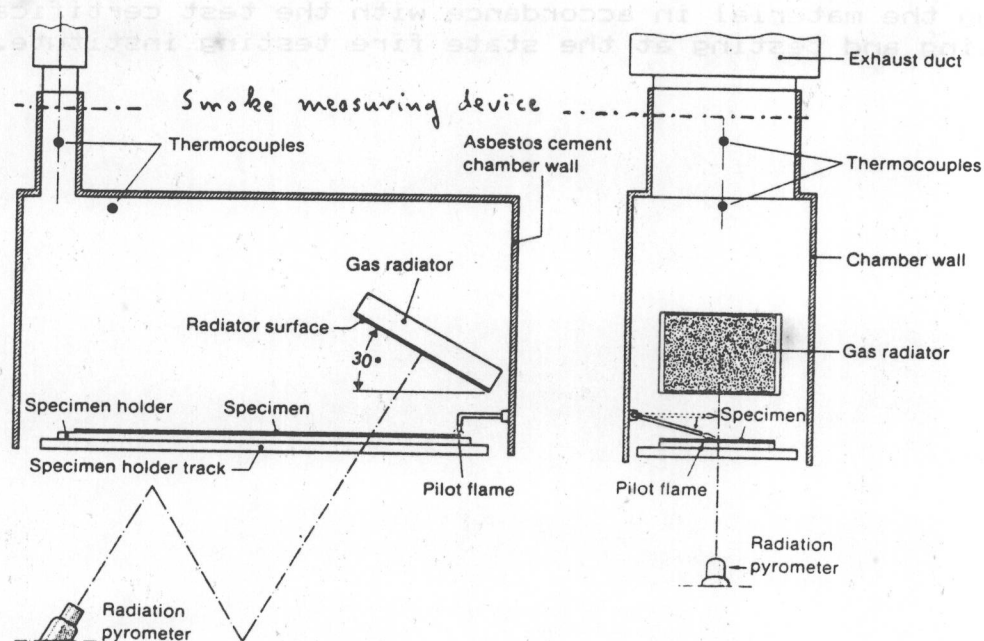


Figure 3. Flooring-radiant-panel test to DIN 4102 part 14

Table 4. Test criteria flooring-radiant-panel

Specimens	3 specimens 230 mm x 1060 mm x usual thickness
Specimen position	horizontal
Ignition source	<ul style="list-style-type: none"> gas heated radiator 305 mm x 457 mm. Operating temperature up to 815 °C, inclined at 30° to the horizontal; lower edge 140 mm above the specimen; radiation on specimen 1.1 to 0.1 W/cm² swivelling propane pilot flame, inner blue flame cone 13 mm long. Flame impinges perpendicularly to the longitudinal axis on the middle of the narrow edge on the radiant panel side; ignition flame can be pivoted up parallel to the specimen at a height of 50 mm
Duration of test	10 min of flaming and irradiation; if ignition does not occur, swing flame up and irradiate for additional 10 min, if ignition occurs, continue till flame extinguishes, up to a maximum of 30 min
Conclusions	passed if the average of the burnt length corresponds to a radiation flux of at least 0.45 W/cm ² and smoke development is not exceeding 300% x min *

*new rate: 750% x min

1.3 France

In France building materials are classified according to Table 5. The classification of the different building materials is based on several reaction to fire tests. The usual tests are the Epiradiateur-test and the brûleur-électrique-test. The testing devices and the criteria are shown in the following.

Table 5. Classification of the fire performance of french building materials

M.0	incombustible	(non-combustible)
M.1	non inflammable	(non-flammable)
M.2	difficilement inflammable	(low flammability)
M.3	moyennement inflammable	(moderately flammable)
M.4	facilement inflammable	(high flammability)

