

RESOLUTION A.517(13) adopted on 17 November 1983
RECOMMENDATION ON FIRE TEST PROCEDURES FOR
"A", "B" AND "F" CLASS DIVISIONS



ASSEMBLY - 13th session
Agenda item 10(b)

Distr.
GENERAL

A 13/Res.517
29 February 1984

Original: ENGLISH

IMO

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**RECOMMENDATION ON FIRE TEST PROCEDURES FOR
"A", "B" AND "F" CLASS DIVISIONS**

THE ASSEMBLY,

RECALLING Article 16(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations concerning maritime safety,

NOTING Assembly resolution A.163(ES.IV), entitled "Recommendation for Fire Test Procedures for "A" and "B" Class Divisions", as amended by resolution A.215(VII),

RECOGNIZING the need to improve test procedures for determining the compliance of insulating values, as defined in regulation 3(c) and (d) of chapter II-2 of the International Convention for the Safety of Life at Sea, 1974, and regulation 3.3 and 3.4 of chapter II-2 of the 1981 and 1983 amendments to that Convention, as well as regulation 2(34), 2(35) and 2(37) of chapter I of the Torremolinos International Convention for the Safety of Fishing Vessels, 1977,

HAVING CONSIDERED the recommendations made by the Maritime Safety Committee at its forty-eighth session,

1. ADOPTS the Recommendation on Fire Test Procedures for "A", "B" and "F" Class Divisions, the text of which is annexed to the present resolution, which supersedes the recommendation annexed to resolution A.163(ES.IV) as amended by resolution A.215(VII);
2. INVITES all Governments concerned to apply the revised recommendation in compliance with the relevant definitions in regulation 3 of chapter II-2 of the International Convention for the Safety of Life at Sea, 1974, and the 1981 and 1983 amendments thereto and regulation 2 of chapter I of the Torremolinos International Convention for the Safety of Fishing Vessels, 1977.

ANNEX

RECOMMENDATION FOR FIRE TEST PROCEDURES FOR "A", "B" AND "F" CLASS DIVISIONS*

A TESTING

1 GENERAL

1.1 Under the provisions of the International Convention for the Safety of Life at Sea, 1974, and subsequent amendments thereto, and the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, constructions and materials for use in passenger ships, cargo ships, and fishing vessels as "A" class bulkheads and decks, "A" class doors, "B" class bulkheads, ceilings and decks, "B" class doors, "F" class bulkheads, decks, ceilings and linings and "F" class doors should have an insulating value to the satisfaction of, and be approved by, the Administration.

Such approval will be based on reports from a testing laboratory recognized by the Administration of results obtained from tests carried out on the construction and material in question, and therefore the manufacturer or agent should, if required, submit test specimens and information to the testing laboratory as laid down in section 2.

1.2 The dimensions of the structural cores of the test specimens given in section 2 are intended for structural cores of stiffened flat plates of steel or aluminium alloy. The Administration may require tests to be carried out on specimens having structural cores of materials other than steel or aluminium alloy if such materials are more representative of the construction to be used on board ships.

1.3 Although both steel and aluminium alloy constructions are included in this test procedure, uninsulated steel bulkheads or decks of suitable scantlings and without openings meet the requirements for "A" class divisions with regard to the passage of smoke and flame whereas uninsulated aluminium alloy bulkheads or decks do not meet the requirements.

1.4 It is intended that insulating materials which pass the appropriate test for "A" class divisions and "B" class decks may be used in conjunction with constructions of steel or aluminium, whichever is applicable, having heavier scantlings than indicated in section 2.

1.5 A material used to insulate the structural core of a test specimen for an "A" class division and panels of a material used in the construction of a test specimen for a "B" or "F" class division should be tested without paint or other superimposed finish; provided that where such materials and panels are only produced with a superimposed finish, and subject to the agreement of the Administration, such materials and panels may be tested as produced. Such a material or panels may be required to be tested with a superimposed finish if such a finish is considered by the Administration to have a detrimental effect on the performance of the "A", "B" or "F" class division of which such a material or panel is part.

* As defined in the International Convention for the Safety of Life at Sea, 1974, chapter II-2, part A and the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, chapter I except that "F" class divisions are defined only in the latter Convention.

2 NATURE, SIZE AND ERECTION OF TEST SPECIMENS

2.1 Insulated "A" class bulkheads

2.1.1 *Dimensions of structural core:*

The dimensions of the structural core should be in accordance with figure 1 and the following:

Thickness of plating	Steel	4.5 ± 0.5 mm
	Aluminium	6.0 ± 0.5 mm
Vertical stiffeners spaced at 600 mm	Steel	$65 \pm 5 \times 65 \pm 5 \times 6 \pm 1$ mm
	Aluminium	$100 \pm 5 \times 75 \pm 5 \times 9 \pm 1$ mm

2.1.2 *Insulating materials:*

The following materials should be submitted by the manufacturer:

The identification mark and trade name.

Principal details of composition.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

2.1.3 *Dimensions of panels of insulation material:*

If the insulation medium consists of panels of a material, the test specimen should be constructed of the panels at least one of which is to be the maximum width which may be used in practice, subject to at least one joint being incorporated.

2.1.4 *Drawings:*

A drawing of the test specimen indicating the following should be submitted by the manufacturer:

Details and dimensions of the structural core.

Thickness of insulation in way of plating and stiffeners.

Methods of securing insulation and details of materials used for this purpose.

Details of joints, connections and air gaps, if any.

2.1.5 The testing laboratory should determine the actual thickness of the insulating material of the test specimen and the density and, where applicable, the water and/or binder content of reference specimens of the insulating material after they have been conditioned in the same manner as specified for the test specimen in 3.1.1.

The methods of determining these properties should be as specified in 3.3. The reference specimens for sprayed insulating materials should be made when the material is sprayed on the bulkhead panel and they should be sprayed in the vertical position in a similar manner as the bulkhead panel.

2.2 Insulated "A" class decks

2.2.1 *Dimensions of structural core:*

The dimensions of the structural core should be in accordance with figure 1 and the following:

Thickness of plating	Steel	4.5 ± 0.5 mm
	Aluminium	6.0 ± 0.5 mm
Deck beams spaced at 600 mm	Steel	$100 \pm 5 \times 70 \pm 5 \times 8 \pm 1$ mm
	Aluminium	$150 \pm 5 \times 100 \pm 5 \times 9 \pm 1$ mm

2.2.2 *Insulating materials:*

The following information should be submitted by the manufacturer:

Identification mark and trade name.

Principal details of composition.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

2.2.3 *Dimensions of panels of insulation material:*

If the insulation medium consists of panels of a material, the test specimen should be constructed of the panels at least one of which should be of the maximum size which may be used in practice, subject to at least one joint being incorporated.

2.2.4 *Drawings:*

A drawing of the test specimen indicating the following should be submitted by the manufacturer:

Details and dimensions of the structural core.

Thickness of insulation in way of plating and beams.

Methods of securing insulation and details of materials used for this purpose.

Details of joints, connections and air gaps, if any.

