Treaty Series No. 48 (2025)

Amendments

to the International Code for Application of Fire Test Procedures (FTP Code) of the International Convention for the Safety of Life at Sea

Resolution MSC.307(88) adopted on 3 December 2010
Resolution MSC-173(79) adopted on 10 December 2004

[The Amendments entered into force on:
Resolution MSC.307(88) – 1 January 2012
Resolution MSC-173(79) – 1 July 2006]

Presented to Parliament
by the Secretary of State for Foreign, Commonwealth and Development Affairs
by Command of His Majesty
August 2025

CP 1397

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ISBN 978-1-5286-5957-4
E03431694 08/25

Printed on paper containing 40% recycled fibre content minimum

Printed in the UK by HH Global on behalf of the Controller of His Majesty's Stationery Office

ANNEX 7

RESOLUTION MSC.173(79)
(adopted on 10 December 2004)

ADOPTION OF AMENDMENTS TO THE INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES (FTP CODE)

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

NOTING resolution MSC.61(67), by which it adopted the International Code for Application of Fire Test Procedures (hereinafter referred to as "the FTP Code"), which has become mandatory under chapter II-2 of the International Convention for the Safety of Life at Sea (SOLAS), 1974 (hereinafter referred to as "the Convention"),

NOTING ALSO article VIII(b) and regulation II-2/3.23 of the Convention concerning the procedure for amending the FTP Code,

HAVING CONSIDERED, at its seventy-ninth session, amendments to the FTP Code proposed and circulated in accordance with article VIII(b)(i) of the Convention,

1. ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the FTP Code, the text of which is set out in the Annex to the present resolution;

2. DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the amendments shall be deemed to have been accepted on 1 January 2006 unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have notified their objections to the amendments;

3. INVITES Contracting Governments to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on 1 July 2006 upon their acceptance in accordance with paragraph 2 above;

4. REQUESTS the Secretary-General, in conformity with article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the Annex to all Contracting Governments to the Convention;

5. FURTHER REQUESTS the Secretary-General to transmit copies of this resolution and its Annex to Members of the Organization, which are not Contracting Governments to the Convention.

ANNEX

AMENDMENTS TO THE INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES (FTP CODE)

ANNEX 1 - FIRE TEST PROCEDURES

Part 2 - Smoke and toxicity test

2.6 Classification criteria

2.6.2 Toxicity

In the table of limits, the following text is added after the entry "SO_2 120 ppm":

"(200 ppm for floor coverings)".

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RESOLUTION MSC.307(88)
(adopted on 3 December 2010)

ADOPTION OF THE INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES, 2010 (2010 FTP CODE)

THE MARITIME SAFETY COMMITTEE,

RECALLING article 28(b) of the Convention on the International Maritime Organization concerning the function of the Committee,

NOTING the International Code for Application of Fire Test Procedures (FTP Code) and chapter II-2 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, hereinafter referred to as "the Convention", which made the FTP Code mandatory under the Convention,

NOTING ALSO resolution MSC.57(67) by which it adopted amendments to chapter II-2 of the Convention to make the provisions of the International Code for Application of Fire Test Procedures (FTP Code) mandatory under the Convention for ships constructed on or after 1 July 1998,

NOTING FURTHER resolution MSC.97(73) by which it adopted the International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code) providing for the application of fire test procedures for materials used in the construction of high-speed craft to which that Code applies, in accordance with the FTP Code,

RECOGNIZING that the continual development of materials for use in the construction of ships and improvement of marine safety standards since the adoption of the FTP Code necessitate the revision of the provisions of the fire test procedures in order to maintain the highest practical level of safety,

HAVING CONSIDERED, at its eighty-eighth session, the draft 2010 FTP Code which has been developed following a thorough revision of the FTP Code,

1. ADOPTS the International Code for Application of Fire Test Procedures, 2010 (2010 FTP Code), the text of which is set out in the Annex to the present resolution;

2. INVITES Contracting Governments to the Convention to note that the 2010 FTP Code will take effect on 1 July 2012 upon entry into force of the associated amendments to chapter II-2 of the Convention;

3. NOTES that under the amendments to chapter II-2 of the Convention, amendments to the 2010 FTP Code shall be adopted, brought into force and take effect in accordance with the provisions of Article VIII of the Convention, concerning the amendment procedure applicable to the annex to the Convention other than chapter I.

4. REQUESTS the Secretary-General of the Organization to transmit certified copies of the present resolution and the text of the 2010 FTP Code, contained in the Annex, to all Contracting Governments to the Convention;

5. FURTHER REQUESTS the Secretary-General of the Organization to transmit copies of the present resolution and the text of the Code contained in the Annex to all Members of the Organization which are not Contracting Governments to the SOLAS Convention.

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INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES, 2010 (2010 FTP CODE)

1 SCOPE

1.1 This Code is intended for use by the Administration and the competent authority of the flag State when approving products for installation in ships flying the flag of the flag State in accordance with the fire safety requirements of the International Convention for the Safety of Life at Sea, 1974, as amended.

1.2 This Code shall be used by testing laboratories when testing and evaluating products under this Code.

2 APPLICATION

2.1 This Code is applicable for products which are required to be tested, evaluated and approved in accordance with the Fire Test Procedures Code as referenced in the Convention.

2.2 Where reference to the Code is indicated in the Convention by the terminology "... in accordance with the Fire Test Procedures Code", the subject product shall be tested in accordance with the applicable fire test procedure or procedures as referred to in paragraph 4.1.

2.3 Where reference is made to the fire performance of a product only in the Convention using such terminology as "... and their exposed surfaces shall have low flame-spread characteristics", the subject product shall be tested in accordance with the applicable fire test procedure or procedures as referred to in paragraph 4.1.

3 DEFINITIONS

3.1 *Administration* means the Government of the State whose flag the ship is entitled to fly.

3.2 *Approval expiry date* means the last date on which the subsequent approval is valid as proof of meeting the fire safety requirements of the Convention.

3.3 *Competent authority* means an organization authorized by the Administration to perform functions required by this Code.

3.4 *Convention* means the International Convention for the Safety of Life at Sea, 1974, as amended.

3.5 *Fire Test Procedures Code* means the International Code for Application of Fire Test Procedures as defined in chapter II-2 of the 1974 SOLAS Convention, as amended.

3.6 *High-Speed Craft Code 1994 (1994 HSC Code)* means the International Code of Safety for High-Speed Craft adopted by the Maritime Safety Committee of the Organization by resolution MSC.36(63), as amended.

3.7 *High-Speed Craft Code 2000 (2000 HSC Code)* means the International Code of Safety for High-Speed Craft, 2000, adopted by the Maritime Safety Committee of the Organization by resolution MSC.97(73), as amended.

3.8 *Laboratory recognized by the Administration* means a testing laboratory which is acceptable to the Administration concerned. Other testing laboratories may be recognized on a case-by-case basis for specific approvals as agreed upon by the Administration concerned.

3.9 *Standard fire test* means a test in which specimens are exposed in a test furnace to temperatures corresponding approximately to the standard time-temperature curve.

3.10 *Sustained flaming* means a presence of flames on or over any part of a specimen lasting 5 s or longer.

3.11 *Test expiry date* means the last date on which the given test procedure may be used to test and subsequently approve any product under the Convention.

3.12 *The standard time-temperature curve* means the time-temperature curve defined by the formula:

$$T = 345 \log_{10}(8t + 1) + 20$$

where:

T is the average furnace temperature (°C)

t is the time (min).

4 TESTING

4.1 Fire test procedures

4.1.1 Annex 1 of this Code presents the required test procedures which shall be used in testing products as a basis for approval (including renewal of approval), except as provided in paragraph 8.

4.1.2 The test procedures identify the test methods and the acceptance and classification criteria.

4.2 Testing laboratories

4.2.1 The tests shall be carried out in testing laboratories recognized by the Administrations concerned.*

4.2.2 When recognizing a laboratory, the Administration shall consider the following criteria:

.1 that the laboratory is engaged, as a regular part of its business, in performing inspections and tests that are the same as, or similar to, the tests as described in the applicable part;

.2 that the laboratory has access to the apparatus, facilities, personnel, and calibrated instruments necessary to perform these tests and inspections; and

.3 that the laboratory is not owned or controlled by a manufacturer, vendor or supplier of the product being tested.

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* Refer to the list of testing laboratories recognized by the Administrations which is issued and updated in a series of FP circulars.

4.2.3 The testing laboratory shall use a quality control system audited by the competent authority based on standard ISO/IEC 17025.

4.3 Test reports

4.3.1 In general, the test reports shall be in accordance with standard ISO/IEC 17025.

4.3.2 The fire test procedures in annex 1 state the required contents of the test reports.

4.3.3 In general, a test report is the property of the sponsor of the test.

5 APPROVAL

5.1 General

5.1.1 The Administration shall approve products in accordance with their established approval procedures by using the type approval procedure (see paragraph 5.2) or the case-by-case approval (see paragraph 5.3).

