TC 92

INTERNATIONAL STANDARD 1182

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Fire tests — Building materials — Non-combustibility test

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1182 was developed by Technical Committee ISO/TC 92, *Fire tests on building materials, components and structures*, and was circulated to the member bodies in November 1976.

It has been approved by the member bodies of the following countries :

Australia	Finland	Norway
Belgium	Hungary	Poland
Brazil	India	Romania
Bulgaria	Italy	South Africa, Rep. of
Canada	Japan	Sweden
Czechoslovakia	Korea, Rep. of	Turkey
Denamrk	Mexico	USA
Egypt, Arab Rep. of	New Zealand	USSR

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Netherlands
Spain
United Kingdom

This International Standard cancels and replaces ISO Recommendation R 1182-1970, of which it constitutes a technical revision.

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Fire tests — Building materials — Non-combustibility test

0 INTRODUCTION

0.1 It may be important to ascertain whether a material will or will not contribute directly to fire development and this test has been designed to allow this to be done. Its results will provide information from which regulating authorities will be assisted in deciding whether the material in question may be used without undue hazard in certain locations in buildings, for example access routes and escape ways. (See also A.1.)

0.2 From a technical point of view the test gives no absolute statement concerning "non-combustibility". For regulatory purposes it may be necessary to carry out additional tests. A statement on the relationship of combustibility/non-combustibility tests to reaction to fire tests is given in clause 1 of ISO/TR 3814.

0.3 The method of test is closely in line with the test used by the Intergovernmental Maritime Consultative Organization (the IMCO test), but at present it is not identical with it.

0.4 This specification supersedes ISO/R 1182. The basic principles of the test are however unchanged and any material may be considered, for regulatory and other purposes, to enjoy in general the same performance in relation to the tested quality of reaction to fire as those materials which would have passed the superseded ISO/R 1182 test.

0.5 The specification is provided with a commentary which is at annex B. This annex is not a mandatory part of the specification, but all who use the test are strongly recommended to read the commentary before doing so.

1 SCOPE[1)]

This International Standard specifies a method for testing one aspect of reaction to fire of a material with a view to evaluating the tendency of that material to release more than a certain amount of heat or to flame in the circumstances of the test.

SAFETY WARNING : So that suitable precautions are taken to safeguard health, the attention of all persons concerned in fire tests is drawn to the possibility that toxic or harmful gases may be evolved in combustion of test specimens.

2 FIELD OF APPLICATION

This test is intended for building materials or products whether coated or uncoated, but it is not intended to apply to the coating alone.

NOTE — This test may also be used for materials or products for other forms of construction, for example in ships.

3 SAMPLING

The sample shall be sufficiently large to be representative of the material, particularly in the case of non-homogeneous materials.

4 APPARATUS[2)]

4.1 General description

4.1.1 The apparatus of which an illustration is shown at figure 1 shall essentially comprise :

a) a refractory tube (the "tube"), surrounded by heating coils and insulation (this whole assembly is the "furnace");

1) IMPORTANT NOTE : This standard method of test and its results should be used solely to describe the combustibility or non-combustibility of a material in response to heat under controlled laboratory conditions. It should not by itself be used for describing or appraising the fire hazard of materials under actual fire conditions or as a sole source on which a valid assessment of hazard pertaining to combustibility can be based.

2) Working drawings and other details of an apparatus known to conform to the requirements of this standard will be made available, at a date to be announced later, by the Secretariat of ISO/TC 92 or by the national standards body of the following countries : Belgium, Denmark, France, Netherlands, Switzerland, United Kingdom and U.S.A.

b) an air flow stabilizer, at the base of the tube;

c) a draught shield, at the open top of the tube;

d) a specimen holder (see figure 3) equipped with a suitable insertion device for lowering and raising it on the axis of the tube;

e) three thermocouples (see figure 2) :

1) furnace thermocouple,

2) specimen centre thermocouple (centre thermocouple),

3) specimen surface thermocouple (surface thermocouple);

f) a temperature recorder;

g) a stand for the furnace;

h) air flow shields (see figure 1).