2.2.5 The testing laboratory should determine the actual thickness of the insulating material of the test specimen and the density and, where applicable, the water and/or binder content of reference specimens of the insulating material after they have been conditioned in the same manner as specified for the test specimens in 3.1.1.

The methods of determining these properties should be as specified in 3.3.

The reference specimens for sprayed insulating materials should be made when the material is sprayed on the deck panel and they should be sprayed in the overhead position in a manner similar to the deck panel.

2.2.6 *Light fittings and ventilation units in ceilings forming the insulating medium for "A" class decks:*

The Administration may require tests to be carried out on ceiling constructions which incorporate light fittings and ventilation units in order to verify that the fire performance of the ceilings is not impaired by such fittings and units.

2.3 "A" class doors and frames

2.3.1 *General:*

The specimen should be representative of the door and frame to be used on board ships, including the materials and the method of construction.

2.3.2 *Materials of construction:*

The door and frame should be constructed of steel or other equivalent material and insulated as necessary to achieve the desired standard of insulation. Door furniture such as hinges, locks, latches, shoot bolts, handles etc. should be constructed of materials having melting points of not less than 950°C.

2.3.3 *Erection of the test specimen:*

- .1 The door and frame should always be tested as an assembly.
- .2 The doorframe should be mounted in an "A" class steel bulkhead constructed in accordance with 2.1.1. The bulkhead stiffeners should be on the unexposed side of the bulkhead and the bulkhead should be insulated on the exposed side with a material approved by the Administration to at least the same standard as that which the door is intended to achieve, e.g. a door of "A-15" standard should be tested in a bulkhead insulated to at least "A-15" standard. The door which is tested should be the maximum size which is intended to be used on board ships.
- .3 A door should be tested from the side expected to give the inferior performance. A hinged door is to open away from the fire unless the Administration deems otherwise.
- .4 A door is not to be locked when tested.

2.3.4 *Insulating materials:*

The following information should be submitted by the manufacturer if the door is insulated:

Identification mark and trade name.

Principal details of composition.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

2.3.5 *Drawings:*

A drawing of the test specimen indicating the following should be submitted by the manufacturer:

Dimensions and details of the "A" class bulkhead.

Dimensions and details of the door and frame construction including the clearances between the edges of the door and the doorframe.

Details of the connection of the frame to the bulkhead.

Method of securing insulation and details of materials used for this purpose.

Details of fittings such as hinges, shoot bolts, latches, locks etc.

2.3.6 Before the test, the laboratory should determine the actual clearances between the edges of the door and the doorframe after the test specimen has been erected.

2.4 "B" or "F" class bulkheads and linings

2.4.1 *Materials:*

The following information should be submitted by the manufacturer:

Identification mark and trade name of the material.

Principal details of composition and construction. The panel widths are to be specified.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

Whether the materials are combustible or non-combustible.

2.4.2 *Dimensions:*

The dimensions of the test specimen should be in accordance with figure 2. The test specimen should be constructed of panels at least one of which is the maximum width which may be used in practice, subject to at least one joint being incorporated.

2.4.3 *Drawings:*

A drawing of the test specimen indicating the following should be submitted by the manufacturer:

Panel identification mark and trade name.

Measurements and details of joints and materials used.

2.4.4 The testing laboratory should determine the actual dimensions of the panels and the density and, where applicable, the water and/or binder content of reference specimens of the panels after they have been conditioned in the same manner as specified for the test specimen in 3.1.1.

The methods of determining these properties should be as specified in 3.3.

2.5 "B" or "F" class ceilings

2.5.1 *General:*

The test specimen should be suspended from a steel deck panel constructed in accordance with the structural core of an "A" class deck outlined in 2.2.1. The construction of the ceiling and method of suspension should be representative of the construction and method to be used on board ships. Small viewing and access openings should be provided in the restraint frame or furnace wall between the ceiling and the deck panel in order that observations can be made of the upperside of the ceiling and tests for the penetration of hot gases may be carried out as required by 4.2.2. Such access openings should be provided with suitable covers or plugs.

2.5.2 *Materials:*

The following information should be submitted by the manufacturer:

Identification and trade name.

Principal details of composition and construction. The panel sizes should be specified.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

Whether the materials are combustible or non-combustible.

Details and dimensions of supporting steel deck panel.

2.5.3 *Dimensions:*

The dimensions of the panels of material from which the ceiling is constructed should be the maximum which are to be used in practice, subject to at least one joint being incorporated.

2.5.4 *Drawings:*

The drawing of the test specimen indicating the following should be submitted by the manufacturer:

Panel identification and trade name.

Measurements and details of ceiling joints, suspension and all materials used.

Measurements and details of supporting steel deck panel.

2.5.5 The testing laboratory should determine the actual dimensions of the panels and the density and, where applicable, the water and/or binder content of the reference specimens of the panels after they have been conditioned in the same manner as specified for the test specimen in 3.1.1.

The methods of determining these properties should be as specified in 3.3.

2.5.6 *Light fittings and ventilation units in "B" or "F" class ceilings:*

The Administration may require tests to be carried out on ceiling constructions which incorporate light fittings and ventilation units in order to verify that the fire performance of the ceilings is not impaired by such fittings and units.

2.6 "B" class decks

2.6.1 *General:*

This section is for decks constructed of aluminium alloy which are required to meet a B-0 standard. Uninsulated intact steel decks meet the requirements of "B" class standard with regard to preventing the passage of flame and therefore satisfy B-0 standard.

2.6.2 *Dimensions of structural core:*

The structural core should be of aluminium alloy having dimensions in accordance with figure 1 and scantlings as follows:

Thickness of plating	6.0 ± 0.5 mm
Deck beams spaces at 600 mm	$150 \pm 5 \times 100 \pm 5 \times 9 \pm 1$ mm

2.6.3 *Insulating materials:*

The following information should be submitted by the manufacturer:

Identification mark and trade name.

Principal details of composition.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

2.6.4 Dimensions of panels of insulation material:

If the insulation medium consists of panels of a material, the test specimen should be constructed of the panels at least one of which should be of the maximum size which may be used in practice, subject to at least one joint being incorporated.

2.6.5 Drawings:

A drawing of the test specimen indicating the following should be submitted by the manufacturer:

Details and dimensions of the structural core.

Thickness of insulation in way of plating and beams.

Method of securing insulation and details of materials used for this purpose.

Details of joints, connections and air gaps, if any.

2.6.6 The testing laboratory should determine the actual thickness of the insulating material of the test specimen and the density and, where applicable, the water and/or binder content of reference specimens of the insulating material after they have been conditioned in the same manner as specified for the test specimen in 3.1.1.

The method of determining these properties should be as specified in 3.3.

The reference specimens for sprayed insulating materials should be made when the material is sprayed on the deck panel and they should be sprayed in the overhead position in a manner similar to the deck panel.

2.6.7 Light fittings and ventilation units in ceilings forming the insulating medium for a "B" class deck:

The Administration may require tests to be carried out on ceiling constructions which incorporate light fittings and ventilation units in order to verify that the fire performance of the ceilings is not impaired by such fittings and units.