5.1.2 The Administration may authorize competent authorities to issue approvals on their behalf.

5.1.3 An applicant who seeks approval shall have the legal right to use the test reports on which the application is based (see paragraph 4.3.3).

5.1.4 The Administration may require that the approved products are provided with special approval markings.

5.1.5 The approval shall be valid when the product is installed on board a ship. If a product is approved when manufactured, but the approval expires before the product is installed on the ship, the product may be installed as approved material, provided that the criteria have not changed since the expiry date of the approval certificate.

5.1.6 The application for approval shall be sought from the Administration or competent authority. The application shall contain at least the following:

.1 the name and address of the applicant and of the manufacturer;

.2 the name or trade name of the product;

.3 the specific qualities for which approval is sought;

.4 drawings or descriptions of the assembly and materials of the product as well as instructions, where applicable, for its installation and use;

.5 a report on the fire test(s); and

.6 for cases where an unsuccessful test had been conducted prior to the final approval test, a description of the modifications made to the test specimen that resulted in the successful test.

5.1.7 Any significant alteration to a product shall make the relevant approval cease to be valid. To obtain a new approval**,** the product shall be retested.

5.2 Type approval

5.2.1 Type approval certificates shall not be issued on the basis of test reports which are more than 5 years old when submitted to the Administration. If the approval depends on several test reports with different dates, the date of the oldest report governs. However, the Administration may renew a type approval of a product without retesting provided that the test report is not more than 15 years old and that no alteration of components or construction has been made to the product.

5.2.2 The Administration shall require that the manufacturers have a quality control system audited by a competent authority to ensure continuous compliance with the type approval conditions. Alternatively, the Administration may use final product verification procedures where the compliance with the type approval certificate is verified by a competent authority before the product is installed on board ships.

5.2.3 The type approval certificates shall be valid for no more than 5 years from the date of issue.

5.2.4 Type approval certificates shall include at least the following:

.1 identification (name or trade name and description) of the product;

.2 type approval certificates for surface materials shall state what substrate was applied for the test. The restriction of the base materials, which products would be applied on, shall be considered (see annex 1, part 5, appendix 4, paragraph 3);

.3 type approval certificates for surface materials shall state the specimen information such as the colour, organic contents and thickness of the products. The restriction of the products shall be considered by that information (see annex 1, part 5, appendix 4, paragraph 3);

.4 type approval certificates for "A", "B" and "F" class divisions shall state the detail information for the thickness and density of the insulation materials, how to fix the materials to the division, and how to insulate to the stiffener in ships. The restriction of the products shall be considered by that information;

.5 type approval certificates for non-combustible materials shall state the organic content;

.6 classification and any restrictions in the use of the product;

.7 name and address of the manufacturer and applicant;

.8 fire test procedure(s) used in test(s);

.9 identification of the test report(s) and applicable statements (including date of issue, possible file number and the name and address of the testing laboratory);

.10 date of issue and possible number of the type approval certificate;

.11 expiration date of the certificate;

.12 name of the issuing body (competent authority) and, if applicable, authorization;

.13 type approval certificates for windows shall state which side of the window was exposed to the heating condition during the test;

.14 the certificate shall include a reference to optional test(s) such as hose stream test and/or thermo radiation test; and

.15 information required in subparagraphs .2 to .5 may be specified in a manual/booklet of the product which shall be clearly referred to in the certificate.

5.2.5 In general, the type approved products may be installed for their intended use on board ships flying the flag of the approving Administration.

5.3 Case-by-case approval

5.3.1 The case-by-case approval means approval where a product is approved for installation on board a specific ship without using a type approval certificate.

5.3.2 The Administration may approve products using the applicable test procedures for specific ship applications without issuing a type approval certificate. The case-by-case approval is only valid for the specific ship.

6 PRODUCTS WHICH MAY BE INSTALLED WITHOUT TESTING AND/OR APPROVAL

Annex 2 to this Code specifies the groups of products, which (if any) are considered to comply with the specific fire safety regulations of the Convention and which may be installed without testing and/or approval.

7 USE OF EQUIVALENTS AND MODERN TECHNOLOGY

7.1 To allow modern technology and development of products, the Administration may approve products to be installed on board ships based on tests and verifications not specifically mentioned in this Code but considered by the Administration to be equivalent with the applicable fire safety requirements of the Convention.

7.2 The Administration shall inform the Organization of approvals referenced in paragraph 7.1 in accordance with regulation I/5 of the Convention and follow the documentation procedures as outlined below:

.1 in the case of new and unconventional products, a written analysis as to why the existing test method(s) cannot be used to test this specific product;

.2 a written analysis showing how the proposed alternative test procedure will prove performance as required by the Convention; and

.3 a written analysis comparing the proposed alternative test procedure to the required procedure in the Code.

8 PERIOD OF GRACE FOR TYPE APPROVALS ISSUED IN ACCORDANCE WITH THE PREVIOUS FTP CODE

8.1 The newest test procedures adopted by the Organization are considered as being the most suitable for demonstrating that the products concerned comply with the applicable fire safety requirements of the Convention.

8.2 The Administration may issue type approval certificates of products tested in accordance with the previous version of this Code*, provided the tests were conducted no later than one year after entry into force of this Code. The purpose is to allow test laboratories a practical period of grace to obtain test equipment necessary to comply with this Code. Tests conducted later than one year after entry into force of this Code shall be conducted in accordance with the present version.

8.3 The Administration may renew a type approval of a product tested in accordance with the previous version of this Code* without retesting, provided that the test report is not more than 15 years old and that no alteration of components or construction has been made to the product.

9 LIST OF REFERENCES

The following ISO and IEC standards are referred to in this Code. Wherever a reference is made to ISO or IEC standards, the year of publication shall be understood as specified below:

.1 ISO 834-1: 1999, Fire resistance tests – Elements of building construction – Part 1: General requirements;

.2 ISO 1182: 2010, Reaction to fire tests for building and transport products – Non-combustibility test;

.3 ISO 1716: 2010, Reaction to fire tests for building products – Determination of the heat of combustion;

.4 ISO 5658-2: 2006, Reaction to fire tests – Spread of Flame – Part 2: Lateral spread on building and transport products in vertical configuration;

.5 ISO 5659-2: 2006, Plastics, Smoke generation – Part 2: Determination of optical density by a single chamber test;

.6 ISO 5660-1: 2002, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 1: Heat release rate (cone calorimeter method);

.7 ISO 5660-2: 2002, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 2: Smoke production rate (dynamic measurement);

.8 ISO 9705: 1993, Fire tests – Full-scale room test for surface products;

.9 ISO 13943: 2008, Fire safety – Vocabulary;

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* Refer to the International Code for Application of Fire Test Procedures, as adopted by the Maritime Safety Committee of the Organization by resolution MSC.61(67).

.10 ISO 14934-3: 2006, Fire tests – Calibration and use of heat flux meters – Part 3: Secondary calibration method;

.11 ISO/IEC 17025: 2005, General requirements for the competence of testing and calibration laboratories;

.12 ISO 19702: 2006, Toxicity testing of fire effluents – Guidance for analysis of gases and vapours in fire effluents using FTIR gas analysis;

.13 ISO 291: 2005; Plastics – Standard atmosphere for conditioning and testing;

.14 ISO 554: 1976; Standard atmosphere for conditioning and/or testing – Specifications;

.15 ISO 14697: 2007; Reaction to fire test – Guidance on the choice of substrates for building and transport products; and

.16 IEC 60584-1: 1995, Thermocouples – Part 1: reference tables.

ANNEX 1

FIRE TEST PROCEDURES

PREAMBLE

1 This annex contains the fire test procedures which shall be used for verifying that the products comply with the applicable requirements. For other test procedures, the provisions in paragraphs 7 and 8.2 of the Code shall apply.

2 Reference to the test procedures of this annex shall be made (e.g., in the test report and in the type approval certificate) by referring to the applicable part number or numbers as follows:

Example: Where a primary deck covering has been tested in accordance with parts 2 and 5 of annex 1, the reference shall be "IMO 2010 FTP Code parts 2 and 5".

3 Some products or their components are required to be tested in accordance with more than one test procedure. For this purpose**,** references to other parts are given in some parts of this annex. Such references are here for information only, and the applicable guidance shall be sought in the relevant requirements of the Convention.

4 For products which may be installed without testing and/or approval, refer to annex 2 to the Code.

PART 1 – NON-COMBUSTIBILITY TEST

1 APPLICATION

1.1 Where a material is required to be non-combustible, it shall be determined in accordance with this part.

1.2 If a material passes the test as specified in paragraph 3, it shall be considered as "non-combustible" even if it consists of a mixture of inorganic and organic substances.

