

A I R R E G I S T R A T I O N B O A R D

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FLAME-RESISTANCE TESTING OF AIRCRAFT

FURNISHING MATERIALS

1 INTRODUCTION

A minimum standard of flame-resistance is required for furnishing materials used in civil aircraft, as specified in British Civil Airworthiness Requirements, Section D, Chapter D4-3. The materials concerned include, for instance, interior panelling, curtains, carpets and other floor covering, upholstery, interlining and lagging intended for use in passenger, crew or baggage compartments.

Such materials, either inherently or by virtue of their mode of application or size, shall not be of such a nature that accidental contact with, say lighted matches, cigarettes, or local heating due to electric short circuits or lightning strikes, would lead to propagation of fire which could prejudice safe operation of the aircraft.

The routine assessments of flame-resistance suitability are based on the results of tests covering the foregoing conditions and for the purpose of making these assessments the following test methods and criteria, or their equivalents, are acceptable to the Board.

2 TESTS

2.1 Sequence of Testing The tests can be done in any order desired and a material is acceptable if it passes any one of the three tests specified in this paragraph 2. If the Full-Scale Test is failed then the material is unacceptable for use in the manner represented. If either the Vertical Strip Test or the Inclined Sheet Test is first attempted and is failed, then the remaining one of these two tests can be attempted. If both of these tests are failed then the Full-Scale Test may be attempted.

2.2 Vertical Strip Test A strip of the material is held so that it hangs freely and the flame of a lighted match or petrol lighter is applied to its lower edge. The material is acceptable if the test strip shows no tendency to burn or is self-extinguishing in the immediate neighbourhood of the area of contact of the test

Inclined Sheet Test

2.3.1 Arrangements of Apparatus* The following arrangement of apparatus is used:-

- (a) Heat source container. A heat source container consisting of a hollow cylindrical metal cup 11/16 ins. outside diameter, 9/32 ins. overall height, wall and base thickness 1/32 ins. rests on a platform of low thermal conductivity material (e.g. a piece of cork 1 1/4 ins. diameter and 3/4 ins. high) supported at a height such that the cup base centre is 1 inch vertically below the centre of the lower face of the specimen under tests.
- (b) Test Stand. The test stand arrangement is such that the lower surface of the specimen in test position makes an angle of 45° to the horizontal and two edges of the specimen are horizontal.
- (c) Grid. For non-rigid materials, a grid supports the lower surface of the specimen in test position.
- (d) Method of Support. Whatever particular method of support is used, it is such as to ensure that:
 - (i) the central position of the specimen is not shielded from the test flame;
 - (ii) the support or supports do not prevent access of air for combustion nor provide an appreciable heat sink; and
 - (iii) the apparatus is such that the progress of the test can be observed.

Figure 1 illustrates the usual layout of apparatus which is satisfactory for testing specimens of rigid and non-rigid materials 6 to 7 ins. square in size.

2.3.2 Preparation of Specimens. Cut out the specimens 6 ins. square minimum size. (The number of specimens tested shall be at the discretion of the testing authority.) Test at least 3 specimens to obtain an assessment for any one combination of conditions. Condition the specimens immediately before testing for 24 hours at 20°C and 65% Relative Humidity. (Ordinary room temperature and humidity are normally acceptable in the United Kingdom).

- (b) Carpeting, upholstery and other covering material, which is intended to be used in direct contact with another material underneath, can be assessed on the basis of flame tests applied to the free surface, or surfaces, of a combination of the materials. In the case of certain fabrics when subjected to flame, the material melts locally and burning droplets fall away so that the remaining portion does not burn. If such material is backed by another to which it can stick and burn (e.g. certain lining materials on glass fibre lagging), a set of specimens of the particular combinations must be tested.
- (c) For coated materials, or combinations of materials, if the intended use is such that an ignition source in the aircraft could attack either surface first, flame tests applied to each surface are required. Alternatively, if the use is such that the ignition source could attack either surface at the same time (e.g. at an edge hole, tear or other discontinuity of the material), flame tests applied to the upper edge of a 1 inch diameter hole in the specimens are required.