2.7 "F" class decks

2.7.1 General:

The specimen should be representative of the deck to be used on board fishing vessels including the materials and method of construction.

2.7.2 Materials:

The following information should be submitted, where applicable, by the manufacturer:

Identification marks and trade names of the materials.

Principal details of composition and construction.

Nominal density at ambient temperature.

Specific heat at ambient temperature.

Thermal conductivity at ambient temperature.

Whether the materials are combustible or non-combustible.

2.7.3 *Dimensions:*

The dimensions of the materials from which the deck is constructed and insulated, if applicable, should be representative of those which are to be used in practice and joints should be incorporated where applicable.

2.7.4 *Drawings:*

A drawing of the test specimen indicating the following, where applicable, should be submitted by the manufacturer:

Identification marks and trade names of the materials.

Measurements and details of the construction of the test specimen including the deck, beams, insulation and method of securing the insulation, joints and all materials used.

2.7.5 The testing laboratory should determine the actual dimensions of the components of the test specimen and density of the insulating material, if any.

2.8 "B" or "F" class doors and frames

2.8.1 *General:*

The specimen should be representative of the door and frame to be used on board ships, including the materials and method of construction.

2.8.2 *Material of construction:*

- .1 Hinges should be constructed of materials having melting points of not less than 950°C. The remaining door furniture such as locks, latches and handles should be constructed of materials having melting points of not less than 845°C unless it can be shown by the fire test that materials having melting points below 845°C do not adversely affect the performance of the door.
- .2 The following information should be submitted by the manufacturer:
 - Identification mark and trade name.
 - Principal details of composition and construction.
 - Nominal density at ambient temperature.
 - Specific heat at ambient temperature.
 - Thermal conductivity at ambient temperature.
 - Whether the materials are combustible or non-combustible.

2.8.3 *Erection of test specimen:*

- .1 The door and frame should always be tested as an assembly.
- .2 The doorframe should be mounted as appropriate in a "B" or "F" class bulkhead constructed in accordance with 2.4.2. The bulkhead should be constructed of a material approved by the Administration.
- .3 A door should be tested from the side expected to give the inferior performance. A hinged door is to open away from the fire unless the Administration deems otherwise.
- .4 A door is not to be locked when tested.

2.8.4 *Drawings:*

A drawing of the test specimen indicating the following should be submitted by the manufacturer:

Dimensions and details of the "B" or "F" class bulkhead as appropriate.

Dimensions and details of the door and frame construction including the clearances between the edges of the door and the doorframe.

Details of the connection of the frame to the bulkhead.

Details of hinges, locks, handles, ventilation louvres, escape panels, etc.

2.8.5 Before the test, the laboratory should determine the actual clearances between the edges of the door and doorframe after the test specimen has been erected.

3 METHOD OF TESTING

3.1 Fire resistance test

This test should be carried out with the specimens mentioned in 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 and 2.8.

3.1.1 *Conditioning of test specimen:*

Test specimens should be conditioned to approximately constant weight with an atmosphere of a relative humidity of $55 \pm 15\%$ and a temperature of $20^\circ \pm 5^\circ\text{C}$. The duration of conditioning a test specimen should be determined by the time taken for the small reference specimen of the insulating material used in the test specimen to attain approximately constant weight in the above atmosphere. Other reliable methods of verifying that the material has reached equilibrium with the specified conditions may be used by the testing laboratory. After conditioning but before testing the temperature of the specimen should not exceed 40°C .

3.1.2 *Means of fastening specimens in the furnace:*

- .1 The specimens constructed as indicated in 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 and 2.8 should be mounted in the furnace in such a way as to give an exposed surface of at least 4.65 m^2 and a bulkhead height or deck panel length of at least 2.44 m.
- .2 Bulkheads and doors should be tested in a vertical position and decks and ceilings in a horizontal position.
- .3 A specimen of a construction which is required to withstand fire from either side should be tested from each side if required by the Administration. Where one side of the specimen is expected to give a performance inferior to that of its other side, the Administration may require the specimen to be tested only from that side which is expected to give the inferior performance.
- .4 A specimen of a deck or ceiling construction should be tested with only the underside of the specimen exposed to the furnace.
- .5 The specimen should be secured as follows:
 - .5.1 In the case of an "A" class division, or a "B" class deck or ceiling, or an "F" class deck or ceiling, the specimen should be restricted against expansion on all four sides, except if it is intended in service to provide movement for expansion at the edges of a ceiling or at intervals across it in the longitudinal or transverse direction, the test specimen should simulate these conditions. Details of the method of securing and restricting the specimen should be shown in the test report.

- .5.2 In the case of a "B" or "F" class bulkhead, the specimen should be supported at the top and secured on the vertical sides and at the bottom in a manner representative of the conditions in service. Details of the method of securing the specimen should be shown in the test report. If provision for movement at the edges of a bulkhead is made for a particular construction in service, the specimen should simulate these conditions.
- .5.3 The method of securing should be such that there is no possibility of misinterpretation of test results of passage of flame and smoke for "A" class divisions and passage of flame for "B" or "F" class divisions at the edges of the specimen when the method of fixing is not the subject of the test.

3.1.3 *Furnace control:*

- .1.1 In the case of a specimen size specified in figures 1 and 2, the furnace temperature should be determined by means of four thermocouples of not less than 0.75 mm diameter and not more than 1.5 mm diameter. For specimens larger than specified in figures 1 and 2, additional thermocouples should be provided in the proportion one per 1.25 m² of the specimen area. In the case of a door assembly, specimen area refers to the entire bulkhead construction with the door fitted. Thermocouples should be uniformly disposed over the specimen area with a spacing between the thermocouples in the horizontal and vertical plane, within the range of 0.75 m to 1.25 m.
- .1.2 The thermocouples should be arranged with each hot junction at such a position that an arc of 100 mm radius described from that junction meets the exposed face of the specimen or any projection. The hot junctions of the thermocouples should not be located at positions within the furnace where they are subject to direct flame impingement.
- .1.3 The hot junction of the thermocouples may be formed by welding or crimping the ends of the wires. The crimping should be done by using a crimping tip as shown in figure 3.
- .1.4 Other types of thermocouples may also be used to control the furnace temperature. In all cases the response time characteristics of the thermocouples should not be inferior to that provided by a crimped tip thermocouple having a mass of 0.38 g.
- .1.5 The wires should be insulated from each other by ceramic insulators or similar of not more than 10 mm diameter and the hot junction should project 25 mm from the end of the insulators. The insulated wires should be housed and supported in suitable heat resisting steel tubes (e.g. "Inconel" or chromite) and arranged so that the ceramic or similar insulated portion projects 75 mm. The steel tubes should be sealed and packed with a high temperature insulant or fire clay. A sketch of a thermocouple is shown in figure 4.
- .1.6 Provision should be made for the steel tubes to be movable in order that the 100 mm spacing may be maintained between the hot junctions of the thermocouples and the test specimen where distortion of the specimen occurs.
- .1.7 The thermocouple wire should be either continuous to the recording instrument or suitable compensating wire should be used with all junctions maintained as near as possible at ambient temperature conditions.
- .2 The furnace temperature rises should be continuously controlled so as to follow the standard time-temperature curve within the limits specified in .4 below.