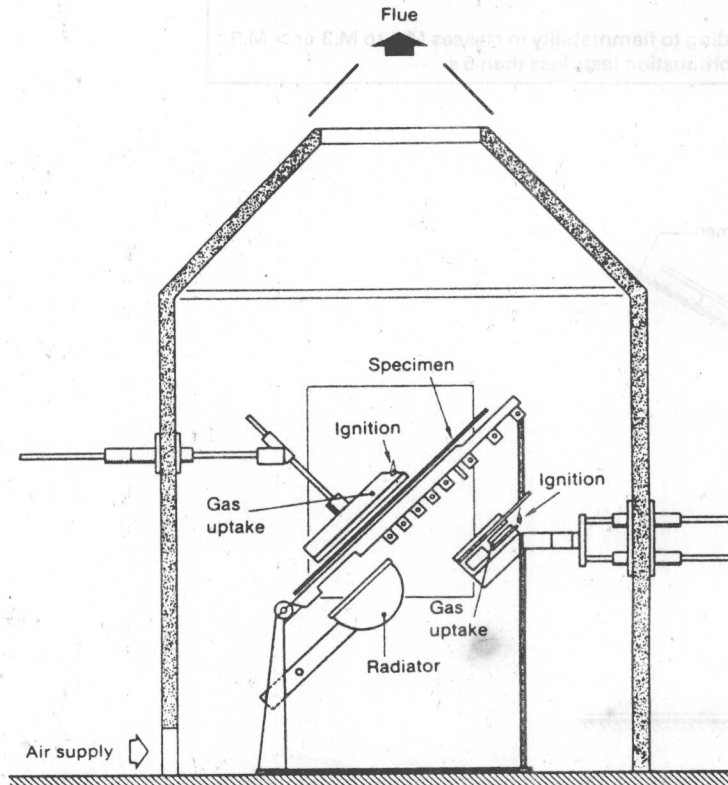


Figure 4. Epiradiateur cabin

Table 6. Test criteria Epiradiateur

Specimens	4 specimens 300 mm x 400 mm
Specimen position	inclined at 45°
Ignition sources	<ul style="list-style-type: none"> – electric radiator (inclined at 45°) 500 W, radiation falling on specimen (distance from radiator: 30 mm): 3 W/cm² – 2 butane pilot flames for igniting the combustible decomposition gases above and below the specimen
Test duration	20 min
Conclusion	classification according to flammability in classes M.1 to M.3 or >M.3, M.1 achieved if specimen burns ≤ 5 s

Table 7. Test criteria Brûleur électrique

Specimens	4 specimens 600 mm x 180 mm
Specimen position	inclined at 30° to horizontal
Ignition sources	<ul style="list-style-type: none"> – 500 W electric radiator, 30 mm from specimen – butane gas pilot flame (orifice 20 mm x 0.5 mm, flame 30 mm high)
Test duration	5 min for radiation, if the specimen continues to burn, until extinction of specimen
Conclusion	classification according to flammability in classes M.1 to M.3 or > M.3 M.1 is achieved if combustion lasts less than 5 s

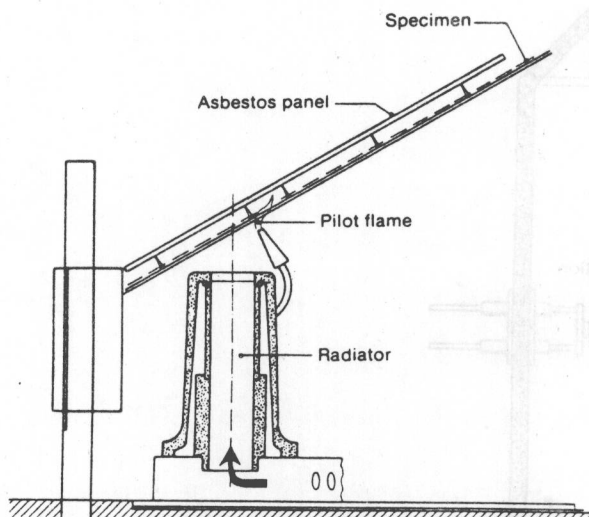


Figure 5. Brûleur électrique

The épiradiateur-Test according to NF 92-501 is used for testing rigid materials of any thickness and flexible materials more than 5 mm thick. For flexible materials less than 5 mm thick, the Brûleur-Électrique-test is used.