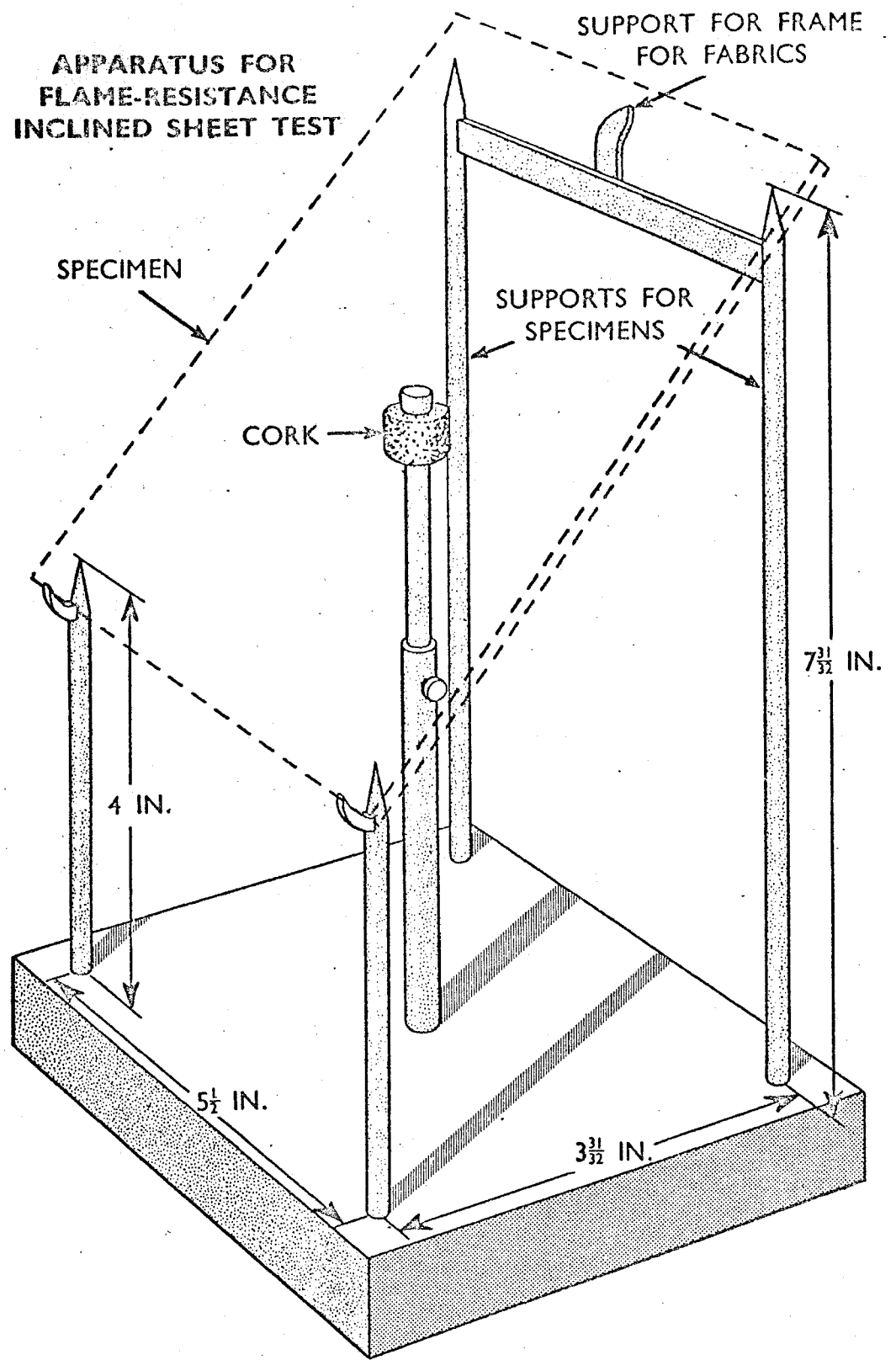
2.3.3. Test Procedure

- (a) Carry out the tests in a draught-free room or enclosure.
- (b) Place the specimens in turn in the test position and test each by burning 0.30 ml. of absolute alcohol or methylated spirit in the cup. Allow the cup to reach room temperature before adding the spirit.
- (c) In each case, observe the total time taken for any burning or glowing of the specimen to extinguish itself after the test flame has burnt out. In addition, measure the distance of uncharred material remaining along a horizontal line on the specimen, above and 3 inches from the point of application of the test flame; subtract from the original width of the specimen and report the difference as the distance charred.

- (c) If a clear indication of flame-resistance suitability cannot be obtained from testing specimens of minimum size, a set of larger specimens should be tested, under otherwise identical conditions, to substantiate that the burning out process is completed within a distance of 5 ins. from the point of application of the test flame, in which case the material is acceptable.
- (d) Materials which fail to meet these criteria are not acceptable unless:
 - (i) the test conditions can be claimed to be unrepresentative and satisfactory results can be proved by a full-scale representative test (see para. 2.4.); or
 - (ii) their mode of application or size in the aircraft is such that their complete combustion cannot lead to a propagation of fire prejudicing the safety of the aircraft or its occupants.

2.4 Full-Scale Representative Tests. The final discriminating test is that of a fully representative specimen, the testing of new types of which should be agreed by the board in each case. One case of this is carpeting where an otherwise inflammable carpet may be acceptable when stuck closely to a metal floor. Another example is where a juxtaposition of materials in a cabin wall may show different results when tested as a representative whole.

**APPARATUS FOR
FLAME-RESISTANCE
INCLINED SHEET TEST**



**FRAME FOR
FABRICS**