- .3 The standard time-temperature curve is defined by a smooth curve drawn through the following points measured above the initial furnace temperature:

At the end of the first 5 minutes	556°C
At the end of the first 10 minutes	659°C
At the end of the first 15 minutes	718°C
At the end of the first 30 minutes	821°C
At the end of the first 60 minutes	925°C

- .4 The accuracy of the furnace control should be as follows:

- .4.1 During the first 10 minutes of the test the area under the curve of mean furnace temperature should not vary by more than $\pm 15\%$ of the area under the standard curve.
- .4.2 During the first half hour of the test the area under the curve of mean furnace temperature should not vary by more than $\pm 10\%$ of the area under the standard curve.
- .4.3 For any period after the first half hour of the test the area under the curve of mean furnace temperature should not vary by more than $\pm 5\%$ of the area under the standard curve.
- .4.4 At any time after the first 10 minutes of the test the mean furnace temperature should not differ from the standard curve by more than $\pm 100^\circ\text{C}$.

- .5 Pressure in the furnace:

- .5.1 An overpressure should exist in the furnace relative to the laboratory during the whole heating period of an "A", "B" or "F" class test except during the first 5 minutes of the test when the overpressure may be outside the limits specified in 5.2 below.
- For bulkhead and door assemblies, the overpressure should exist over at least the upper two thirds of the height of the test specimen.
- .5.2 An overpressure equal to 10 ± 2 pascals (1 ± 0.2 mm water gauge) based on a short period average of rapid fluctuations should be measured and monitored:
- in the case of deck and ceiling constructions, at a point 100 mm below the lower surface of the test specimen; and
 - in the case of bulkheads or bulkheads incorporating door assemblies, at a point located approximately three quarters of the height of the test specimen.

3.1.4 *Construction of thermocouples for measuring the temperature on the unexposed side of the specimen* (see figure 5):

- .1.1 Each thermocouple should be of 0.5 mm diameter wires brazed to a copper disc 12 mm in diameter and 0.2 mm in thickness.
- .1.2 Both wires should be brazed to the same face of the disc, at positions diametrically opposite with an overlap onto the copper disc of at least 4 mm (see figure 5).
- .1.3 The thermocouples should be covered with an asbestos pad, 30 mm square by 2 mm thick.
- .1.4 The asbestos pad should have a density of $900 \text{ kg/m}^3 \pm 10\%$ and a thermal conductivity of $0.13 \text{ W/m/}^\circ\text{C} \pm 10\%$ at 100°C . Other materials with similar thermal properties may be used in place of the asbestos.

- .1.5 The thermocouple constructional procedure should be as follows: the pad should be drilled to allow the wires to pass through it, the holes being the same diameter as the wire, at positions along a centreline 12 mm apart equally spaced from the edges. The face of the thermocouple disc with wires brazed thereto should be in contact with the face of the pad thus ensuring a smooth surface for contact with the specimen. No adhesive should be used between the thermocouple and the pad.
- .1.6 The thermocouple wires should protrude from the pad by at least 150 mm and should be insulated with a woven sleeving of glass or similar fibre. Any other suitable material may be used to sheathe the thermocouple wires provided that such material is not likely to become damaged during the test.
- .1.7 Connection to the measuring instrument should be by wires of similar or appropriate compensating type.
- .1.8 The thermocouple leads should be supported in such a way that the thermocouples and/or leads do not become disconnected during the test due to their weight or to the distortion of the test specimen.
- .2 The thermocouples should be fixed to the unexposed surface of the specimen as follows:
 - .2.1 Steel: The asbestos pad with the thermocouple fitted should be bonded to the cleaned surface of the steel using a "water-based ceramic cement" produced by integrating the components to form a high temperature resistant adhesive. The adhesive should be of such a consistency that no mechanical aid is necessary for retention purposes during the drying process, but where difficulty in bonding is experienced, retention by adhesive tape may be employed provided that the tape is removed sufficiently long in advance of the test to allow complete drying of the adhesive. Care is required in the removal of the tape to ensure that the asbestos pad is not damaged. If the thermocouple pad is damaged when the tape is removed then the thermocouple should be replaced.
 - .2.2 Fibrous surfaces: The thermocouples with asbestos pads fitted should be arranged in such a way that if a surface wire mesh is present it may aid retention and in all cases the bond to the fibrous surface should be made using a "contact" adhesive. The nature of the adhesive necessitates a drying time before mating surfaces are put together thus obviating the need for external pressure.
 - .2.3 Site applied wet fibrous spray: Thermocouples should not be fitted until the insulation has reached a stable moisture condition. In all cases the bonding technique for steel should be used and where a surface wire mesh is present the thermocouples should be affixed to the insulation in such a way that the wire mesh aids retention.
 - .2.4 Site applied mineral aggregate spray: The technique specified for wet fibrous spray should be employed.
 - .2.5 Boards of fibrous or mineral aggregate composition: The bonding technique for steel should be used.
 - .2.6 In all cases of adhesive bonding the adhesive should be applied in a thin* film sufficient to give an adequate bond and there should be a sufficient lapse of time between the bonding of the thermocouples and the test for stable moisture conditions to be attained in the case of the ceramic adhesive and evaporation of the solvent in the case of the content adhesive.

* Thin means the minimum thickness which experience shows to be practical for an adequate bond which ensures that the copper disc is in contact with the surface of the test specimen.

.3 Preparation of the surfaces to receive the thermocouples:

- .3.1 Steel: Surface finishes should be removed and the surface cleaned with a solvent. Loose rust and scale should be removed by wire brush.
- .3.2 Irregular surfaces: A smooth surface not greater than 100 mm² to provide adequate adhesive bond should be made for each thermocouple by smoothing the existing surface with a suitable abrasive paper. The material removed should be the minimum to provide adequate bonding surface. Where the surface cannot be smoothed, fillings should be used of minimum quantity to provide a suitable surface. The filling should comprise a ceramic cement and when the filled surface is dry it should be smoothed, if necessary, with abrasive paper.

3.1.5 *Construction of thermocouples for measuring the temperature of the structural core:*

The thermocouples should be constructed from wires not greater than 0.75 mm in diameter with the hot junctions formed by welding or crimping (as detailed under 3.1.3). The wires should be untwisted at the junctions and suitably insulated. The structural component should be drilled to receive either the welded junction or the "crimped tip" and the surrounding structural component material peened over to lock the thermocouple in position. The depth of the hole to be drilled in the case of the welded junction or "crimped tip" should be 2 mm.

3.1.6 *Flaming on unexposed side of the specimen:*

Where flaming occurs on the unexposed side of an "A", "B" or "F" class specimen within the duration of the test, the specimen should be deemed to have failed the test.