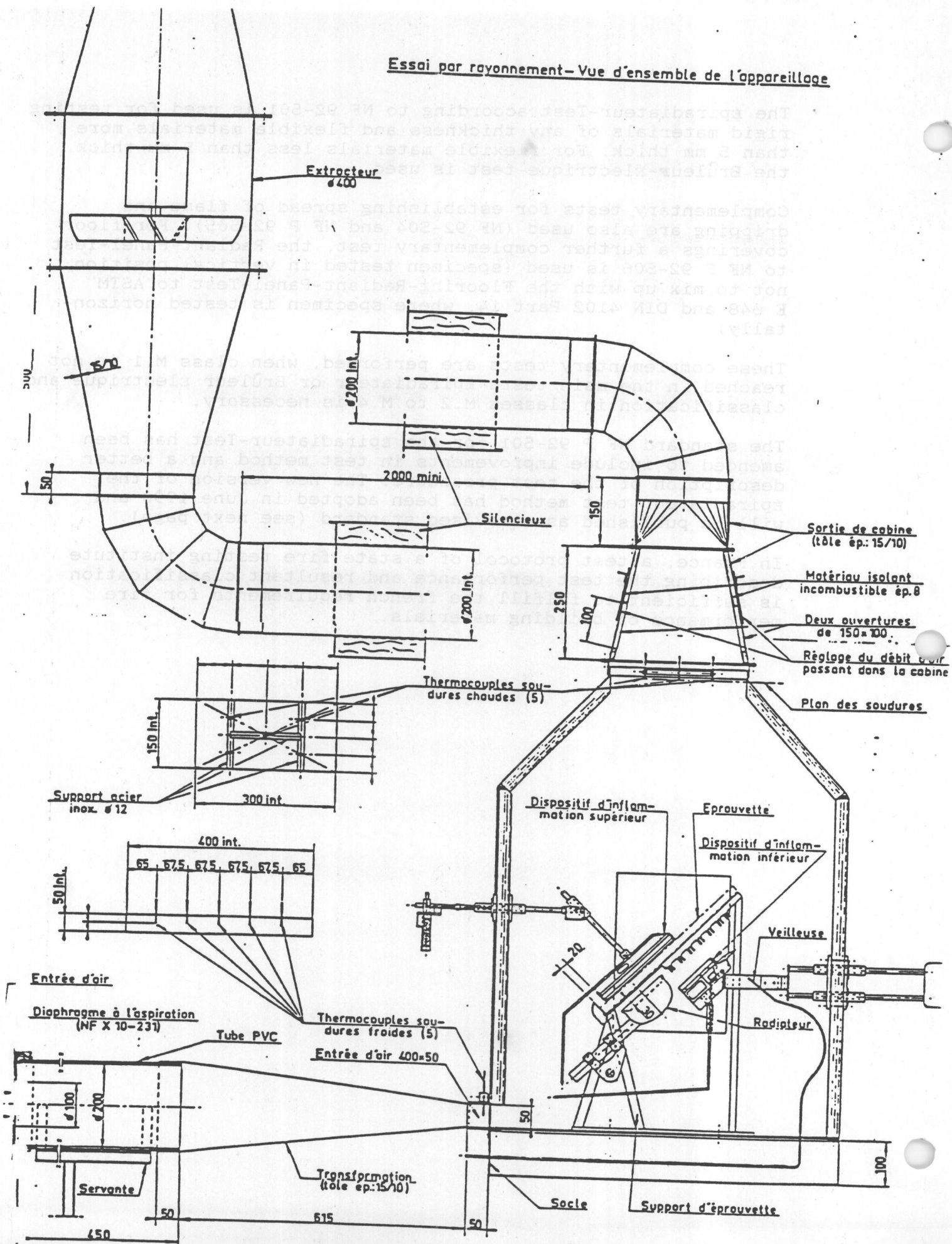
Complementary tests for establishing spread of flame and dripping are also used (NF 92-504 and NF P 92-505). For floor coverings a further complementary test, the Radiant-Panel-Test to NF P 92-506 is used (specimen tested in vertical position; not to mix up with the Flooring-Radiant-Panel-Test to ASTM E 648 and DIN 4102 Part 14, where specimen is tested horizontally).

These complementary tests are performed, when class M.1 is not reached in the main tests épiradiateur or Brûleur Électrique and classification in classes M.2 to M.4 is necessary.

The standard NF P 92-501 for the épiradiateur-Test has been amended to include improvements in test method and a better description of the test procedure. The new version of the épiradiateur test method has been adopted in June 1990 and will be published as a revised standard (see next page).

In France, a test protocol of a state fire testing institute describing the test performance and resultant classification is sufficient to fulfill the french requirements for fire performance of building materials.