4.1.2 In addition, means shall normally be provided for checking the temperature of the inner wall of the tube to assist calibration. Either :

a) a sheathed thermocouple scanning device,

or

b) an optical micropyrometer

shall normally be provided for this purpose.

4.2 Furnace, stand and air flow shields

4.2.1 The tube shall be made of alumina refractory material (density 2 700 ± 500 kg/m^3) and shall be 150 ± 1 mm high with an inner diameter of 75 ± 1 mm and a wall thickness of 10 ± 1 mm. The overall wall thickness, with applied refractory cement to retain the electrical winding, shall not exceed 15 mm.

4.2.2 The tube shall be provided with one or more electrical heating coils so that the temperature of the tube can be raised to the requirements specified in 6.2.

4.2.3 The tube shall be well insulated within an insulating surround consisting of magnesium oxide powder of bulk density 140 kg/m^3 ± 15 % contained by a cover made of asbestos cement or similar material and completed with a top and bottom plate of insulating board having a thickness of 10 ± 1 mm.

4.2.4 The furnace shall be provided with a firm stand to ensure that the bottom of the furnace is held steady at least 750 mm above floor level. The stand shall be made of steel or other suitable material adequate to provide a firm base for the furnace and air flow stabilizer.

4.2.5 When tests are in progress air flow shields shall be fixed to the stand to enclose the space below the air flow stabilizer up to a height of approximately 550 mm above the floor (see figure 1).

4.3 Air flow stabilizer

4.3.1 At the base of the tube an open-ended conical air flow stabilizer, as shown in figure 1, shall be attached. The joint between the air flow stabilizer and the tube shall be smooth and airtight under all conditions and shall be provided with a seal. The stabilizer shall have a smooth inside face and its upper half shall be insulated on the external face. Below the stabilizer there shall be a gap of approximately 250 mm which shall be protected against disturbance by air currents.

4.3.2 The stabilizer shall be 500 mm long. Its internal diameter at the top shall be 75 mm and shall reduce uniformly to an internal diameter at the bottom of 10 mm.

4.3.3 The stabilizer shall be made of sheet steel approximately 1 mm thick and finished smooth on the inside. Its upper half shall be insulated on the outside with a layer of fibrous insulating material 25 ± 2 mm thick and of density between 40 and 120 kg/m^3.

4.4 Draught shield

4.4.1 At the open top of the tube a draught shield shall be provided conforming to figure 1. It shall have a smooth and airtight joint with the tube and shall be insulated on the external face.

4.4.2 The draught shield shall be made of the same material as the air flow stabilizer (see 4.3.3) and shall have an internal diameter of 75 mm and a height of 50 mm. It shall be insulated on the outside with a layer of fibrous material 25 ± 2 mm thick.

4.5 Specimen holder and insertion device[1)]

4.5.1 The specimen holder (see figure 3) shall be provided with a suitable insertion device for lowering it precisely down the axis of the tube and for rapidly raising it again on the same axis without shock. They shall be made in such a way as to ensure that the specimen when in position for the test occupies a position in the middle of the controlled temperature zone of the furnace (see 6.3) and is equidistant from the walls of the tube.

4.5.2 The specimen holder, which is basically cylindrical, shall conform to the dimensions given in figures 1 and 3, and shall have a mass between 15 g and 20 g. It shall be capable of holding a specimen which conforms to 5.2.

1) To facilitate observation of sustained flaming, it is recommended that a mirror be installed above the apparatus. It should be of such size and at such a distance from the furnace as not to affect the test results. A mirror (300 mm × 300 mm) at an angle of 30° to the horizontal and 1 000 mm above the furnace has been found suitable.

4.5.3 The holder and the insertion device shall be designed in such a way as to permit the attachment of the two specimen thermocouples (see 4.6.2, 4.6.3 and figure 3).