2 FIRE TEST PROCEDURES

The non-combustibility shall be verified in accordance with the test procedure in the appendix to this part (ISO 1182). However, the test exposure need not exceed 30 min duration.

3 ACCEPTANCE CRITERIA OF NON-COMBUSTIBILITY

Materials to be classified as non-combustible shall satisfy the following criteria:

.1 the average furnace thermocouple temperature rise as calculated in paragraphs 8.4 and 8.5 of the appendix does not exceed 30°C;

.2 the average specimen surface thermocouple temperature rise as calculated in paragraphs 8.4 and 8.5 of the appendix does not exceed 30°C;

.3 the average duration of sustained flaming as calculated in paragraph 8.3 of the appendix does not exceed 10 s; and

.4 the average mass loss as calculated in paragraph 8.2 of the appendix does not exceed 50%.

4 TEST REPORT

The test report shall include the information in paragraph 9 of the appendix and classification of the material according to the test criteria specified in paragraph 3 above.

5 REFERENCE DOCUMENT

ISO 1182, Reaction to fire tests for building and transport products – Non-combustibility test.

APPENDIX

FIRE TEST PROCEDURES FOR NON-COMBUSTIBILITY TEST

INTRODUCTION

This fire test is for identification of products which produce only a very limited amount of heat and flame when exposed to temperatures of approximately 750°C.

SAFETY WARNING

The attention of all persons concerned with managing and carrying out this test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Operational hazards may also arise during the testing of specimens and the disposal of test residues.

An assessment of all potential hazards and risks to health shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

1 SCOPE

1.1 This appendix specifies test procedures for determining the non-combustibility.

1.2 Information on the precision of the test method is given in annex A of standard ISO 1182.

2 NORMATIVE REFERENCES

The following normative documents contain provisions which constitute provisions of this appendix.

.1 ISO 1182, Reaction to fire tests for building and transport products –Non-combustibility test; and

.2 ISO 13943, Fire safety – Vocabulary.

3 TERMS AND DEFINITIONS

For the purpose of this appendix, the terms and definitions given in Fire safety – Vocabulary (ISO 13943), together with the following, apply:

3.1 *Homogeneous product* is a product, consisting of a single material, having uniform density and composition throughout the product.

3.2 *Loose fill material* is a material without any physical shape.

3.3 *Material* is a single basic substance or uniformly dispersed mixture of substances, e.g., metal, stone, timber, concrete, mineral wool with uniformly dispersed binder, polymers.

3.4 *Non-homogeneous product* is a product that does not satisfy the requirements of a homogeneous product. It is a product composed of more than one component, substantial and/or non-substantial.

3.5 *Product* is material, element or component about which information is required.

3.6 *Sustained flaming* shall be taken as the persistence of flames on, or over any part of, the visible part of the specimen lasting 5 s or longer.

3.7 Moisture content

3.7.1 The specimen for determining the moisture content and organic contents shall not be used for the non-combustibility test.

3.7.2 The moisture content (W_1-W_2) of each specimen shall be calculated using the following method, and indicate a percentage of the dry weight (W_2), and which information is required.

3.7.3 In the following, W_1, W_2 and W_3 are mean values of three weight measurements. W_1 shall be higher than 25 g. Three specimens of each material, taken in the width of the production's direction and measuring width x minimum 20 mm x thickness of the material, shall be weighed (initial conditioned weight W_1) and then heated in a ventilated oven at a temperature of 105 ± 2°C for 24 h and reweighed when cooled (W_2). However, gypsum-based, cementations and similar materials shall be dried at a temperature of 55 ± 5°C to constant weight (W_2).

3.7.4 The moisture content (W_1-W_2) of each specimen shall be calculated as a percentage of the dry weight (W_2).

3.8 Organic content

3.8.1 The information of organic content is required. After the percentage moisture contents have been calculated as specified above, the three specimens shall be further heated in an oven at a temperature of 500 ± 20°C for 2 h and again weighed (W_3). The organic content (W_2-W_3) shall be calculated as a percentage of the dry weight (W_2).

3.8.2 The organic content of each material used in the test specimen shall be within ± 0.3% absolute of the value stated as the nominal organic content.

Note: A bigger tolerance can be accepted as long as the tested specimen represents the upper limit of the tolerance. In this case, it shall be specified in the test report and in the type approval certificate.

4 TEST APPARATUS

The test apparatus including thermocouples, specimen holders and other necessary peripherals shall be in accordance with Reaction to fire tests for building and transport products – Non-combustibility test (ISO 1182). Calibration of the test apparatus shall be conducted in accordance with the ISO standard.

5 TEST SPECIMEN

5.1 General

5.1.1 The test specimen shall be taken from a sample which is sufficiently large to be representative of the product.

5.1.2 The test specimens shall be cylindrical and each shall have a diameter of 43 mm to 45 mm and a height of 50 ± 3 mm.

5.2 Preparation

5.2.1 If the thickness of the material is different from 50 ± 3 mm, specimens of the height of 50 ± 3 mm shall be made by using a sufficient number of layers of the material and/or by adjustment of the material thickness.

5.2.2 For non-homogeneous materials, the specimen of height of 50 ± 3 mm shall be constructed such that all layers are represented in the specimen in proportion to their presence, by volume, in the original specimen.

5.2.3 The layers shall occupy a horizontal position in the specimen holder and shall be held together firmly, without significant compression, by means of two fine steel wires, of maximum diameter 0.5 mm, to prevent air gaps between layers. The specimens of loose fill materials shall be representative in appearance, density, etc., as in use.

Note: When a specimen is composed of a number of layers, the overall density should be as close as possible to that of the product provided by the manufacturer.

5.3 Number

For homogeneous products, five specimens shall be made. For non-homogeneous products, 10 specimens shall be made.

6 CONDITIONING

The test specimens shall be dried in a ventilated oven maintained at 60 ± 5°C, for between 20 h and 24 h, and cooled to ambient temperature in a desiccator prior to testing. The mass of each specimen shall be determined to an accuracy of 0.01 g prior to test.

7 TEST PROCEDURE

7.1 Test environment

The apparatus shall not be exposed to draughts or any form of strong direct sunlight or artificial illumination which would adversely affect the observation of flaming inside the furnace. The room temperature shall not change by more than 5°C during a test.

7.2 Setting up procedure

7.2.1 ***Specimen holder***

Remove the specimen holder and its support from the furnace.

7.2.2 ***Thermocouple***

7.2.2.1 Furnace thermocouple

The furnace thermocouple shall be located with its hot junction 10 ± 0.5 mm from the furnace tube wall and at a height corresponding to the geometric centre of the furnace tube.

7.2.2.2 Specimen surface thermocouple

The specimen surface thermocouple shall be positioned so that its hot junction is 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.

7.2.3 ***Electricity supply***

Connect the heating element of the furnace either to the voltage stabilizer, variable transformer and the electrical input monitor or the power controller. Automatic thermostatic control of the furnace shall not be used during testing.

Note 1: The heating element should normally draw a current of between 9 A and 10 A at approximately 100 V under steady state conditions. In order not to overload the winding, it is recommended that the maximum current does not exceed 11 A.

Note 2: A new furnace tube should be subjected to slow heating initially. A suitable procedure has been found to be to increase the furnace temperature in steps of approximately 200°C, allowing 2 h heating at each temperature.

7.2.4 ***Furnace stabilization***

Adjust the power input to the furnace so that the average furnace temperature, as indicated by the furnace thermocouple, is stabilized for at least 10 min at 750 ± 5°C. The drift (linear regression) shall not be more than 2°C during these 10 min and there shall be a maximum deviation from the average temperature of not more than 10°C in 10 min.

Note: An example of furnace temperature stabilization is given in annex D of standard ISO 1182.

7.3 Standard test procedure

7.3.1 Stabilize the furnace as described in paragraph 7.2.4. If the recorder used does not allow a real-time calculation, the temperature stabilization shall be checked afterwards. If the conditions specified in paragraph 7.2.4 were not satisfied, the test shall be repeated.

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

7.3.3 Insert one specimen prepared and conditioned as specified in paragraph 6 into the specimen holder suspended on its support.

7.3.4 Place the specimen holder in the furnace in the position taking not more than 5 s for this operation. The position of the specimen shall be such that the geometric centre of the specimen is located rigidly at the geometric centre of the furnace during the test.

7.3.5 Start observation of flaming before the specimen is lowered into the furnace.

7.3.6 Start the timing device immediately following the insertion of the specimen into the furnace.

7.3.7 Record in intervals not longer than 1 s, throughout the test, the temperature measured by the furnace thermocouple and the specimen surface thermocouple.

