

RESOLUTION A.472(XII)

*Adopted on 19 November 1981
Agenda item 10(b)*

**IMPROVED RECOMMENDATION ON TEST METHOD FOR QUALIFYING
MARINE CONSTRUCTION MATERIALS AS NON-COMBUSTIBLE**

THE ASSEMBLY,

RECALLING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization,

NOTING that Assembly resolution A.270(VIII) entitled "Recommendation on Test Method for Qualifying Marine Construction Materials as Non-Combustible" is referred to in Regulation 3 of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974,

RECOGNIZING the need to improve test procedures for determining whether materials meet the requirements for non-combustible materials as specified in Regulation 3 of Chapter II-2 of that Convention, taking into consideration the continuous improvement in the technology of test equipment and procedures,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its forty-fourth session,

1. ADOPTS the improved Recommendation on Test Method for Qualifying Marine Construction Materials as Non-Combustible, the text of which is annexed to the present resolution, which supersedes the Recommendation annexed to resolution A.270(VIII);
2. INVITES all Governments concerned:
 - .1 To apply the improved Recommendation in complying with the definition contained in Regulation 3 of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974;
 - .2 To encourage laboratories concerned to provide information for possible further improvement of this Recommendation, in particular by securing data on the final equilibrium furnace and surface temperatures (section 6.3 of the Recommendation);
3. REQUESTS the Maritime Safety Committee to continue in due time work on this subject with a view to further improving the test method.

ANNEX

**IMPROVED RECOMMENDATION ON TEST METHOD FOR QUALIFYING MARINE
CONSTRUCTION MATERIALS AS NON-COMBUSTIBLE**

1 SCOPE

This document specifies a procedure to be used in assessing materials as meeting the requirements for non-combustible materials as specified in Regulation 3 of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974.

2 FIELD OF APPLICATION

The test is intended for marine construction materials.

3 SAMPLING

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

4 APPARATUS

4.1 Furnace

The furnace consists principally of a tube of an alumina refractory material having a mass density of $3,000 \pm 300 \text{ kg/m}^3$ and a height of $150 \pm 1 \text{ mm}$, with an inner diameter of $75 \pm 1 \text{ mm}$ and a wall thickness of $10 \begin{smallmatrix} + \\ - \end{smallmatrix} \frac{2}{0} \text{ mm}$.* The overall wall thickness with applied refractory cement to retain the electrical winding should not exceed 13 mm. The furnace tube is provided with one or more electrical heating coils and is located within an insulated surround, completed with a top and bottom plate of marine board having a thickness of $10 \pm 1 \text{ mm}$. To the lower end of the furnace is attached a cone-shaped air flow stabilizer 500 mm long and reducing from a 75 mm internal diameter at the top to a 9 mm internal diameter at the lower end. The stabilizer can be made of steel sheet, approximately 1 mm thick, and should be finished smooth on the inside, particular attention being given to the smoothness and the tightness of the joint with the furnace which should be provided with a refractory fibre sheet seal. The upper half height of the stabilizer should be insulated on the outside with a layer of refractory fibrous felt having a nominal thickness of 25 mm. At the open top of the furnace a draught shield, which may be made of the same material as the stabilizer cone, should be provided having an internal diameter of 75 mm and a height of 50 mm. The draught shield should be insulated on the outside with a layer of the fibrous felt having a nominal thickness of 25 mm. Details of the furnace are shown in the working drawings.** A general representation of the furnace is shown in figure 1.

4.2 Furnace stand

The furnace is mounted on a stand with a clearance of approximately 250 mm between the floor and the lower end of the stabilizer. This clearance must be protected against disturbance by air currents. An adequate protection can be provided by using shields around the stand to a height of approximately 550 mm from the floor.

4.3 Furnace calibration and control

A calibrating test with the specimen basket and holder removed should be performed on a new furnace or on an existing furnace when so required. The energy input to the furnace should be adjusted so that the furnace thermocouple (see 4.5) gives a steady reading of $750^\circ \pm 10^\circ \text{C}$. In stabilized conditions the wall temperature at the furnace should be measured by an optical micropyrometer at intervals of 10 mm on three equally spaced vertical axes. The wall temperature should not vary by more than 50°C over a mid-height length of 100 mm and this should give an average wall temperature of about 850°C . This provides a constant temperature zone for the specimen and can be achieved by having the electric windings spaced as shown in working drawings. Separate windings may optionally be provided at each end of the furnace tube, controlled independently to obtain the constant temperature zone.

* Evidence shows that the material used for the refractory furnace tube and its fabrication may influence the experimental results. This part of the furnace should be obtained from the source shown on the drawings and comply with the specifications.