3.1.7 *Test for penetration of smoke and/or hot gases:*

The purpose of this test is to indicate whether cracks and openings formed during the test are such that they would lead to the passage of smoke and/or hot gases.

- .1 Where cracks and openings are formed during the test, an ignition test as prescribed in 4.1.2 and 4.2.2 should take place immediately after the appearance of the cracks or damage followed by similar tests at appropriate intervals.
- .2 The cotton wool used for the test prescribed in 4.1.2 and 4.2.2 should consist of new, undyed and soft fibres without any admixture of artificial fibres, and it should be free from thread, leaf and shell fibre dust. A suitable material for this purpose is packaged in the form of rolls for surgical use. A pad should be cut measuring 100 mm² and approximately 20 mm in thickness and weighing between 3 and 4 g. The pad should be oven dried prior to the test and should be attached by means of wire clips to a 100 mm² frame of 1 mm diameter wire. A wire handle approximately 750 mm in length may be attached to the frame to facilitate its use on the test specimen.
- .3 When testing for cracks or openings during the test the pad should be held over the crack or opening with the aperture located in the central part of the cotton wool. Each pad should be applied only once.

3.1.8 *Temperature observations during test:*

- .1 All observations should be taken at intervals not exceeding 5 minutes. The surface temperatures on the unexposed side of the test specimen should be measured by thermocouples located as follows and indicated in figures 1 and 2:
 - .1.1 Four thermocouples each located approximately in the centre of a quarter section of the test specimen and at least 100 mm clear of any joints;

- .1.2 One thermocouple located approximately at the centre of the test specimen and at least 100 mm clear of any joints;
- .1.3 At least one thermocouple placed in way of or as close as possible to each of the central stiffeners in a specimen for an "A" class division;
- .1.4 At least one thermocouple placed at a joint, if any, at 0.75 height in a specimen of an "A" class division;
- .1.5 At least one thermocouple placed at a vertical joint at 0.75 height in a specimen of a "B" or "F" class division;
- .1.6 Additional thermocouples at the discretion of the testing laboratory or Administration for the purpose of determining the temperature at points deemed likely to give a greater temperature rise than any of the thermocouples mentioned in .1.1 and .1.2 above.
- .2 The surface temperatures on the unexposed side of an "A", "B" or "F" class door should be measured by five thermocouples located as for a bulkhead in .1.1 and .1.2 above and at least 100 mm clear of the edges of the door, lock and latch boxes and hinges. The Administration may require additional thermocouples to be located in way of or as close as possible to any stiffeners of the door panels.
- .3 The average temperature rise on the unexposed surface of the test specimen should be obtained as follows:
 - .3.1 For a specimen of an "A" class division or door by the average reading of the thermocouples mentioned in .1.1, .1.2 and .1.3 above.
 - .3.2 For a specimen of a "B" or "F" class division or door by the average reading of the thermocouples mentioned in .1.1 and .1.2 above.
- .4 Where an Administration requires or permits either an insulating material for "A" class divisions and "B" class decks or a material used in the construction of "B" or "F" class divisions to be tested with a superimposed finish e.g. a floor covering material which may have a detrimental effect on the performance of the "A" class deck as mentioned in .1.5 and the superimposed finish is combustible, the finish should be removed in way of the position in which the thermocouples mentioned in .3 above are to be placed such that the thermocouples are in contact with the insulating material. This need not be done when the superimposed finish is non-combustible.
- .5 When testing the specimen with a structural core other than steel, thermocouples should be fixed to the core material in positions corresponding to the surface thermocouples mentioned in .1.1 and .1.2 above to determine the rise in temperature of the core.

3.1.9 *Duration of testing:*

The test should continue for at least one hour for "A" class divisions and doors and one half hour for "B" or "F" class divisions and doors except that in the case of an "A" class division having a steel structural core and where the test is to ascertain the suitability of the specimen to satisfy "A-15" or "A-30" standards, the test may terminate after 15 or 30 minutes whichever is applicable because the steel intact structural core is considered to meet the requirements for "A" class divisions with regard to preventing the passage of smoke and flame (see 1.3). However the tests for "A" class divisions having structural cores other than of steel and "A" class doors are not to be similarly terminated.

3.1.10 The maximum deflection of an "A", "B" or "F" class test specimen and additionally in the case of a door, the maximum displacement of each corner of the door relative to the door-frame should be recorded during the test.

3.2 Non-combustibility test

3.2.1 *General:*

The following materials should be required to be classified as non-combustible:

- .1 insulating materials used in the construction of "A" class divisions and "B" class decks referred to in 2.1.2, 2.2.2 and 2.6.3;
- .2 materials from which "B" class (non-combustible) divisions are constructed referred to in 2.4.1 and 2.5.2;
- .3 materials used in the construction of doors used to close openings in either "A" class bulkheads or "B" class (non-combustible) bulkheads referred to in 2.3.4 and 2.8.2.

3.2.2 *Method of test:*

The test used to classify as non-combustible a material mentioned in 3.2.1 should be carried out at a testing establishment recognized by the Administration and independent of the manufacturer of the material in accordance with resolution A.472(XII).*

3.3 Tests to be carried out on the insulating material by the testing laboratory

3.3.1 The tests referred to in 3.3.2, 3.3.3 and 3.3.4 should be carried out on the insulating material of the test specimens or, where applicable, the reference specimens after they have been conditioned as specified in 3.1.1.

3.3.2 *Thickness of the insulating material:*

- .1 The thickness of a sprayed insulating material should be measured after conditioning using a suitable probe at positions adjacent to the five thermocouples referred to in 3.1.8.1.1 and 3.1.8.1.2 and at the midpoints between the four thermocouples referred to in 3.1.8.1.1.
- .2 The thicknesses of panel and mineral wool insulating materials should be measured by using a suitable gauge or calipers.

3.3.3 *Density of the insulating material:*

- .1 The density of a sprayed insulating material should be determined from the weight and dimensions of the reference specimen.
- .2 The density of panel and mineral wool insulating materials should be determined from the weight and dimensions of the panels and slabs or rolls which are to be used in the test specimens.

3.3.4 *Moisture and/or binder content of the insulating material:*

- .1 Moisture content

At least five samples of the insulating material selected at random, each sample measuring 60 x 60 mm x thickness of the material, should be weighed (initial conditioned weight W_1) and then heated in a ventilated oven at a temperature of $105 \pm 2^\circ\text{C}$ for 24 hours and reweighed (W_2) when cooled. However gypsum based, cementitious

* Improved Recommendation on Test Method for Qualifying Marine Construction Materials as Non-Combustible.

and similar materials should not be oven dried but should be placed in a dessicator charged with a suitable dessicant at a temperature of $55 \pm 5^{\circ}\text{C}$ and dried to constant weight (W_2).

The moisture content ($W_1 - W_2$) of each sample should be calculated as a percentage of the dry weight (W_2).

The percentage moisture contents of the samples should be recorded by the testing laboratory.