7.3.8 Carry out the test for a period of 30 min.

7.3.9 After cooling the specimen to ambient temperature in a desiccator, weigh the specimen. Recover any char, ash or other debris which breaks off the specimen and falls down the tube, either during or following the test, and include this as a part of the unconsumed specimen.

7.3.10 For homogeneous products, test five specimens as described in paragraphs 7.3.1 to 7.3.9.

7.3.11 For non-homogeneous products, test five specimens oriented with one surface on the top of the test specimen as described in paragraphs 7.3.1 to 7.3.9. Repeat with the remaining five specimens oriented with that surface on the bottom.

7.4 Observations during test

7.4.1 Record the mass, in g, before and after the test for each specimen tested according to paragraph 7.3, and note any observations relating to the behaviour of the specimen during the test including during insertion into the apparatus.

7.4.2 Note the occurrence of any sustained flaming and record the duration of such flaming in seconds.

Note: Some specimens exhibit only a steady blue-coloured luminous gas zone; this shall not be considered as flaming but be noted under "observations during test" in the test report.

7.4.3 Record the following temperatures, in °C, as measured by the thermocouples:

.1 the initial furnace temperature, $T_{i(furnace)}$ which is the average temperature over the final 10 min of the stabilization period as defined in paragraph 7.2.4;

.2 the maximum furnace temperature $T_{m(furnace)}$ and the maximum specimen surface temperature $T_{m(surface),}$ which are the discrete values at maximum temperature anywhere over the entire test period; and

.3 the final furnace temperature $T_{f(furnace)}$ and the final specimen surface temperature $T_{f(surface),}$ which is the average temperature over the final 1 min of the test period as defined in paragraph 7.3.8.

8 EXPRESSION OF RESULTS

8.1 Calculation of averages

8.1.1 For homogeneous products, calculate the averages for paragraphs 8.2 (Mass loss) to 8.5 (Average temperature rise) for the five specimens.

8.1.2 For non-homogeneous products, calculate the averages for paragraphs 8.2 (Mass loss) to 8.5 (Average temperature rise) for each set of five specimens in the same orientation. The results for each orientation shall be presented separately, but they shall not be combined. Classification shall be based on the most onerous orientation such that all the averages for each set of five specimens shall meet the requirements in paragraph 3 of part 1.

8.2 Mass loss

8.2.1 Calculate and record the mass loss in percentage for each of the five specimens, expressed as a percentage of the initial mass of the specimen, measured as specified in paragraph 7.4.1.

8.2.2 Calculate the average mass loss in percentage, which is the average of mass loss of the five specimens.

8.3 Flaming

8.3.1 Calculate and record the total duration of sustained flaming, in seconds, for each of the five specimens measured as specified in paragraph 7.4.2.

8.3.2 Calculate the average duration of sustained flaming, which is the average of total duration of sustained flaming of the five specimens.

8.4 Temperature rise

Calculate and record the following temperature rise in °C for each of the five specimens recorded by the thermocouples as specified in paragraph 7.4.3:

.1 furnace temperature rise: $T_{r(furnace)} = T_{m(furnace)} - T_{f\ (furnace)}$; and

.2 specimen surface temperature rise: $T_{r(surface)} = T_{m(surface)} - T_{f\ (surface)}$.

8.5 Average temperature rise

Calculate the average furnace temperature rise $T_{ave\ r(furnace)}$ and the average specimen surface temperature rise $T_{ave\ r(surface)}$ from the values obtained by paragraph 8.4.

9 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with part 1 of the 2010 FTP Code (see also subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 name and/or identification of the product tested;

.8 description of the sampling procedure, where relevant;

.9 description of the product tested including density, mass per unit area and thickness, together with details of the construction, moisture content and organic content of the product;

.10 description of the specimen including dimensions, orientations and construction;

.11 date of sample arrival;

.12 details of specimen conditioning;

.13 date of test;

.14 test results expressed in accordance with paragraph 8;

.15 observations made during the test;

.16 classification of the material; and

.17 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

PART 2 – SMOKE AND TOXICITY TEST

1 APPLICATION

Where a material is required not to be capable of producing excessive quantities of smoke and toxic products or not to give rise to toxic hazards at elevated temperatures, the material shall comply with this part.

2 FIRE TEST PROCEDURES

2.1 General

Smoke generation tests shall be conducted in accordance with appendix 1, and the gas measuring method shall be in accordance with appendix 2 to this part, and additional test procedures as described in this part of the Code. To carry out the tests in accordance with this standard, modifications of the arrangements and procedures of the ISO standard shall be made, if necessary.

2.2 Test specimen

Preparation of test specimen shall be in accordance with the practice outlined in part 5 of this Code. If the product has two faces and either face is likely to be exposed to a fire condition when in use, then both faces shall be evaluated.

2.3 Test results

2.3.1 The maximum specific optical density of smoke (*Ds max*) shall be obtained for each test in accordance with paragraph 9 of appendix 1 to this part.

2.3.2 When making toxicity measurements, the sampling of fumes shall be made during the testing of the second and the third specimen at each test condition, from the geometrical centre of the chamber at the time when the maximum specific optical density of smoke is reached. The concentration of each toxic gas shall be determined as parts per million (ppm) in the chamber volume.

2.4 Classification criteria

2.4.1 ***Smoke***

An average (*Dm*) of the maximum specific optical density of smoke (*Ds max*) of three tests at each test condition in paragraph 8.8.1 of appendix 1 shall be calculated:

.1 for materials used as surface of bulkheads, linings or ceilings, the *Dm* shall not exceed 200 in any test condition;

.2 for materials used as primary deck coverings, the *Dm* shall not exceed 400 in any test condition;

.3 for materials used as floor coverings, the *Dm* shall not exceed 500 in any test condition; and

.4 for plastic pipes, the *Dm* shall not exceed 400 in any test condition.

2.4.2 ***Toxicity***

The average value of the maximum value of the gas concentration measured at each test condition of paragraph 8.8.1 of appendix 1 shall not exceed the following limits:

CO	1,450 ppm	HBr	600 ppm
HCl	600 ppm	HCN	140 ppm
HF	600 ppm	SO_2	120 ppm (200 ppm for floor coverings)
NO_x	350 ppm		

3 ADDITIONAL REQUIREMENTS

Part 5 of this annex is also applicable to paints, floor coverings, primary deck coverings, varnishes and other finishes used on exposed interior surfaces.

4 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test.

.1 reference that the test was carried out in accordance with part 2 of the 2010 FTP Code (see also subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the material, i.e. surface finish, floor covering, primary deck covering, pipes, etc.;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, together with details of the construction of the product;

.11 description of the specimen including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, orientations tested and face subject to the test, and construction;

.12 date of sample arrival;

.13 details of specimen conditioning;

.14 date of test;

.15 test conditions (see appendix 1, paragraph 8.8);

.16 test results:

.1 for the smoke test:

.1 *Ds max* for each test (paragraph 9 of the appendix 1); [ ]

.2 *Dm* for each test conditions (paragraph 2.4.1 above); and

.3 *Dc* for each test (paragraph 9.2 of appendix 1):and

.2 for the toxicity tests, the values listed in paragraph 10 of appendix 2;

.17 observations made during the test; and

.18 classification of the material.

5 REFERENCE DOCUMENTS*

ISO 5659-2, Plastics – Smoke generation, Part 2: Determination of optical density by a single chamber test.

ISO 13943, Fire safety – Vocabulary.

ISO 19702, Toxicity testing of fire effluents – Guidance for analysis of gases and vapours in fire effluents using FTIR gas analysis.

* Method of measurement of gases using Fourier transform infrared spectroscopy (FTIR) in cumulative smoke test is being developed by ISO/TC92/SC1.

APPENDIX 1

FIRE TEST PROCEDURES FOR SMOKE GENERATION

Reference document: ISO 5659-2, Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test

Avoidance of danger to test operators

So that suitable precautions to safeguard health are taken, the attention of all concerned in fire tests is drawn to the fact that harmful gases are evolved in combustion of test specimens. Care must also be taken during cleaning operations on the smoke chamber to avoid inhalation of fumes or skin contact with smoke deposits.

Attention is drawn to the hazards arising from the hot radiator cone, and the use of a mains voltage electricity supply. A safety blow-out panel, as specified in paragraph 7.2.1.1 of standard ISO 5659-2, is essential for the protection of operators from the risk of explosion from sudden pressure surges.

1 SCOPE

1.1 This appendix specifies a method of measuring smoke production from the exposed surface of specimens of essentially flat materials, composites or assemblies not exceeding 25 mm in thickness, when placed in a horizontal orientation and subjected to specified levels of thermal irradiance in a closed cabinet with or without the application of a pilot flame. This method of test is applicable to all plastics and may also be used for the evaluation of other materials (e.g., rubbers, textile coverings, painted surfaces, wood and other materials).

1.2 Values of optical density determined by this test are specific to the specimen or assembly material in the form and thickness tested, and are not to be considered inherent, fundamental properties.