** Copies of the working drawings of the apparatus may be obtained from the IMCO Secretariat.

To minimize temperature fluctuations in the furnace it is necessary to use a voltage stabilizer in the circuit, able to maintain voltage within ± 5 per cent of the nominal value. Automatic thermostatic control of the furnace is not to be used during test.

4.4 Temperature measurement

Temperatures should be measured by means of insulated sheathed thermocouples having an outside diameter of 1.5 ± 0.1 mm with thermo-electric wires of approximately 0.2 mm diameter. Before using for test, new thermocouples should be aged in the heated furnace atmosphere to slightly oxidize their outer sheaths. The temperature should be recorded by an instrument having a measuring range that corresponds with the temperature changes that occur during the tests. Measurement should be made at intervals of not more than 10 seconds. The electromotive force temperature conversion process of the recording device used should have an accuracy of at least 0.5 per cent, and the thermocouples should have a time constant in the range of 15 to 25 seconds.*

4.5 Location of thermocouples

Three thermocouples should be used, the furnace thermocouple to measure the furnace temperature, the surface thermocouple to measure the temperature at the surface of the specimen and the specimen thermocouple to measure the temperature in the centre of the specimen. The furnace thermocouple should be located with its hot junction 10 ± 0.5 mm from the wall of the furnace and at the mid-height of the constant temperature zone as defined by the wall temperature (see figure 2). A method of maintaining the correct distance from the wall is by the use of a guide attached to the draught shield. The surface thermocouple should, prior to the test, have its hot junction next to the surface of the specimen at mid-height and be in contact with the specimen. The specimen thermocouple should be located with its hot junction in the centre of the specimen and should be inserted from the top through a hole of 2 mm diameter.

4.6 Specimen holder and insertion device

The specimen is placed in a basket made of nickel-chromium alloy or heat-resisting steel. At the bottom of the holder, a fine metal gauze in heat-resisting steel should be provided. The mass of the basket should be between 6 ± 0.2 g. The holder is suspended from the lower end of an adjustable tube of heat-resisting steel, having an outside diameter of approximately 6 mm and a bore of 4 mm. The specimen insertion device consists essentially of a metallic sliding rod moving freely in a vertical tube fitted to the side of the furnace. The heat-resisting steel tube with the specimen holder is fixed by a space bar to the sliding rod. The design of the insertion device should be such that the specimen can be introduced into the furnace rapidly and without any shock. The inserted specimen should occupy a specified position in the furnace in the middle of the constant temperature zone and equidistant from the walls.

4.7 Specimen viewing device

A mirror should be mounted above the furnace for observation of any evidence of flaming. It should be mounted in such a way that it is possible to view the specimen continuously following insertion.

5 TEST SPECIMENS

5.1 Preparation of specimens

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

* Time constant is expressed as the time to reach 63.2 per cent of the final temperature value on heating in the furnace (750°C).

If the thickness of the material is less than 50 mm, the specimen must be made of sufficient layers to achieve the thickness required in 5.2. The layers should occupy a horizontal position and should be held together firmly in the specimen holder. The density of the specimen should be representative of the density of the material.

Materials or composite materials which involve thin surface laminations should be tested without such surface laminates unless otherwise specified by the Administration involved.

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 should be prepared to the required thickness by proportionally adjusting the thickness of the different components. The top and bottom faces of the specimen should be the finished faces of the material.

If it is not possible to follow this procedure to prepare the specimen, tests should be performed on the individual components and reported accordingly.

5.2 Number and size

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

diameter:	$45 \pm \frac{0}{2}$ mm
height:	50 ± 3 mm
volume:	80 ± 5 cm ³

5.3 Conditioning

The specimens should be conditioned in a ventilated oven maintained at $60^{\circ} \pm 5^{\circ}\text{C}$ for at least 20 hours and cooled to ambient temperature in a desiccator prior to the tests. The weight of each specimen shall be determined before test.

6 PROCEDURE

6.1 Apparatus

Before starting the test, it is necessary to ascertain that the whole equipment is in good working order – for example, the stabilizer cone is clean, the insertion device is working smoothly, the specimen holder occupies the exact position in the furnace and the furnace thermocouple is accurately located.

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

The furnace with an empty specimen basket in position (figure 2) should be heated and the furnace temperature stabilized at $750^{\circ} \pm 10^{\circ}\text{C}$. For a minimum period of 10 minutes before the insertion of a specimen and during the test no adjustment should be made in the energy input to the furnace.

6.2 Insertion of specimens

The specimen should be placed in the holder described in 4.6. It should be inserted in the furnace taking not more than 5 seconds for this operation.

6.3 Duration of heating

The heating period commences with the insertion of the specimen in the furnace and should be continued for 20 minutes, or until peak temperatures have been passed.