4.5.4 The frame of the holder shall be made of rods of nickel-chromium alloy or of heat resisting steel and shall be suspended from the lower end of a tube of heat resisting steel having an outside diameter of approximately 6 mm and a bore of 4 mm. The bottom of the holder shall be formed using a fine gauze of heat resisting steel. It shall be made so that the lower part can be unhooked from the uppermost ring to permit insertion of the specimen.

4.5.5 The insertion device shall be a metallic sliding rod moving freely within a vertical guide fitted to the side of the furnace (as shown in figure 1). The heat resisting steel tube, from which the specimen holder is suspended (4.5.4), shall be fixed by a space bar to the sliding rod.

4.6 Thermocouples

4.6.1 The furnace thermocouple shall be located with its hot junction $10 \pm 0{,}5$ mm from the tube wall and at mid-height of the controlled temperature zone (see 6.3) as defined by the wall temperature. The correct distance from the wall shall be maintained by use of a guide attached to the draught shield.

4.6.2 The surface thermocouple shall have its hot junction in contact with the specimen at mid-height of the specimen at the start of the test and shall be located diametrically opposite the furnace thermocouple (see figures 2 and 3).

4.6.3 The centre thermocouple shall normally be used and, if so, shall be attached to the specimen holder in such a way that it moves up and down with the holder and is located with its hot junction in the centre of the specimen. It shall be inserted from the top through a hole of 2 mm diameter (see figure 2) so that the hot junction makes contact with the bottom of the hole. In some cases however the centre thermocouple provides no significant additional information and in such cases it need not be used.

4.6.4 All thermocouples, during a test, shall have their hot junctions located in the same horizontal plane which shall correspond to the mid-height of the controlled temperature zone.

4.6.5 Each thermocouple shall be a stainless steel sheathed type having a mineral insulated junction and having an outside diameter of not less than 1 mm and not more than 1,5 mm.

4.7 Temperature recorder and temperature measurement

4.7.1 The temperatures of the furnace and surface thermocouples shall be recorded by a continuous recorder having a measuring range that corresponds to the temperature changes that occur during the tests. For the centre thermocouple regular readings shall be recorded at intervals not greater than 5 s.

4.7.2 The temperature measuring equipment shall have an accuracy of at least 0,5 %.

5 TEST SPECIMENS

5.1 Preparation

The specimens shall be as representative as possible of the average properties of the sample and shall be prepared to the size defined in 5.2.

If the thickness of the material is less than 50 mm, the specimen shall be made of sufficient layers to achieve the thickness required in 5.2. The layers shall occupy a horizontal position and shall be held together firmly by means of fine wire to minimize air gaps between layers. The density of the specimens shall be representative of the density of the material.

For composite materials of a thickness such that a number of layers cannot be put together to give a specimen of the specified size as required in 5.2, the specimen shall be prepared to the required thickness by adjusting the thickness of the different components. The top and bottom faces of the specimen shall be the finished faces of the material. If it is not possible to follow this procedure to prepare the specimen, tests shall be performed on the individual components and reported accordingly.

5.2 Number and size

For test purposes, five cylindrical specimens shall be prepared as described in 5.1. The nominal dimensions and tolerances for the specimen sizes shall be as follows :

diameter : $45 \, {}^{0}_{-2}$ mm;

height : 50 ± 3 mm;

volume : 80 ± 5 cm^3.

5.3 Conditioning

The specimens shall be conditioned in a ventilated oven maintained at 60 ± 5 °C for at least 20 h and cooled to ambient temperature in a desiccator prior to the tests. The mass of each specimen shall be determined prior to test in the furnace.

6 CALIBRATION AND CONTROL

6.1 A calibration test shall be performed on a new apparatus or on any existing apparatus when so required. The aim is to ensure the required degree of uniformity of the furnace wall temperature druing tests and to establish the necessary power input. This test shall be performed with the specimen holder removed from the furnace.