1.3 The test is intended primarily for use in research and development and fire safety engineering in buildings, trains, ships, etc., and not as a basis for ratings for building codes or other purposes. No basis is provided for predicting the density of smoke that may be generated by the materials upon exposure to heat and flame under other exposure conditions, nor has correlation been generally established with measurements derived from other test methods. The fact that this test procedure excludes the effect of irritants on the eye shall also be taken into account when applying the test results.

1.4 It is emphasized that smoke production from a material varies according to the irradiance level to which the specimen is exposed. In making use of the results of this method, it shall be borne in mind that the results are based on exposure to the specific irradiance levels of 25 kW/m^2 and 50 kW/m^2.

2 NORMATIVE REFERENCES

The following normative documents contain provisions which constitute provisions of this appendix:

.1 ISO 291, Plastics – Standard atmospheres for conditioning and testing;

.2 ISO 5659-2, Plastics – Smoke generation, Part 2: Determination of optical density by a single chamber test; and

.3 ISO 13943, Fire safety – Vocabulary.

3 TERMS AND DEFINITIONS

For the purposes of this appendix, the terms and definitions given in standard ISO 13943 and the following apply.

3.1 *Assembly* is fabrication of materials and/or composites, for example, sandwich panels. This may include an air gap.

3.2 *Composite* is a combination of materials which are generally recognized in building construction as discrete entities, for example, coated or laminated materials.

3.3 *Essentially flat surface* is a surface in which departure from a plane does not exceed ± 1 mm.

3.4 *Exposed surface* is that surface of the product subjected to the heating conditions of the test.

3.5 *Intumescent material* is a dimensionally unstable material, developing a carbonaceous expanded structure of thickness greater than 10 mm when exposed to a heat source during the test with the cone heater at 25 mm from the specimen.

3.6 *Irradiance (at a point on a surface)* is radiant flux incident on an infinitesimal element of the surface containing the point divided by the area of that element.

3.7 *Material* is a basic single substance or uniformly dispersed mixture, for example, metal, stone, timber, concrete, mineral fibre, polymers.

3.8 *Mass optical density (MOD)* is a measure of the degree of opacity of smoke in terms of the mass loss of the material under the conditions of the test.

3.9 *Optical density of smoke (D)* is a measure of the degree of opacity of smoke; the negative common logarithm of the relative transmission of light.

3.10 *Product* is a material, composite or assembly about which information is required.

3.11 *Specific optical density (Ds)* is optical density multiplied by a factor which is calculated by dividing the volume of the test chamber by the product of the exposed area of the specimen and the path length of the light beam (see paragraph 9.1.1).

3.12 *Specimen* is a representative piece of the product which is to be tested together with any substrate or treatment. This may include an air gap.

4 SPECIMEN CONSTRUCTION AND PREPARATION

4.1 Number of specimens

4.1.1 The test sample shall comprise a minimum of nine specimens if all three test conditions are to be tested: six specimens shall be tested at 25 kW/m^2 (three specimens with a pilot flame and three specimens without a pilot flame) and three specimens shall be tested at 50 kW/m^2 without a pilot flame.

4.1.2 An additional number of specimens as specified in paragraph 4.1.1 above shall be used for each face, in accordance with the requirements in paragraph 2.2 of part 2.

4.1.3 An additional nine specimens (i.e. three specimens per test mode) shall be held in reserve if required by the conditions specified in paragraph 8.8.2.

4.1.4 In case of intumescent materials, it is necessary to make a preliminary test with the cone heater at 50 mm from the specimen. Therefore, at least two additional specimens are required.

4.2 Size of specimens

4.2.1 The specimens shall be square, with sides measuring 75 ± 1 mm.

4.2.2 Materials of nominal thickness 25 mm or less shall be evaluated at their full thickness. For comparative testing, materials shall be evaluated at a thickness of 1 ± 0.1 mm. All materials consume oxygen when they burn in the chamber, and the smoke generation of some materials (especially rapid-burning or thick specimens) is influenced by the reduced oxygen concentration in the chamber. As far as possible, materials shall be tested in their end-use thickness.

4.2.3 Materials with a thickness greater than 25 mm shall be cut to give a specimen thickness between 24 mm and 25 mm, in such a way that the original (uncut) face can be evaluated.

4.2.4 Specimens of multi-layer materials with a thickness greater than 25 mm, consisting of core material(s) with facings of different materials, shall be prepared as specified in paragraph 4.2.3 (see also paragraph 4.3.2).

4.3 Specimen preparation

4.3.1 The specimen shall be representative of the material and shall be prepared in accordance with the procedures described in paragraphs 4.3.2 and 4.3.3. The specimens shall be cut, sawn, moulded or stamped from identical sample areas of the material, and records shall be kept of their thicknesses and, if required, their masses.

4.3.2 If flat sections of the same thickness and composition are tested in place of curved, moulded or specialty parts, this shall be stated in the test report. Any substrate or core materials for the specimens shall be the same as those used in practice.

4.3.3 When coating materials, including paint and adhesives are tested with the substrate or core as used in practice, specimens shall be prepared following normal practice, and in such cases the method of application of the coating, the number of coats and the type of substrate shall be included in the test report.

4.4 Wrapping of specimens

4.4.1 All specimens shall be covered across the back, along the edges and over the front surface periphery, leaving a central exposed specimen area of 65 mm x 65 mm, with a single sheet of aluminium foil (approximately 0.04 mm thick) with the dull side in contact with the specimen. Care shall be taken not to puncture the foil or to introduce unnecessary wrinkles during the wrapping operation. The foil shall be folded in such a way as to minimize losses of any melted material at the bottom of the specimen holder. After mounting the specimen in its holder, any excess foil along the front edges shall be trimmed off where appropriate.

4.4.2.1 Wrapped specimens of thickness up to 12.5 mm shall be backed with a sheet of non-combustible insulating board of oven-dry density 950 ± 100 kg/m^3 and nominal thickness 12.5 mm and a layer of low density (nominal 65 kg/m^3) refractory fibre blanket under the non-combustible board.

4.4.2.2 Wrapped specimens of thickness of more than 12.5 mm but less than 25 mm shall be backed with a layer of low-density (nominal 65 kg/m^3) refractory fibre blanket.

4.4.2.3 Wrapped specimens of thickness of 25 mm shall be tested without any backing board or refractory fibre blanket.

4.4.3 With resilient materials, each specimen in its aluminium foil wrapper shall be installed in the holder in such a way that the exposed surface lies flush with the inside face of the opening of the specimen holder. Materials with uneven exposed surfaces shall not protrude beyond the plane of the opening of the specimen holder.

4.4.4 When thin impermeable specimens, such as thermoplastic films, become inflated during the test due to gases trapped between the film and backing, they shall be maintained essentially flat by making two cuts of 20 mm long in parallel by 20 mm spacing in the centre in the film to act as vents.

4.5 Conditioning

4.5.1 Before preparing the specimens for test, they shall be conditioned to constant mass at 23 ± 2°C and 50 ± 5% relative humidity. Constant mass shall be considered to have been reached when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0.1% of the mass of the test specimen or 0.1 g, whichever is the greater.

4.5.2 While in the conditioning chamber, specimens shall be supported in racks so that air has access to all surfaces.

Note 1: Forced-air movement in the conditioning chamber may be used to assist in accelerating the conditioning process.

Note 2: The results obtained from this method are sensitive to small differences in specimen conditioning. It is important therefore to ensure that the requirements in paragraph 4.5 are followed carefully.

5 APPARATUS AND ANCILLARY EQUIPMENT

The apparatus and ancillary equipment shall be in accordance with standard ISO 5659-2, Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test.

6 TEST ENVIRONMENT

6.1 The test apparatus shall be protected from direct sunlight, or any strong light source, to avoid the possibility of spurious light readings.

6.2 Adequate provision shall be made for removing potentially hazardous and objectionable smoke and gases from the area of operation, and other suitable precautions shall be taken to prevent exposure of the operator to them, particularly during the removal of specimens from the chamber or when cleaning the apparatus.

7 CALIBRATION PROCEDURES

Calibration of the test apparatus shall be carried out in accordance with standard ISO 5659-2, Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test.

8 TEST PROCEDURES

8.1 Preparation of test chamber

8.1.1 Prepare the test chamber in accordance with the requirements of clause 9 of standard ISO 5659-2 with the cone set at 25 kW/m^2 or 50 kW/m^2. For intumescent materials the distance between the cone heater and the specimen shall be 50 mm and the pilot burner shall be positioned 15 mm down from the bottom edge of the cone heater.