6.4 Test observations

A record should be made of the temperature readings from the three thermocouples during the heating period and note taken of the occurrence and duration of any sustained flaming. The weight of each specimen after test shall be determined. Sustained flaming shall be taken as continuous presence of flames in the furnace.

6.5 Number of specimens tested

The test is carried out on five specimens, prepared as specified in 5.1 and 5.2.

7 CLASSIFICATION OF MATERIALS

7.1 Non-combustibility

A material should be deemed non-combustible, if:

- .1 the average of the five maximum readings of furnace thermocouples does not show a rise above the initial furnace temperature of more than 50°C;*
- .2 the average of the five maximum readings of surface thermocouples does not show a rise above the initial furnace temperature of more than 50°C;*
- .3 the average of all recorded maximum durations of sustained flaming does not exceed 10 seconds; and
- .4 the average loss of weight for the specimens after test is not more than 50 per cent of the original weight after conditioning.

7.2 Combustibility

If one of the four criteria is not satisfied the material is deemed combustible.

8 TEST REPORT

The test report should include the following information:

- .1 name of testing body;
- .2 name of manufacturer of the material;
- .3 date of supply of the materials and of tests;
- .4 name or identification mark of the material;
- .5 description of the material;
- .6 density of the material;
- .7 description of the specimens (only for composite material);
- .8 test method;
- .9 test results including all temperature curves and observations;
- .10 designation of the material according to the test criteria specified in section 7.

* As established before inserting the specimen (see 6.1).