6.2 Under stabilized furnace operating conditions measurements of wall temperatures shall be made by use of either an optical micro-pyrometer or a sheathed thermocouple scanning device (see figure 4). Such measurements shall be made on three equally spaced vertical axes. The wall temperature when measured by the sheathed thermocouple scanning device shall be within the range 800 to 850 °C and have an average value of 825 ± 5 °C[1]. If however this wall temperature is measured by an optical micropyrometer it shall be within the range 815 to 865 °C and have an average value of 840 ± 5 °C. When this requirement is fulfilled, the power input shall be measured and noted as the calibrating power input.

6.3 A controlled temperature zone is achieved either by having closer winding at the two ends of the heated tube or by means of separate windings at the ends controlled independently of the central section. To minimize temperature fluctuations in the furnace it is necessary to use a voltage stabilizer. Between calibrations, the power input is maintained within ± 1 % of the calibrating power input for each tests. Between tests the temperature as measured by the furnace thermocouple shall be used to ensure that the furnace wall temperature returns to its steady state temperature before the next test.[2]

6.4 Automatic thermostatic control of the furnace is not to be used during test.

7 PROCEDURE

7.1 Apparatus

7.1.1 Before starting the test, it is necessary to ascertain that the whole equipment is in good working order, for example that the stabilizer is clean, the insertion device is working smoothly and the specimen holder exactly occupies the required position in the furnace.

7.1.2 The equipment shall be protected against draughts and not be exposed to direct sunlight or artificial illumination.

7.1.3 The furnace shall be heated and the furnace temperature stabilized at the mean temperature established by the calibration test, so that it does not fluctuate by more than ± 10 °C, for a minimum period of 10 min before the insertion of a specimen.

7.2 Insertion of specimens

The specimen shall be placed in the holder described in 4.5 and inserted in the furnace taking not more than 5 s for this operation.

7.3 Duration of heating

The heating period commences with the insertion of the specimen in the furnace and shall be continued for 20 min.

7.4 Test observations

7.4.1 A record shall be made of the temperature readings from the thermocouples during the heating period and note taken of the occurrence and maximum duration of any sustained flaming. Sustained flaming shall be taken as the continuous presence of flames in the furnace lasting for 5 s or longer. The mass loss of each specimen shall be established after each test.

7.4.2 After cooling to ambient temperatures each specimen shall be weighed and the mass recorded. Where char, ash or other debris breaks off and falls down the tube during or following the test this shall be recovered and included as part of the unconsumed specimen mass. The physical form or nature of any unconsumed non-recoverable decomposition products shall be noted.

7.4.3 Any other observations relating to the behaviour of the specimen.

8 EXPRESSION OF RESULTS[3]

8.1 The following results shall be noted and reported :

8.1.1 For each test :

a) the initial furnace temperature (T_o);

b) the maximum furnace thermocouple temperature (T_f);

c) the maximum surface thermocouple temperature (T_s);

d) the maximum centre thermocouple temperature (T_c);

e) the duration of sustained flaming.

8.1.2 For each series of five tests the average temperature rise (see 8.2) of the :

a) furnace thermocouple;

b) surface thermocouple;

c) centre thermocouple.

1) This average value corresponds to approximately 750 °C at the furnace thermocouple.

2) To assist control during the test, it is necessary to prevent excessive variations in ambient conditions in the vicinity of the apparatus.

3) Guidance on evaluation of performance from these results is given in annex A.

8.2 The average temperature rise of the furnace thermocouple [see 8.1.2 a)] shall be calculated from the formula :

$$\sum_{i=1}^{5} \frac{T_{fi} - T_o}{5}$$

and similarly using T_s for 8.1.2 b) and using T_c for 8.1.2 c).

8.3 For each series of five tests in which sustained flaming (as defined in 7.4.1) is recorded, the average recorded duration of sustained flaming shall be reported. This is arrived at by taking the sum of all the recorded durations of flaming and dividing by 5.

8.4 The following mass loss shall be reported :

a) the mass loss of each individual specimen in each test;

b) the average mass loss of the five specimens in each series of five tests.

9 TEST REPORT

The test report shall include the following information :

a) name of the manufacturer or of the supplier of the material;

b) name or identification of the product;

c) description of the material;

d) density of the material;

e) date of supply of the materials and date of the tests;

f) description of the specimens;

g) test method;

h) test results required by clause 8;

j) name of the testing laboratory;

k) the "Important Note" appended to clause 1 shall be repeated on all test reports.