Essai par rayonnement - Vue d'ensemble de l'appareillage



1.4 Great Britain

The classification of building materials is described in the "building regulations" and in the standards BS 476 Parts 6 and 7. Building materials are classified following the surface-spread-of-flame-test to BS 476 Part 7 in class 1 (best) to 4 (poorest).

To fulfil class 0 (highest requirements for combustible building materials) materials of class 1 must be tested to the fire-propagation-test of BS 476 Part 6. Test methods and specification are shown in the following.

Table 8. Test criteria surface-spread-of-flame-test

Specimens	minimum of 6 and maximum of 9 specimens 885 mm x 270 mm x max. 50 mm
Specimen position	vertical, longitudinal axis (885 mm), perpendicular to the radiant panel
Ignition sources	- gas fired radiant panel, radiation intensity 75 mm from radiant panel surface: 32.5 kW/m ² - gas pilot flame (height: 75 to 100 mm) impinging on the specimen on the same side as the radiant panel
Test duration	10 min
Conclusion	classification in classes 1 to 4 depending on test performance

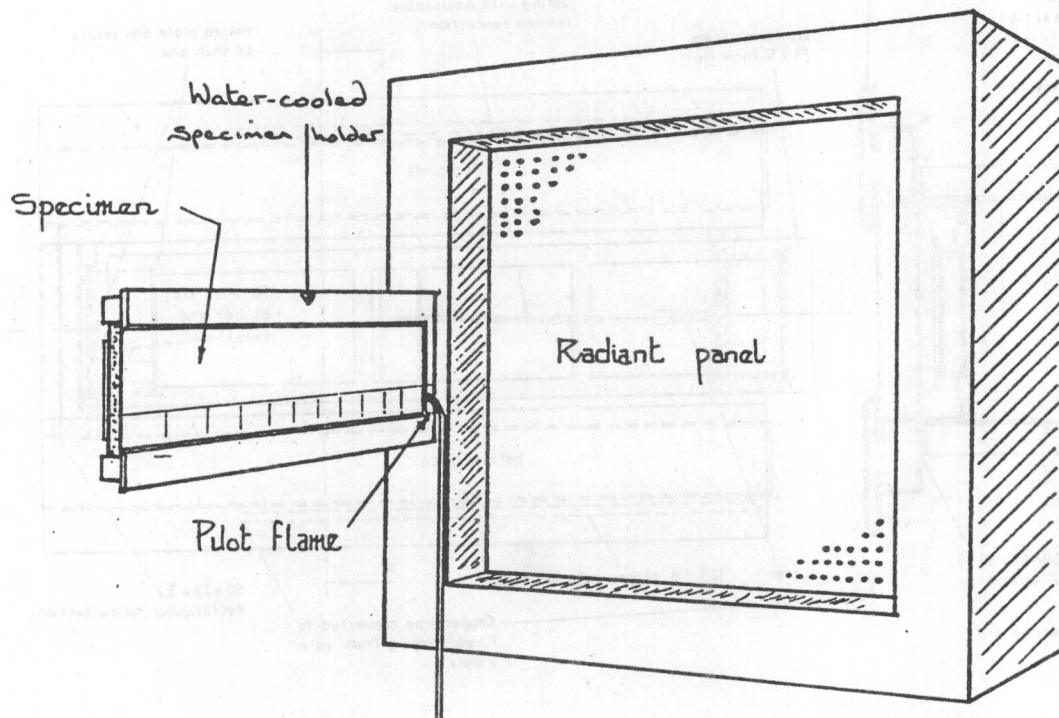
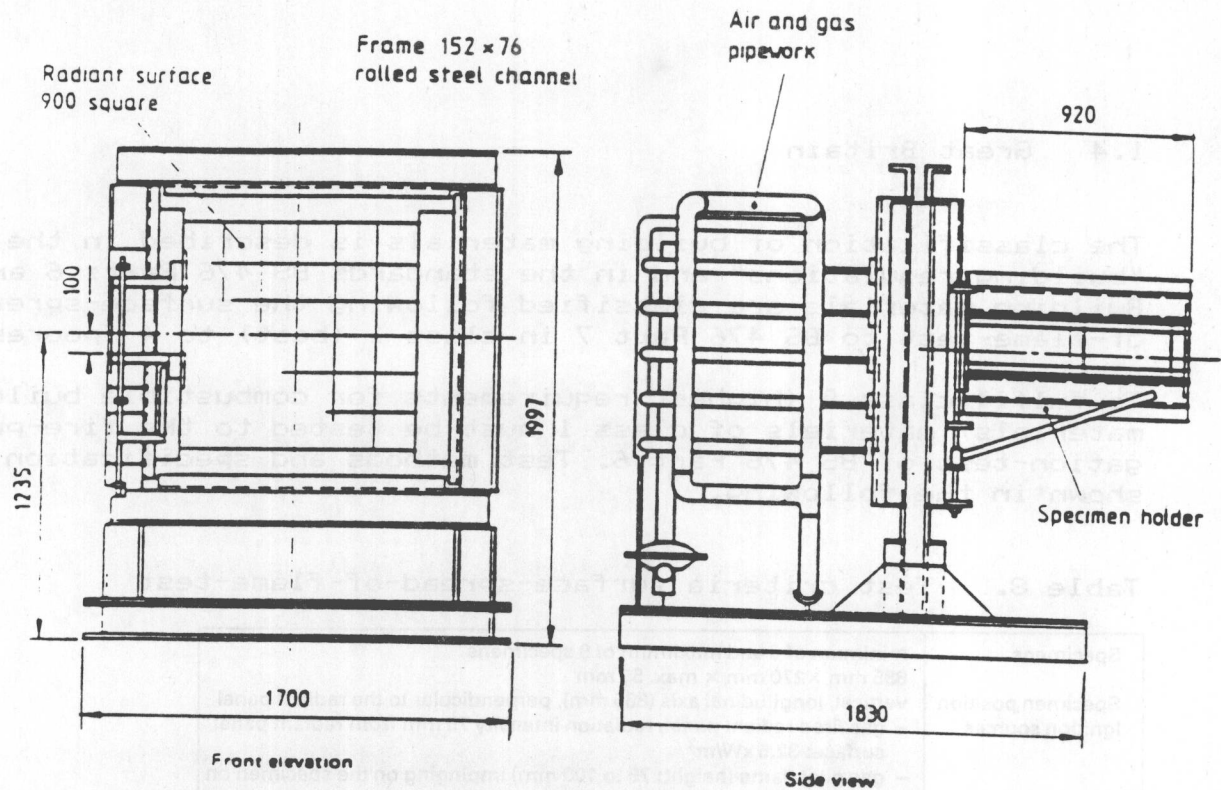