.2 Binder content

After the percentage moisture contents have been calculated as specified in .1 above the samples should be further heated in an oven at a temperature of $600 \pm 10^{\circ}\text{C}$ for 24 hours and again weighed (W_3). The binder content ($W_2 - W_3$) should be calculated as a percentage of the dry weight (W_2).

The percentage binder contents of the samples should be recorded by the testing laboratory.

4 TEST REQUIREMENTS

4.1 "A" class divisions and "A" class doors:

4.1.1 *Thermal insulation:*

The insulating value of the specimen should be such that the average temperature reading of the thermocouples on the unexposed surface described in 3.1.8.3.1 will not rise more than 139°C above the initial temperature, nor will the temperature at any one point on the surface, including any joint, rise more than 180°C above the initial temperature, during the time specified by the Administration. If "A" class divisions or doors are to be "A-60", "A-30", "A-15" or "A-0" standards, the above temperature rise limits should not be exceeded during the time listed below:

"A-60" standard	60 minutes
"A-30" standard	30 minutes
"A-15" standard	15 minutes
"A-0" standard	0 minutes

4.1.2 *Penetration of smoke and/or hot gases:*

Cracks and openings which may be formed in "A" class divisions with the structural core other than steel and "A" class doors should not be such as to lead to flaming of a cotton wool test pad as described in 3.1.7 held at a distance of approximately 25 mm from the aperture for a period of 30 seconds. If no flaming occurs the pad should be removed and pads applied at intervals not exceeding 5 minutes. Each pad should be applied only once.

4.1.3 *Average temperature of structural core:*

In the case of load-bearing divisions of aluminium alloy, the average temperature of the structural core obtained by the thermocouples described in 3.1.8.5 should not rise more than 200°C above its initial temperature at any time during the test for one hour. Where the structural core is of a material other than steel or aluminium alloy the Administration should decide the rise in temperature which is not to be exceeded during the test for one hour.

4.2 "B" or "F" class divisions and "B" or "F" class doors

4.2.1 *Thermal insulation:*

The insulation value of the specimen should be such that the average temperature reading of the thermocouples on the unexposed surface described in 3.1.8.3.2 will not rise more than 139°C above the initial temperature, nor will the temperature at any one point on the surface, including any joint, rise more than 225°C above the initial temperature during the period specified by the Administration. For combustible "B" class bulkheads and those assembled "B" class bulkheads with a non-combustible core which are referred to in the International Convention for the Safety of Life at Sea, 1974, chapter II-2, part D, regulation 51(b) and part F, regulation 70(c), the above temperature rise limits should not be exceeded for a period of 30 minutes and this should also apply to "F" class divisions. If non-combustible "B" class divisions are to be "B-15" or "B-0" standard, the above temperature rise limits should not be exceeded during the times listed below:

"B-15" standard	15 minutes
"B-0" standard	0 minutes

4.2.2 *Penetration of smoke and/or hot gases:*

Cracks and openings which may be formed in "B" or "F" class divisions and doors should not be such as to lead to flaming of a cotton wool test pad as described in 3.1.7 held at a distance of approximately 25 mm from the aperture for a period of 30 seconds. If no flaming occurs, the pad should be removed and pads applied at intervals not exceeding 5 minutes. Each pad should be applied only once.

4.2.3 *Average temperature of structural core:*

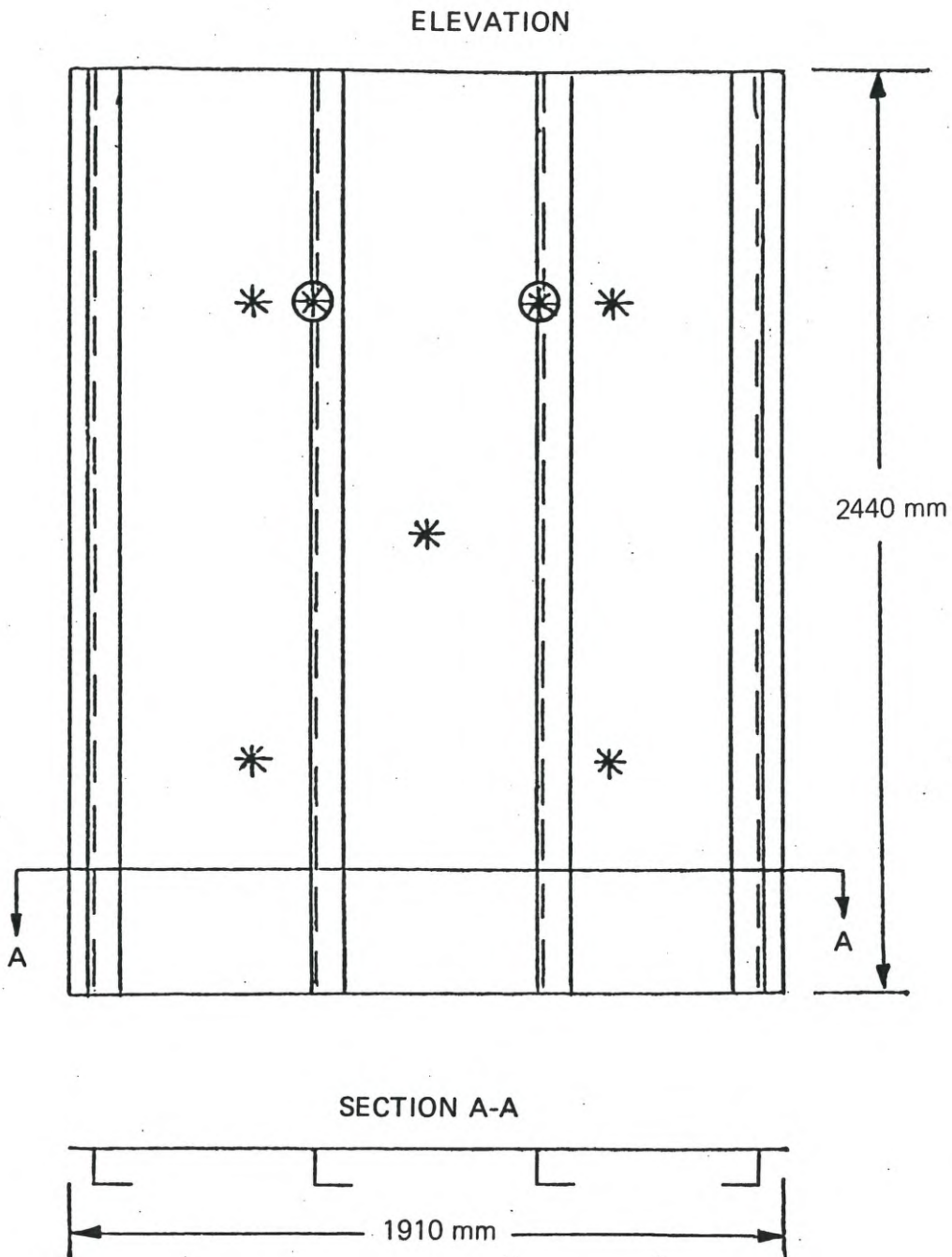
In the case of load-bearing divisions of aluminium alloy, the average temperature of the structural core obtained by thermocouples described in 3.1.8.5 should not rise more than 200°C above its initial temperature at any time during the test for one half hour. Where the structural core is of a material other than steel or aluminium alloy, the Administration should decide the rise in temperature which is not to be exceeded during the test for one half hour.