8.1.2 If a test has just been completed, flush the test chamber with air until it is completely clear of smoke with the test chamber door closed and both exhaust and inlet vents open. Inspect the inside of the cabinet and clean the walls and the supporting framework if necessary (see paragraph 9.9 of standard ISO 5659-2). Clean the faces of the optical windows inside the chamber before each test. Allow the apparatus to stabilize until the chamber wall temperature is within the range 40 ± 5°C for tests with the radiator cone at 25 kW/m^2 or within the range 55 ± 5°C for tests with the radiator cone at 50 kW/m^2. Close the inlet valve.

8.1.3 For intumescent materials testing, the chamber wall temperature shall be within 50 ± 10°C for tests with the radiator cone at 25 kW/m^2 or within 60 ± 10°C for tests with the radiator cone at 50 kW/m^2.

> **Note**: If the temperature is too high, the exhaust fan may be used to draw in cooler air from the laboratory.

8.2 Tests with pilot flame

For tests with the pilot flame, with the burner in its correct position, turn on the gas and air supplies and ignite the burner, check the flow rates and, if necessary, adjust the flow rates to ensure that the flame is as specified in paragraph 7.3.6 of standard ISO 5659-2.

8.3 Preparation of photometric system

Set the zero and then open the shutter to set the full-scale 100% transmission reading. Close the shutters again and check and reset the zero if necessary, using the most sensitive (0.1%) range. Recheck the 100% setting. Repeat the sequence of operations until accurate zero and 100% readings are obtained on the amplifier and recorder when the shutters are opened and closed.

8.4 Loading the specimen

8.4.1 Place a wrapped specimen, prepared in accordance with paragraphs 4.3 and 4.4. Place the holder and specimen on the supporting framework below the radiator cone. Remove the radiation shield from below the cone and simultaneously start the data recording system and close the inlet vent. The test chamber door and the inlet vent shall be closed immediately after the start of the test.

8.4.2 If preliminary tests indicate that the pilot flame is extinguished before the shield is removed, immediately relight the pilot burner and release the shield at the same time.

8.5 Recording of light transmission

8.5.1 Record the percentage light transmission and time continuously from the start of the test (i.e. when the radiation shield was removed). Switch the range of the photodetector amplifier system to the next decade when required, so that readings less than 10% of full-scale deflection are avoided.

8.5.2 If the light transmission falls below 0.01%, cover the observation window in the chamber door and withdraw the range-extension filter from the light path.

8.6 Observations

8.6.1 Note any particular burning characteristics of the specimen, such as delamination, intumescence, shrinkage, melting and collapse, and note the time from the start of the test at which the particular behaviour occurs, including the time of ignition and the duration of flaming. Also note the smoke characteristics, such as the colour and nature of the settled particulate matter.

Note 1: The smoke generation from some materials differs significantly depending on whether combustion occurs in a non-flaming or flaming mode (see standard ISO 5659-2). It is important, therefore, to record as much information as possible about the mode of combustion during each test.

Note 2: Coated and faced materials, including sheet laminates, tiles, fabrics and other materials secured to a substrate with an adhesive, and composite materials not attached to a substrate, can be subject to delamination, cracking, peeling or other types of separation affecting their smoke generation.

8.6.2 If the pilot flame is extinguished by gaseous effluent during a test and fails to re-ignite within 10 s, the gas supply to the pilot burner shall be immediately switched off (see paragraph 7.3.6 of standard ISO 5659-2).

8.6.3 If inflation of a thin specimen that has not been cut (see paragraph 4.4.4 above) has occurred, the results from that specimen shall be ignored and an extra cut specimen tested.

8.7 Termination of test

8.7.1 The initial test at each test condition in paragraph 8.8.1 shall last for 20 min to verify the possible existence of a second minimum transmittance value. If the minimum transmittance value is shown by the initial test to occur within the first 10 min, then subsequent tests for that test condition may have an exposure of 10 min. Otherwise, the tests shall last 20 min.

8.7.2 Extinguish the burner if the pilot flame has been used.

Note: The burner is extinguished in order to obviate the possibility of air mixing with combustion products present and causing an explosion.

8.7.3 Move the radiation shield below the cone.

8.7.4 Switch on the exhaust fan and, when the water manometer indicates a small negative pressure, open the inlet vent and continue exhausting until a maximum value of light transmission is recorded, with the appropriate range selected, and noted as the "clear beam" reading *T*c, for use in correcting for deposits on the optical windows.

8.8 Repeat tests

8.8.1 Three specimens shall be tested under each of the following conditions:

.1 irradiance of 25 kW/m^2 in the presence of pilot flame;

.2 irradiance of 25 kW/m^2 in the absence of pilot flame; and

.3 irradiance of 50 kW/m^2 in the absence of pilot flame.

8.8.2 For each individual specimen, determine the percentage value of light transmission and from this calculate the appropriate specific optical density as given in paragraph 9.1. If the value of *Ds max* for any individual specimen differs from the average value for the set of three specimens of which it is part by more than 50% of that average for no apparent reason, test an additional set of three specimens from the same sample in the same mode and record the average of all six results obtained.

Note: Even in the same test condition, a specimen may burn with flaming and the others may not burn with flaming. This would be an apparent reason.

9 EXPRESSION OF RESULTS

9.1 Specific optical density *Ds*

9.1.1 For each specimen, produce a graph of light transmission against time and determine the minimum transmission *Tmin*. Convert *Tmin* to the maximum specific optical density *Ds max* by calculation to two significant figures using the following equation:

$$Ds\ max = 132 \log_{10} (100/Tmin)$$

where:

132 is a factor derived from *V/AL* for the test chamber,
V is the volume of the chamber,
A is the exposed area of the specimen,
L is the length of the light path.

Note: The transmission used in this equation is the measured transmission. For the first four decades this is the value recorded by the system. For the final two decades (where the range-extension filter is removed from the light path) the transmission must be calculated relative to the actual measuring range of 0.01% or 0.001%. For example, if the measuring range is set to 1% with the range-extension filter removed, then the actual measuring range is 0.01%. If the displayed transmission value is 0.523 then the actual measured transmission is 0.00523%.

9.1.2 If required, add, to each value of *Ds max* determined in paragraph 9.1.1, the correction factor C_f, which depends upon the use of the range-extension filter. The value of C_f is:

.1 zero:

.1 if the filter is in the light path at the time the transmission was recorded ($T \geq 0.01\%$); or

.2 if the photometric system is not equipped with a removable filter; or

.3 if the ND-2 filter is found to be of the correct optical density of 2; and

.2 as determined by the procedure described in paragraph 9.5 of ISO 5659-2, if the filter is moved out of the light path at the time it is measured ($T < 0.01\%$).

9.2 Clear-beam correction factor *Dc*

For each specimen, record the value of the "clear beam" reading *Tc* (see paragraph 8.7.4) to determine the correction factor Dc. Calculate *Dc* as for *Ds max* in paragraph 9.1.1. *Dc* shall not be subtracted from *Ds max*. Do not record the correction factor *Dc* if it is less than 5% of *Ds max*.

10 OTHER REFERENCES

"Calibration of heat flux meter", "Variability in the specific optical density of smoke measured in the single-chamber test" and "Determination of mass optical density (MOD)" should be referred to annexes A, B and C of standard ISO 5659-2.

APPENDIX 2

FIRE TEST PROCEDURES FOR TOXIC GAS GENERATION

1 SCOPE

1.1 This appendix specifies methods of measurement of gases developed in cumulative smoke/fire test, using Fourier transform infrared spectroscopy (FTIR). Particular attention is given to the gas sampling systems and conditions of gas measurement.

1.2 It should be noted that there are fire effluents other than gases, such as particles, smoke or vapours, which may be toxic and that some gases such as hydrogen halides may be trapped by moisture in sampling lines or by filters designed to remove only smoke particles.

1.3 Gas measurements by FTIR shall be carried out when the maximum smoke density is obtained. That time is determined by a smoke density measurement tests carried out in accordance with appendix 1.

2 NORMATIVE REFERENCES

The following normative documents contain provisions which constitute provisions of this appendix:

ISO 5659-2, Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test.

ISO 13943, Fire safety – Vocabulary.

ISO 19702, Toxicity testing of fire effluents – Analysis of gases and vapours in fire effluents using FTIR technology.

3 TERMS AND DEFINITIONS

For the purposes of this document, the terms and definitions given in standards ISO 13943 and ISO 19702 and the following apply.

3.1 *Maximum smoke density sampling time* (*DmST*) is the sampling time, expressed in seconds, used in toxicity tests correspondent to the time to reach the maximum specific optical density as per paragraph 2.4.1 of part 2.

3.2 *Sampling Response Period* (*SRP*) is the minimum time necessary during the sampling period to completely load the FTIR gas cell including the time to transfer the effluents flow from the smoke chamber into the cell.