ANNEX A

CRITERIA FOR EVALUATION

In order to be able to assess materials in relation to "combustibility" or "non-combustibility", regulating authorities will need to define appropriate criteria for acceptance. It is obviously desirable that, in general, when materials are assessed by a test in an International Standard, every assessment should be based on the same criteria unless very special factors exist in a particular case. Unless a uniform assessment is adopted throughout the world the usefulness of the test in eliminating trade barriers will be seriously weakened. It is therefore very strongly recommended that, in all save the most exceptional circumstances, no criteria other than the following should be used; it may not, however, be necessary or possible to use all criteria in every case (see 4.6.3).

A.1 The average of all five maximum readings of the furnace thermocouple should not exceed the initial furnace temperature by more than 50 °C.

A.2 The average of all five maximum readings of the surface thermocouple should not exceed the initial furnace temperature by more than 50 °C.

A.3 The calculated average duration of recorded sustained flaming should not exceed 20 s.

A.4 The average of all five maximum readings of the centre thermocouple should not exceed the initial furnace temperature by more than 50 °C. (See 4.6.3 and B.4.)

A.5 The average mass loss shall not exceed 50 % of the average original mass (see B.5.1).

It is the responsibility of the regulating authority to decide which aspects of the test are appropriate to particular usages.

ANNEX B

COMMENTARY

B.1 BACKGROUND TO THE DEVELOPMENT OF THE TEST

This fire test has been developed for use by those responsible for selection of construction materials which, whilst not completely inert, produce only a limited amount of heat and flame when exposed to ambient surroundings at 750 °C. It is expected that it will be applied mainly in connection with building and shipbuilding work.

B.2 APPLICATION OF QUALIFIED MATERIAL

Materials which qualify in accordance with the criteria defined in annex A are expected not to burn appreciably even when exposed to severe fire conditions. The assumed application conditions involve use of the materials in slab or other forms up to roughly a few tenths of a metre in thickness.

B.3 SELF HEATING NOT COVERED

The test does not rule out the possibility of self heating and ignition of improperly cured or other sensitive materials when stored in bulk at elevated temperatures in piles of size several metres. A self heating test would be required to provide assurance that materials are safe with regard to this type of hazard.

B.4 GLASS AND MINERAL FIBRE INSULATING MATERIALS

The criteria provided have been selected to qualify materials including both glass and mineral fibre insulating materials with similar calorific value. Problems in achieving this resulted from the fact that glass fibre materials melt at the temperature of the test while mineral fibre materials do not. In this case performance criteria based on the temperature registered by the centre thermocouple should not be established (see 4.6.3).

B.5 LIMITED MASS LOSS

B.5.1 The inclusion of a possible performance criterion based on a limited mass loss requirement was to avoid the possibility of qualifying low density materials of low melting point, but which might be highly flammable. Certain materials of this type are known to release their limited heat content so rapidly that the test results would be very favourable in the absence of a mass loss result. Materials which show a high mass loss only should not in consequence automatically be considered to be combustible (see A.5).

B.5.2 It was also recognized that, as with many other tests, certain anomalies were possible. For instance an ice cube would melt, drip and evaporate. In a similar manner, metals which melt at a temperature below 750 °C would also show excessive mass loss.

It was the majority opinion of those responsible for the test that these and other similar anomalies could readily be recognized as such by the testing laboratory performing the test.

B.6 APPLICATION TO COMPOSITE MATERIALS

Composite materials consisting of small elements relative to the size of the test specimen may be submitted to the test and the test results used for assessing behaviour.

For composite elements consisting of larger elements where it is not possible to prepare a representative test specimen, each element may be tested separately.