Dimensions in millimetres

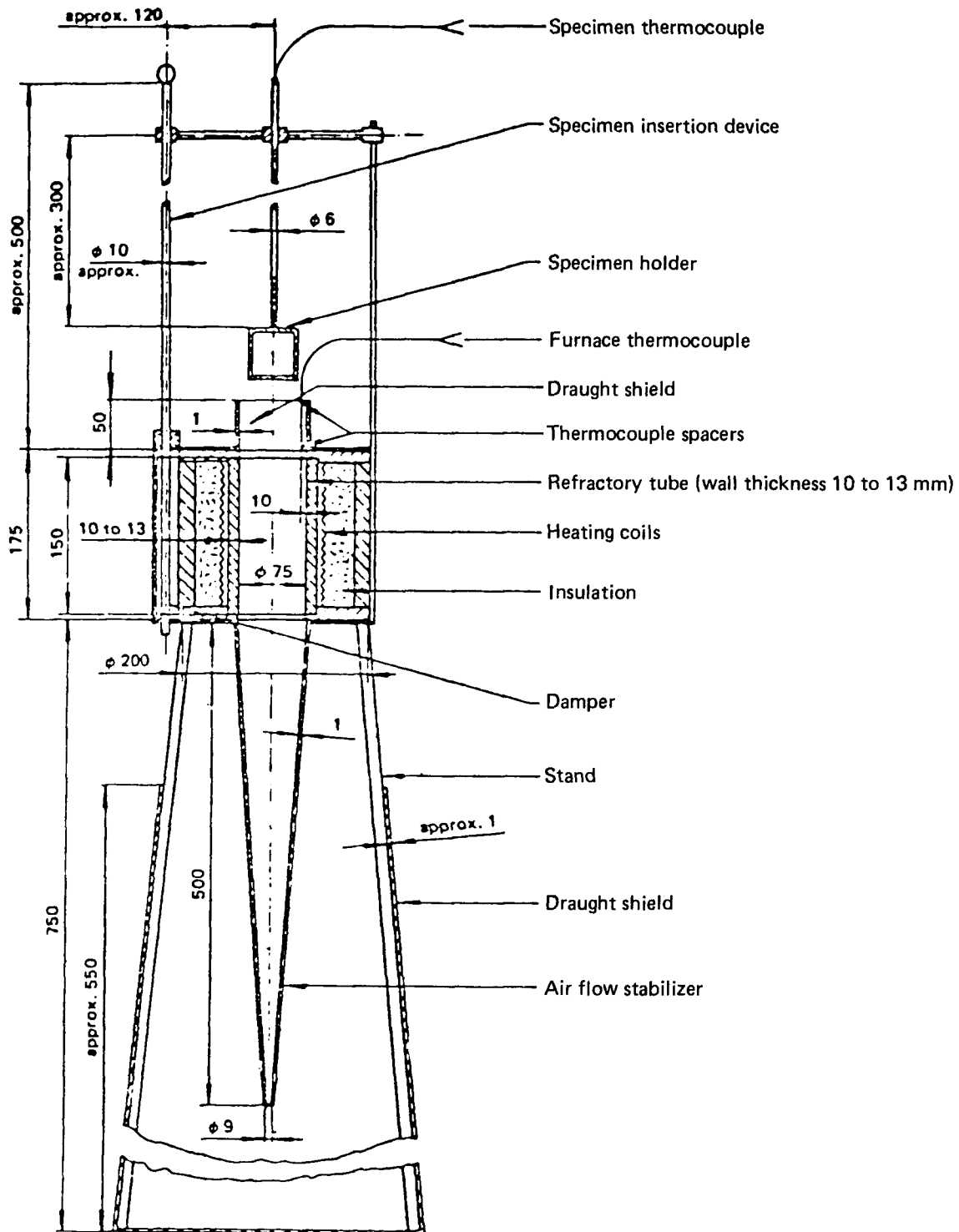


Figure 1 – General arrangement: Non-combustibility apparatus

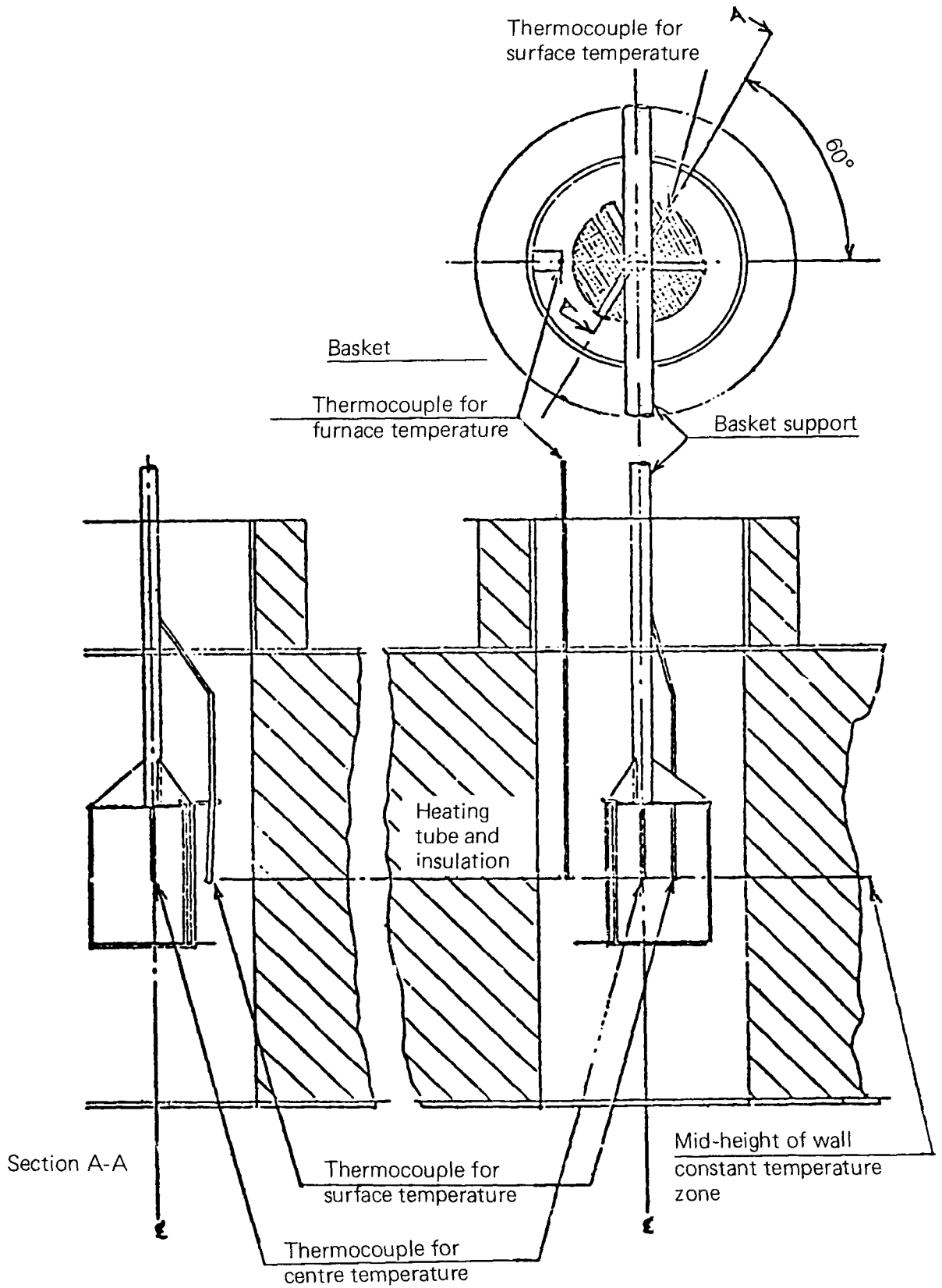


Figure 2 – Arrangement of empty specimen basket and thermocouples in furnace during stabilization prior to test.