4 PRINCIPLES

Fire effluents are sampled from a cumulative smoke chamber of a smoke test (appendix 1) at a single time point called Dm sampling time (DmST) which is pre-determined by the first smoke density test in appendix 1. This time represents the time where the smoke density reaches the maximum level during the standard 20 min test. Gas sampling shall be such that the sample represents the gas, the fire effluent, in quality and quantity, in the chamber, and that any effect of gas sampling systems (filters, probes, pipes, tubes and pumps) in minimized. It is recommended to minimize the travelling time and distance of fire effluent

through the gas sampling system. A filtering system for fire effluent shall be installed within the gas sampling system to prevent smoke particles from entering into the gas analyser. FTIR shall be used to analyse the sampled gases.

5 GAS SAMPLING SYSTEM

Gas sampling system should consist of probe, heated gas sampling line, filter, valves and sampling pump.

6 GAS ANALYSIS TECHNIQUE

An FTIR system as described in standard ISO 19702 shall be used.

7 CALIBRATION

Calibration of the FTIR system shall be carried out for gases to be measured in accordance with standard ISO 19702.

8 TEST PROCEDURES

8.1 Operation before each test

8.1.1 Check the internal walls condition of the test chamber and eventually clean them removing all dirty layers and particles. The same operation shall be done on the surface of the internal probe for FTIR sampling.

8.1.2 The inlet of the probe shall be cleaned.

8.1.3 Keep the filter, gas sampling line and valves and gas cell at the temperature of 150°C to 180°C for at least 10 min prior to the test.

8.1.4 The wavelength resolution of the spectrometer shall be 4 cm^{-1} or better. Set the Mid-IR whole spectral region for collection between 650 cm^{-1} to 4,500 cm^{-1}.

8.1.5 Close the chamber door, and introduce the air in the chamber into the gas cell of FTIR. Wait for 1 min and record the background spectrum.

8.1.6 Turn the sampling valve to introduce the open air into the gas cell.

Note: It is recommended, before the start of any smoke test on that day, to carry out a dummy gas measurement where the ambient air in the smoke chamber is sampled and analysed by the normal test procedure, and to make sure that no gas is detected. It is also recommended that such a dummy gas measurement be carried out whenever a questionable gas measurement result is obtained. It is also recommended that this screening measurement be carried out after the smoke chamber is cleaned by volatile solvent.

8.2 Operation during a test

8.2.1 During the smoke density test specified in appendix 1, the sampling shall start by turning the sampling valve to introduce gas in the chamber into the sampling line, at *DmST* – (*SRP* x 0.5) (s).

8.2.2 Wait for a minimum period equal to SRP then collect the spectrum, stop the sampling from the chamber and turn the sampling valve to introduce open air side.

8.2.3 Continue the smoke density test until a 20 min period has elapsed. To verify end, ensure that the smoke density peak has already occurred.

8.2.4 At the end of the test, follow the end of the test procedures described in appendix 1.

8.2.5 If the smoke chamber pressure drops below the permitted minimum as specified in standard ISO 5659-2 by any phenomena of the combustion of the specimen, the gas inlet valve of the chamber will automatically open according to standard ISO 5659-2. If this happens, this shall be reported.

8.2.6 If the smoke chamber pressure exceeds the permitted maximum as specified in standard ISO 5659-2 by any phenomena of the combustion of the specimen, the gas release value of the chamber will automatically open according to standard ISO 5659-2. If this happens, this shall be reported.

8.3 Repeat tests

In case an additional set of three smoke measurement tests are repeated in accordance with appendix 1, paragraph 8.8.2, in any of the test conditions in paragraph 8.8.1 of appendix 1, gas measurements shall be conducted at the second and third test of the second set of the tests in accordance with this appendix and the test results shall be reported in accordance with paragraph 10.

9 GAS ANALYSIS

9.1 FTIR gas analysis

FTIR gas analysis shall be carried out in accordance with standard ISO 19702.

9.2 Calculation of concentration correction for acid gases

9.2.1 Analysis of filtering materials used in the gas sampling line shall be carried out, and total acid gases trapped by the filtering materials (*Qa* (g)) shall be obtained*.

9.2.2 The relative concentration shall be calculated based on the total gas volume (*Vs* (l)) passing through the filter for the gas sampling period:

$$Vs = Sfl \times St$$

where:

Sfl is the gas sampling flow rate (*l*/s),
St is the gas sampling time (s).

9.2.3 Relative volume of the gas (*Va* (*l*)) shall be calculated by:

$$Va = (Qa/PMa) \times Vm$$

* A relevant standard is being developed by ISO/TC92/SC1.

where:

Vm is the molar volume at standard conditions,
PMa is the molar mass of the gas.

9.2.4 The concentration correction (*Cca* (ppm)) for an acid gas shall be obtained by:

$$Cca = Va/Vs \times 10^6$$

10 TEST RESULTS

The following test results shall be included in the test report:

.1 for each test:

.1 maximum gas concentration *C* (ppm) measured by FTIR for each gas listed in paragraph 2.4.2 of this part;

.2 gas concentration correction (*Cca*), if applicable;

.3 corrected maximum gas concentration (*C* + *Cca*), if applicable; and

.4 *DmST* and *SRP*;

.2 for each test condition (see paragraph 8.8.1 of appendix 1), the average value of the maximum value of the gas concentration measured and corrected, if applicable, at each test condition; and

.3 data regarding the test apparatus:

.1 the inner volume of the gas cell;

.2 the inner volume and the length of gas sampling line; and

.3 the capacity of the gas sampling pump.

PART 3 – TEST FOR "A", "B" AND "F" CLASS DIVISIONS

1 APPLICATION

Where products (such as decks, bulkheads, doors, ceilings, linings, windows, fire dampers, pipe penetrations and cable transits) are required to be "A" or "B" or "F" class divisions*, they shall comply with this part.

2 FIRE TEST PROCEDURES

The products shall be tested and evaluated in accordance with the fire test procedures specified in appendices 1 and 2 to this part. Appendix 2 contains test procedures for windows, fire dampers and pipe and duct penetrations in its appendices.

3 PERFORMANCE CRITERIA

3.1 Insulation

3.1.1 ***"A" class divisions, including "A" class doors***

The average unexposed-face temperature rise as determined in accordance with paragraph 8.4.1 of appendix 1 shall not be more than l40°C, and the temperature rise recorded by any of the individual unexposed-face thermocouples shall not be more than l80°C during the periods given below for each classification:

class "A-60"	60 min
class "A-30"	30 min
class "A-15"	15 min
class "A-0"	0 min.

3.1.2 ***"B" and "F" class divisions, including "B" and "F" class doors***

The average unexposed-face temperature rise as determined in accordance with paragraph 8.4.1 of appendix 1 shall not be more than 140°C, and the temperature rise recorded by any of the individual unexposed-face thermocouples shall not be more than 225°C during the periods given below for each classification:

class "B-15"	15 min
class "B-0"	0 min
class "F-15"	15 min
class "F-0"	0 min.

* As defined in the International Convention for the Safety of Life at Sea, 1974, chapter II-2, part A, and the Torremolinos Protocol of 1993 relating to the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, chapter V. "F" class divisions are defined only in the latter Convention.

3.2 Integrity

For all "A", "B" and "F" class divisions, including "A", "B" and "F" class doors, the following requirements shall be satisfied for the minimum test duration relevant to the classification (see paragraph 8.5 of appendix 1):

.1 flaming: there shall be no flaming on the unexposed face;

.2 cotton-wool pad: there shall be no ignition, i.e. flaming or glowing, of the cotton-wool pad when applied in accordance with paragraph 8.4.3 of appendix 1 or when used to assist evaluation of flaming (see paragraph 8.4.2 of appendix 1); and

.3 gap gauges: it shall not be possible to enter the gap gauges into any opening in the specimen in the manner described in paragraph 8.4.4 of appendix 1.

"A", "B" and "F" class doors are not required to be able to be opened or closed, during or after the specified test duration.

3.3 Structural core temperature

In the case of load-bearing divisions of aluminium alloy, the average temperature of the structural core obtained by the thermocouples described in paragraph 7.7 of appendix 1 shall not rise more than 200°C above its initial temperature at any time during the minimum test duration relevant to the classification (see paragraph 8.5 of appendix 1). Where the structural core is of a material other than steel or aluminium alloy the Administration shall decide the rise in temperature which shall not be exceeded during the test duration.

3.4 Continuous "B" class ceilings and linings

Where ceilings or linings are required to be continuous "B" class ceilings or linings, they may be tested and evaluated in accordance with appendix 4 to this part.

3.5 Additional requirements

3.5.1 The specimen of the "A" and "B" class constructions shall be constructed from non-combustible materials. The following exceptions are permissible:

.1 adhesives and vapour barriers used in the construction of the specimen are not required to be non-combustible; however, they shall have low flame-spread characteristics;

.2 sealing materials used in penetration systems;

.3 seals for gas-, water- and weather-tight doors;

.4 seals for windows; and

.5 filling material within glazing systems.