Dimensions in millimetres

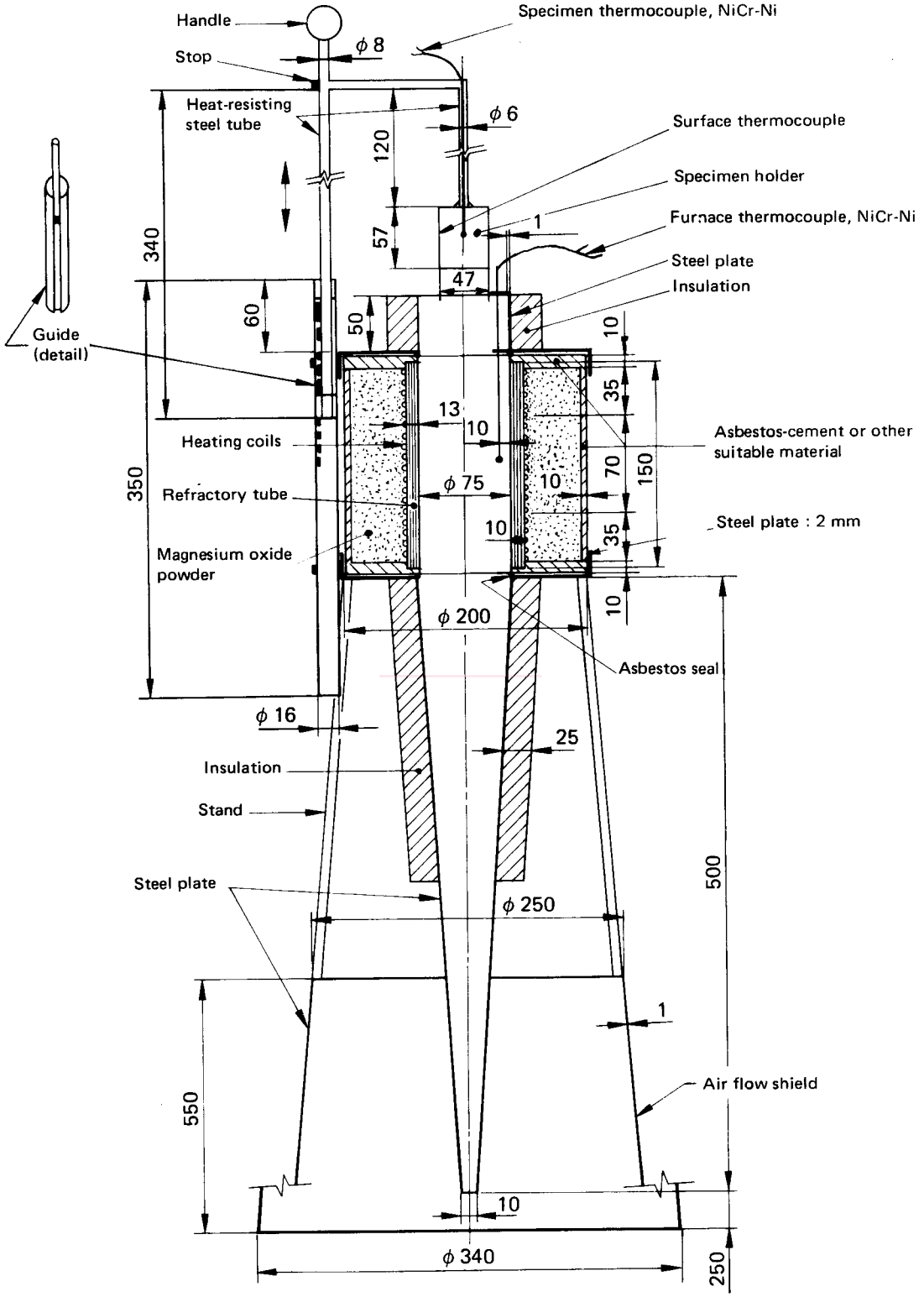


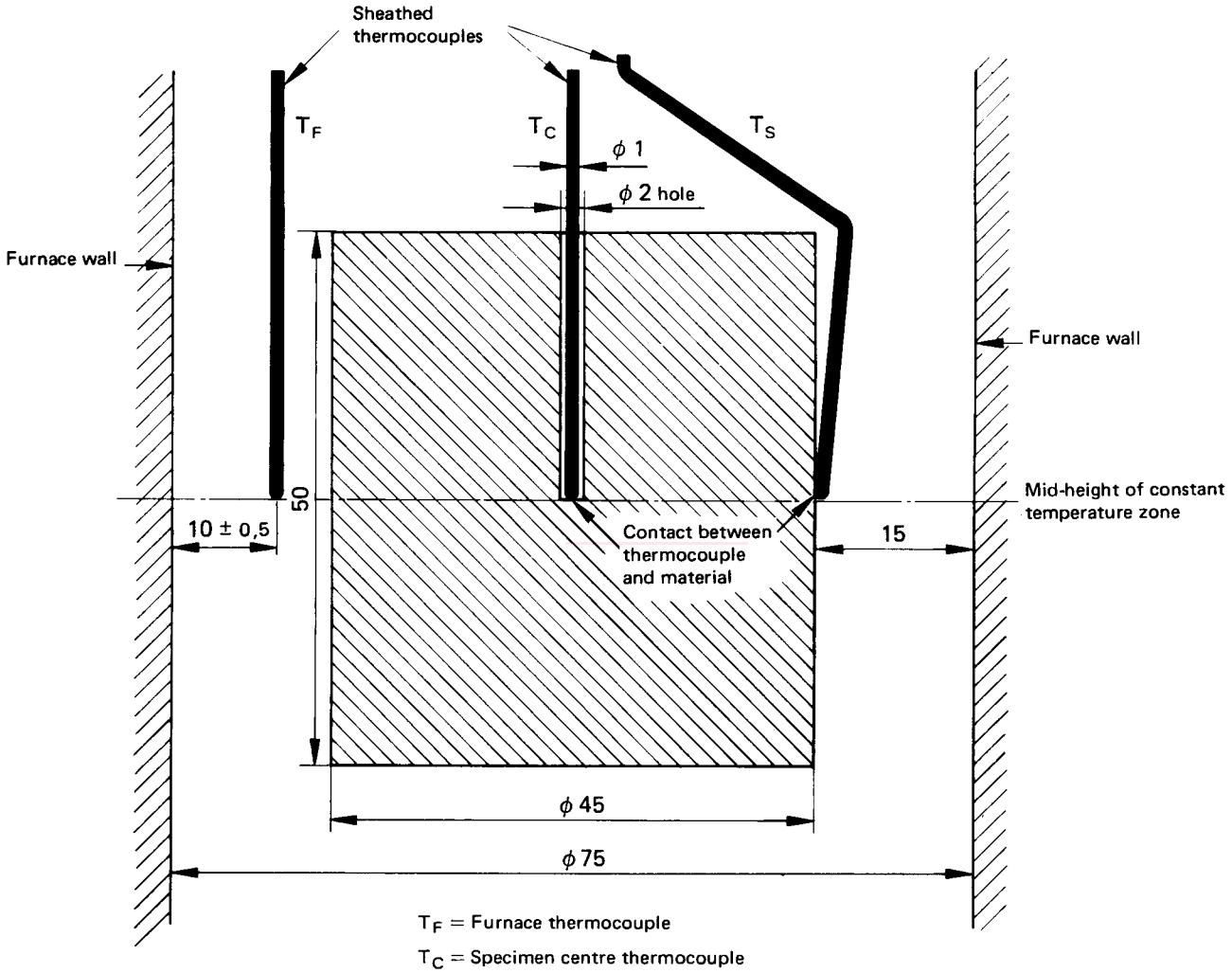
FIGURE 1 — **Non-combustibility test apparatus — General arrangement**

NOTES

1 Dimensions are for information only except where specified in the text.

2 Working details are shown on working drawings : see footnote to clause 4.

Dimensions in millimetres



T_F = Furnace thermocouple

T_C = Specimen centre thermocouple

T_S = Specimen surface thermocouple

FIGURE 2 – **Relative position of furnace, specimen and thermocouples**