B TEST REPORTS

5.1 Reports of "A", "B" and "F" class tests should contain the following:

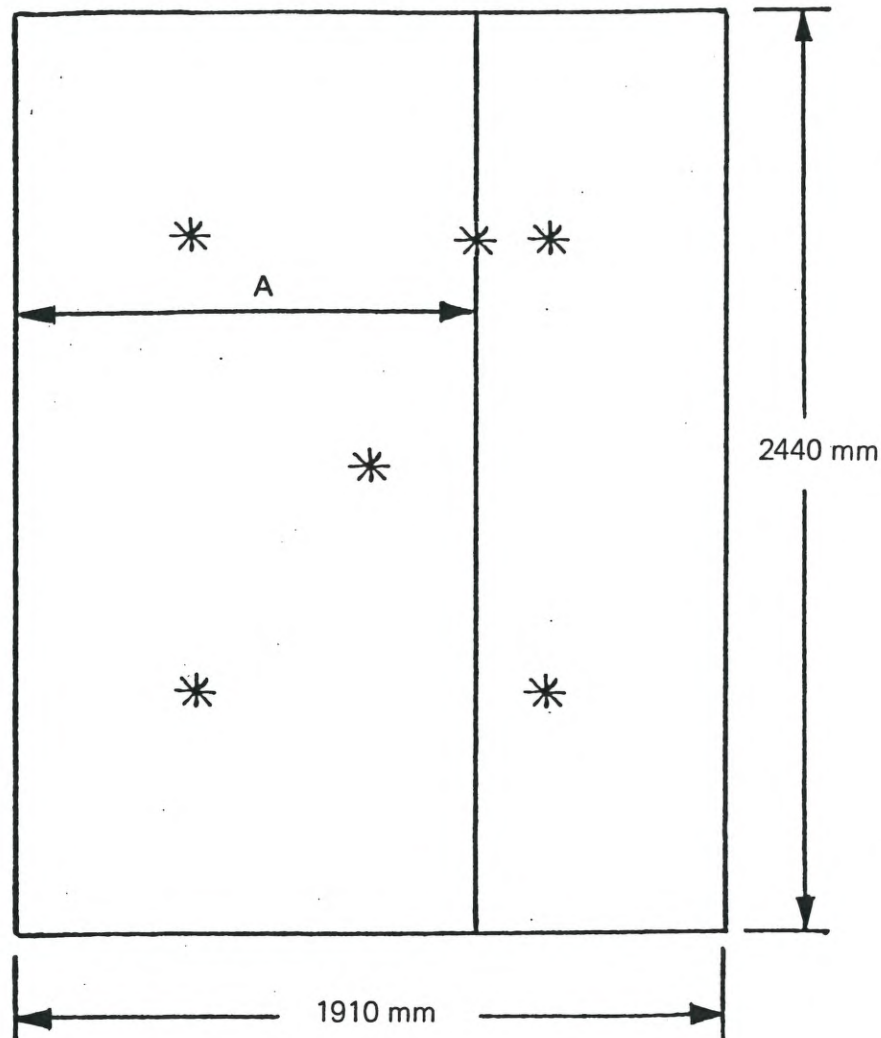
- .1 Name of manufacturer.
- .2 Name of representative of the Administration present at test; when a test is not witnessed by a representative of the Administration a note to this effect shall be made in the report.
- .3 Date of test.
- .4 Purpose of test.
- .5 Description and drawing of the test specimen.
- .6 Principal details of components with manufacturer's identification mark and trade names.

- .7 Measurements of the thickness, density and, where applicable, the water and/or binder content of the insulating material as determined by the testing laboratory.
 - .8 Test conditions.
 - .9 Testing procedure.
 - .10 Observations during test including temperature curves and photographs, if any.
 - .11 Summary of test results including:
 - .11.1 the standard attained;
 - .11.2 either the mean and maximum temperature rises and the core temperature rise, when applicable, recorded at the end of the test or, if the test is terminated due to the limiting temperature rises referred to in 4.1.1, 4.1.3, 4.2.1 and 4.2.3 having been exceeded, the times at which such limiting temperatures were exceeded;
 - .11.3 a sketch showing the dimensions and positions of any cracks in either "A" class insulating materials or the panels of materials from which "B" class divisions are constructed, or the materials from which "F" class divisions are constructed;
 - .11.4 the maximum deflection of an "A", "B" or "F" class specimen or the maximum deflection at the centre of an "A", "B" or "F" class door and the maximum displacement of each corner of the door relative to the doorframe.
- 5.2 A report of a non-combustibility test should state, for each specimen of the material which has been tested, the rises in temperature recorded by the thermocouples situated in the furnace, on the surface of the specimen and in the centre of the specimen, the duration in seconds of any flaming and the percentage loss of weight of the specimen.



- NOTES: 1. The dimensions of specimen shown are minimum and may be increased to fit the supporting frame in a laboratory.
2. * and ⊗ indicate positions of surface thermocouples (see paragraph 3.1.8).
3. Thermocouples marked ⊗ are not required to be fitted to a specimen of a "B" class deck.

Figure 1 — Fire test specimen for "A" class divisions and "B" class decks



- NOTES: 1. The dimensions of specimen shown are minimum and may be increased to fit the supporting frame in the laboratory.
2. Dimension A is the maximum width of panel used in practice.
3. * indicates positions of surface thermocouples (see paragraph 3.1.8.)

Figure 2 — Fire test specimen for "B" or "F" class bulkheads

Diameter of thermocouple wire (mm)	Dimensions of crimping tip (mm)			Mass of crimping tip (g)
	Length	Width "A"	Width "B"	
0.75 to 0.8	2	3	2	0.15
1.5	3	6	4	0.38

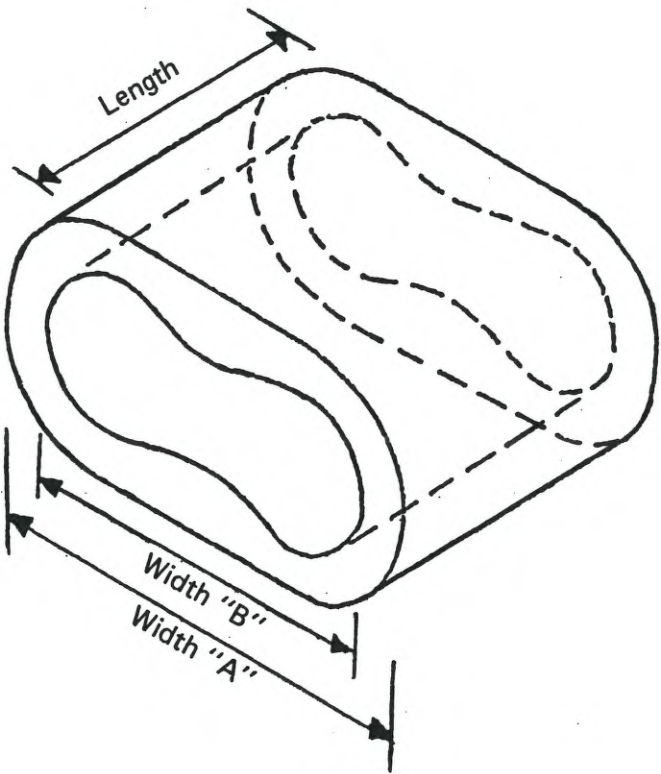


Figure 3 – Detail of crimping tip used for fabricating thermocouple junctions
(see paragraph 3.1.3.1.3)