Figure 6. Surface spread of flame - test apparatus



General arrangement of the apparatus

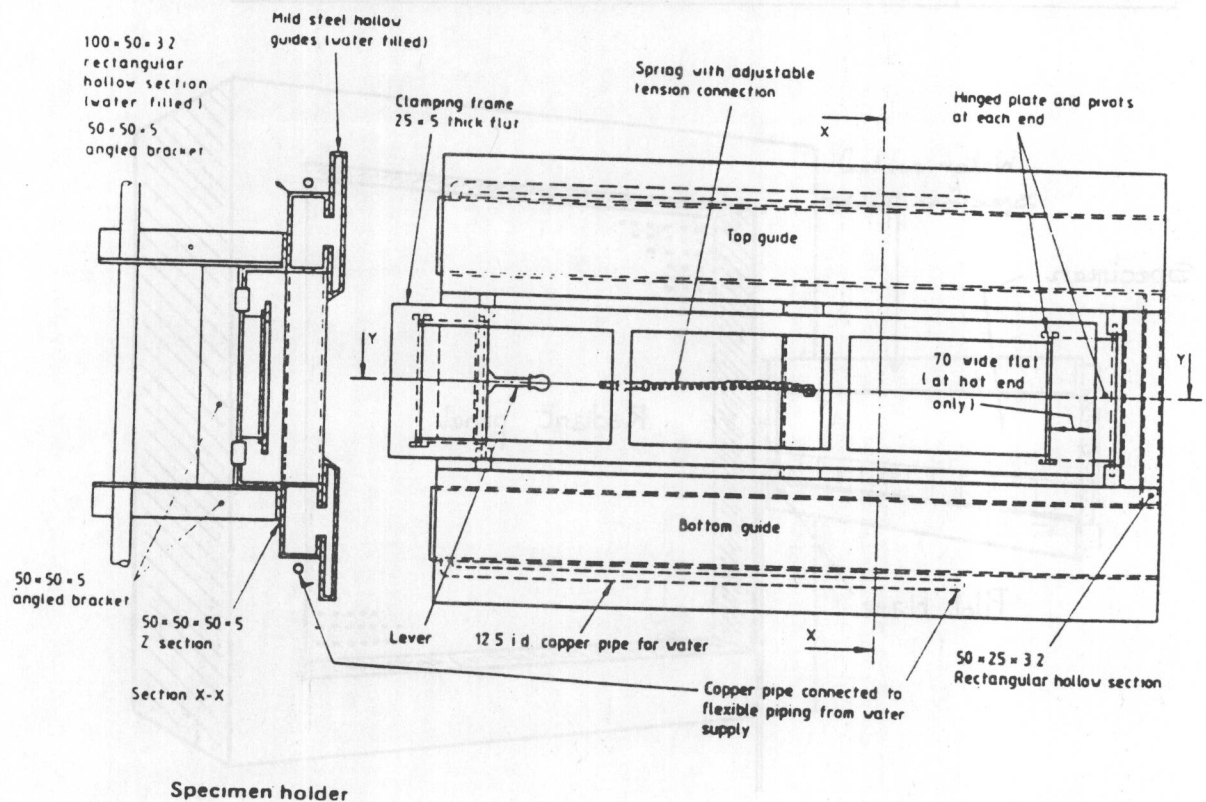


Table 9. Criteria fire-propagation-test

Specimens	3 specimens 228 mm × 228 mm × max. 50 mm
Specimen position	vertical
Ignition sources	<ul style="list-style-type: none"> – two 1000 W electric elements with variable output (1800 W after 2 min 45 s and 1500 W after 5 min); distance from specimen: 45 mm – gas pipe burners (internal diameter 9 mm) with 14 holes (internal diameter 1.5 mm) at 12.5 mm centres, distance from specimen 3 mm, flame applied 25 mm above the bottom of the exposed face of the specimen
Test duration	20 min
Conclusion	class 0 achieved if indices $i_1 \leq 6$ and $I \leq 12$ (for explanation, see below)

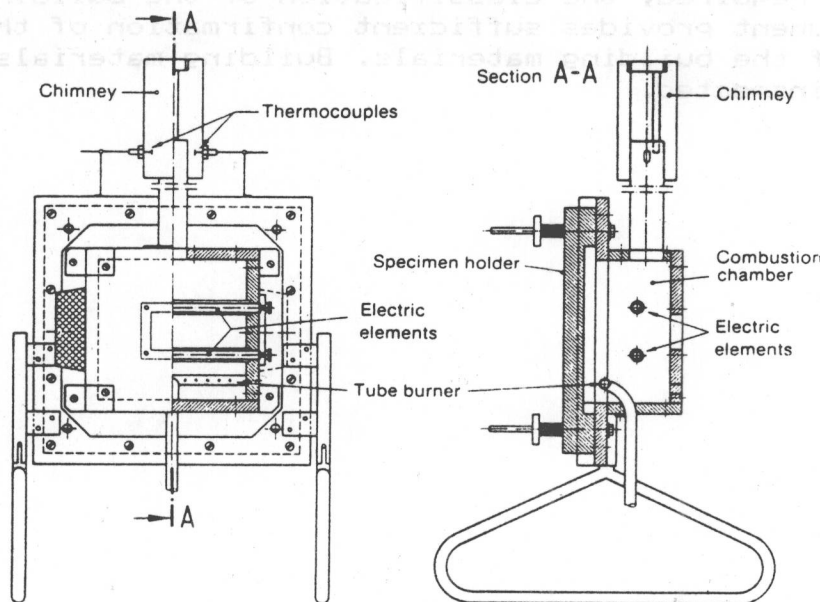


Figure 7. Fire propagation test apparatus

The test methods for fire performance referred to in the technical provisions of the building regulations, in general, are for all types of building materials and not specific groups. However, where the usual test methods have been found inappropriate or unduly stringent, for example with some thermoplastics, use is made of quality control test methods to provide information on plastics performance to allow for their uses as, for example, roof lights, ceiling tiles, etc.. the use of such materials is, however, subject to restrictions on size, thickness and separation from each other depending on their application.