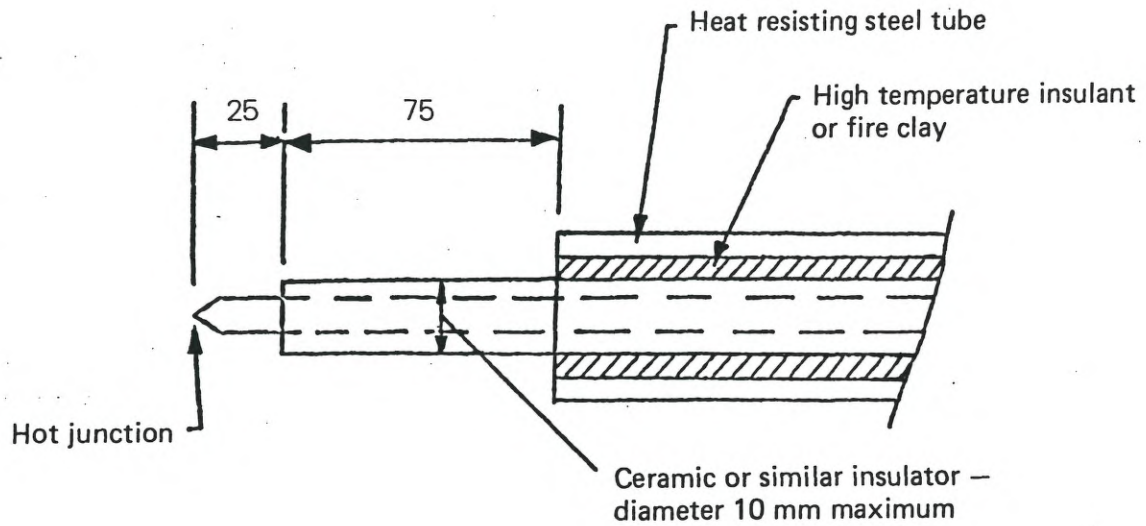


Figure 4 — Details of thermocouples for measuring furnace temperatures
(see paragraph 3.1.3.1.5)

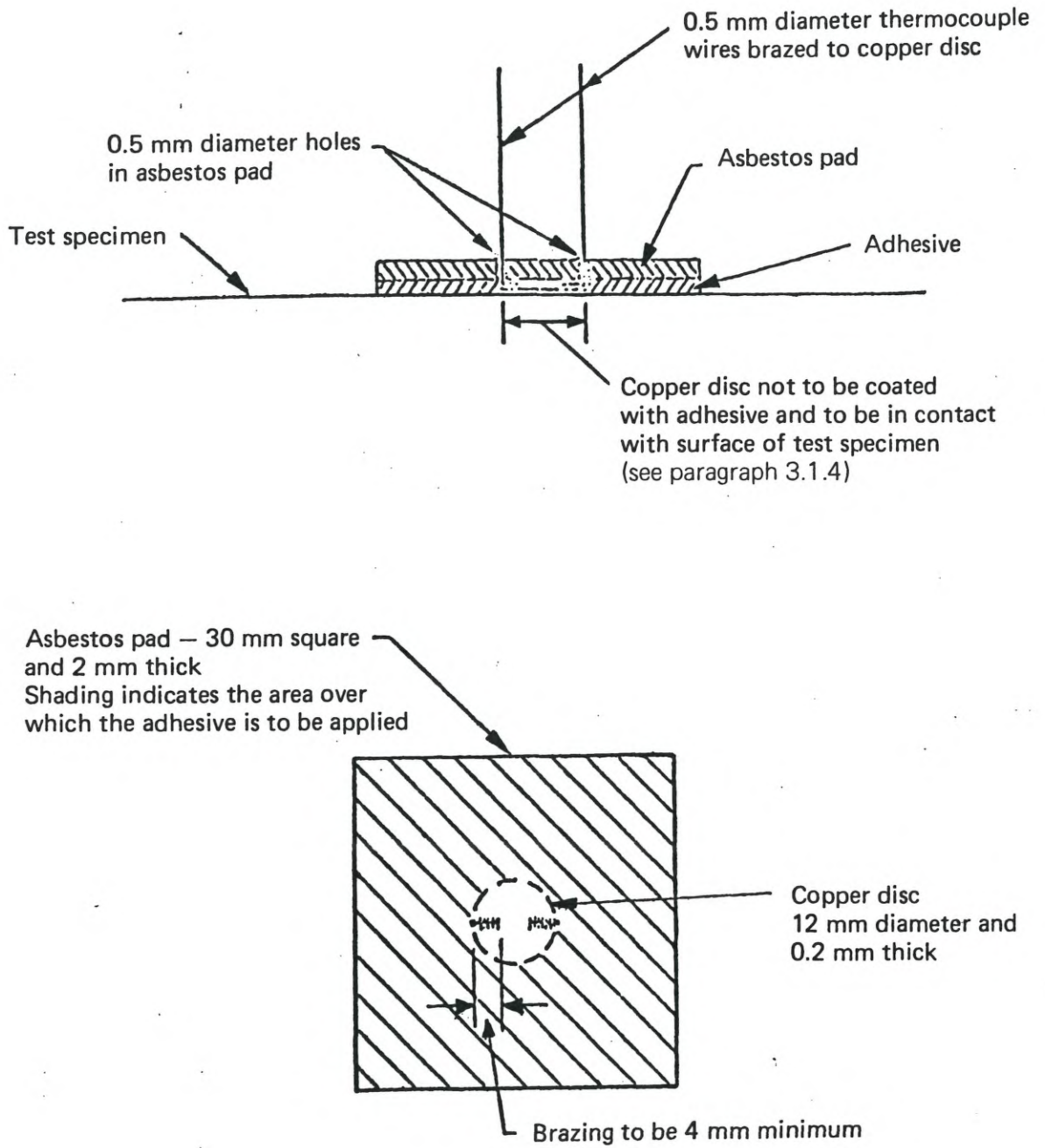


Figure 5 — Details of thermocouples fitted to unexposed side of test specimens
(see paragraph 3.1.4)

RESOLUTION A.517(13) adopted on 17 November 1983
RECOMMENDATION ON FIRE TEST PROCEDURES FOR
"A", "B" AND "F" CLASS DIVISIONS