Adhesives and sealing materials used in testing of penetration systems shall be used in the actual structure. Materials mentioned in paragraphs 3.5.1.3 to 3.5.1.5 may be installed in constructions of the specimen. Such inclusions shall be stated in the test report.

The material used in the test shall not be replaced by any other materials that have not been tested in accordance with this Code and/or accepted by the Administration.

3.5.2 ***Thermal radiation through windows***

3.5.2.1 Where thermal radiation through windows is required to be limited by an Administration, the window assembly may be tested and evaluated in accordance with appendix 3 to this part.

3.5.2.2 The cotton-wool pad need not be used on the unexposed face after the period relevant to the insulation classification of the product.

4 OTHER REFERENCES

4.1 The non-combustibility of materials used in "A" and "B" class divisions shall be verified in accordance with part 1.

4.2 Where combustible veneers are allowed to be provided in "A" and "B" class divisions, the low flame-spread characteristics of such veneers, if required, shall be verified in accordance with part 5.

4.3 If an aluminium deck is tested with insulation installed below the deck, then the result will apply to decks which are bare on the top. Aluminium decks shall not be provided with deck coverings or insulation on the top unless tested with the deck covering or insulation included, to verify that the 200°C temperature of the aluminium is not exceeded.

5 TEST REPORT

The test report shall include the information contained in paragraph 9 of appendix 1.

6 REFERENCE DOCUMENTS

ISO 834-1 – Fire-resistance tests – Elements of building construction – Part 1: General requirements.

IEC 60584-1 – Thermocouples – Part 1 Reference tables.

APPENDIX 1

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

1 GENERAL

1.1 Approval of constructions will be restricted to the orientation in which they have been tested; therefore, bulkheads, linings and doors shall be tested vertically mounted and decks and ceilings shall be tested horizontally mounted. It is only necessary to test decks with the underside exposed to the heating conditions, and "B" and "F" class ceilings and linings are required only to be tested from the side incorporating the ceiling or the lining.

1.2 For "A" class bulkheads and doors for "general application", i.e. for use of the insulation material on either side of the structural core, and also for "B" class bulkheads and doors, approval usually requires that the construction has been tested from each side separately, using two separate specimens, unless the Administration considers that only a single test to one side, that being the side expected to provide a performance inferior to the other side, is appropriate.

1.3 In tests for "A" class bulkheads for "general application" it may be possible for approval to be granted on the basis of a single test only, provided that the bulkhead has been tested in the most onerous manner, which is considered to be with the insulation on the unexposed face and the stiffeners also on that side.

1.4 In tests for "A" class bulkheads for "restricted application", i.e. where the fire hazard has been identified as being from the insulated side only, the bulkhead can be tested with the insulation on the exposed face and with the stiffeners also on that side.

1.5 If approval of an "A" class bulkhead is being sought involving the use of "double-sided application" of the insulation, the thickness of the insulation being equal on both sides of the structural core, it shall be tested with the stiffeners on the unexposed side of the bulkhead, otherwise it shall be tested with the side with the thinnest thickness of insulation on the exposed face.

1.6 The thickness of insulation on the stiffeners need not be same as that of the steel plate.

1.7 If insulation of an "A" class division is to be provided by membrane protection, i.e. by a "B" class ceiling to a structural steel core or a "B" class lining to a structural steel core, the distance between the membrane, i.e. the ceiling or the lining, and the structural core shall be the minimum for which approval is being sought. For "A" class bulkheads, the division is required to be tested both from the structural core side, and from the "B" class lining side. For both ceilings and linings which may form part of such deck or bulkhead constructions, they shall satisfy at least "B-0" classification.

1.8 When the insulation of an "A" class division is provided by membrane protection, the stiffeners of the structural core shall be positioned in the cavity between the steel plate of the structural core and the membrane protection. For an "A" class bulkhead the Administration may accept or require the stiffeners to be on the opposite side of the steel plate of the structural core to enable the distance between the membrane protection and the structural core to be reduced to a minimum.

1.9 The dimensions of the structural cores of the test specimens given in paragraph 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.

1.10 "A" class divisions which consist of an uninsulated steel bulkhead or deck of suitable scantlings and without openings can be deemed to satisfy the requirements for class "A-0" divisions, i.e. to satisfy the requirements for the passage of smoke and flame, without the need for testing. All other divisions, including class "A-0" divisions with a structural core of aluminium, are required to be tested.

1.11 Results obtained on an insulating material used in conjunction with an "A" class division may be applied to constructions incorporating heavier scantlings than those tested and providing the orientation of the construction is the same, i.e. results from bulkhead tests shall not be applied to decks and vice versa.

1.12 The construction to be tested shall be, as far as possible, representative of that to be used on board ships, including the materials and method of assembly.

1.13 The designs of the specimens proposed in this appendix are considered to reflect the worst case situations in order to provide maximum usefulness of the classifications to end-use applications. However, the Administration may accept or request special test arrangements which provide additional information required for approval, especially of those types of constructions which do not utilize the conventional components of horizontal and vertical divisions, e.g., where cabins may be of a modular type construction involving continuous connections between bulkheads, decks and ceilings.

1.14 Doors, windows and other division penetrations intended to be installed in fire divisions made of material other than steel shall correspond to prototype(s) tested on a division made of such material, unless the Administration is satisfied that the construction, as approved, does not impair the fire resistance of the division regardless of the division construction.

1.15 Constructions shall be tested without paint or other superimposed finish, provided that where they are only produced with a superimposed finish, and subject to the agreement of the Administration, they may be tested as produced. Such constructions 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 construction in the test.

1.16 "B" class constructions shall be tested without finishes. For constructions where this is not possible, the finishes may be included in the "B" class test specimen, and shall be included in the non-combustibility test of the construction.

2 NATURE OF TEST SPECIMENS

2.1 "A" class bulkheads

2.1.1 ***Dimensions***

2.1.1.1 The minimum overall dimensions of the test specimen, including the perimeter details at the top, bottom and vertical edges, are 2,440 mm width and 2,500 mm height. When the maximum overall height in practice is less than that given above, then the test specimen shall be of the maximum height to be used in practice.

2.1.1.2 The minimum bulkhead panel height shall be a standard height of the manufactured panel with a dimension of 2,400 mm.

2.1.1.3 The overall dimensions of the structural core shall be 20 mm less in both the width and the height than the overall dimensions of the specimen, and the other dimensions of the structural core shall be as follows:

– thickness of plating:	steel	4.5 ± 0.5 mm
	aluminium	6.0 ± 0.5 mm
– stiffeners spaced at 600 mm:	steel	(65 ± 5) x (65 ± 5) x (6 ± 1) mm
	aluminium	(100 ± 5) x (75 ± 5) x (9 ± 1) mm

2.1.1.4 The width of the structural core may be greater than the specified dimensions providing that the additional width is in increments of 600 mm to maintain the stiffener centres and the relationship between the stiffeners and the perimeter detail.

2.1.1.5 Any joints in the plating shall be fully welded, at least from one side.

2.1.1.6 The construction of a structural steel core having the recommended dimensions is shown in figure 1; the thickness of the plating and dimensions of the stiffeners shown are nominal dimensions. Irrespective of the dimensions of the structural core and the material of manufacture, the details around the perimeter shall be as illustrated in figure 3.

2.1.2 ***Design***

2.1.2.1 Where insulation is provided by panels (e.g., a "B" class lining), then the test specimen shall be such that at least one of the panels is of full width and this, or these, shall be positioned such that both its/their longitudinal edges are jointed to an adjacent panel and are not secured to the restraint frame.

2.1.2.2 The overall dimensions of the panel insulation system, including the perimeter details at all the edges, shall be 20 mm greater in each direction than the equivalent dimensions of the structural core.

2.1.2.3 If the insulation system is a lining which may incorporate electrical fittings, e.g., light fittings and/or ventilation units, it is necessary that initially a test is performed on a specimen of the lining itself, without the incorporation of these units, to establish the basic performance. A separate test(s) shall be performed on a specimen(s) with the units incorporated to ascertain their influence on the performance of the lining.

2.1.2.4 Where the insulation consists of blankets, the blankets shall be arranged so that not less than two transverse joints between blankets are included. The joints shall be located not less than 600 mm from the edges of the bulkhead.

2.1.3 ***Description***

2.1.3.1 The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details of the thicknesses of insulation used in way of the plating and the stiffeners, the method of securing the insulation system and details of the components used for this purpose, details of joints, connections, air gaps and all other details.

2.1.3.2 Where insulation is provided by panels, the manufacturer shall provide the information required in paragraphs 2.4.3 (bulkheads), 2.7.3 (linings) or 2.8.3 (ceilings). The distance between the steel bulkhead/deck and the insulating membrane shall be stated.

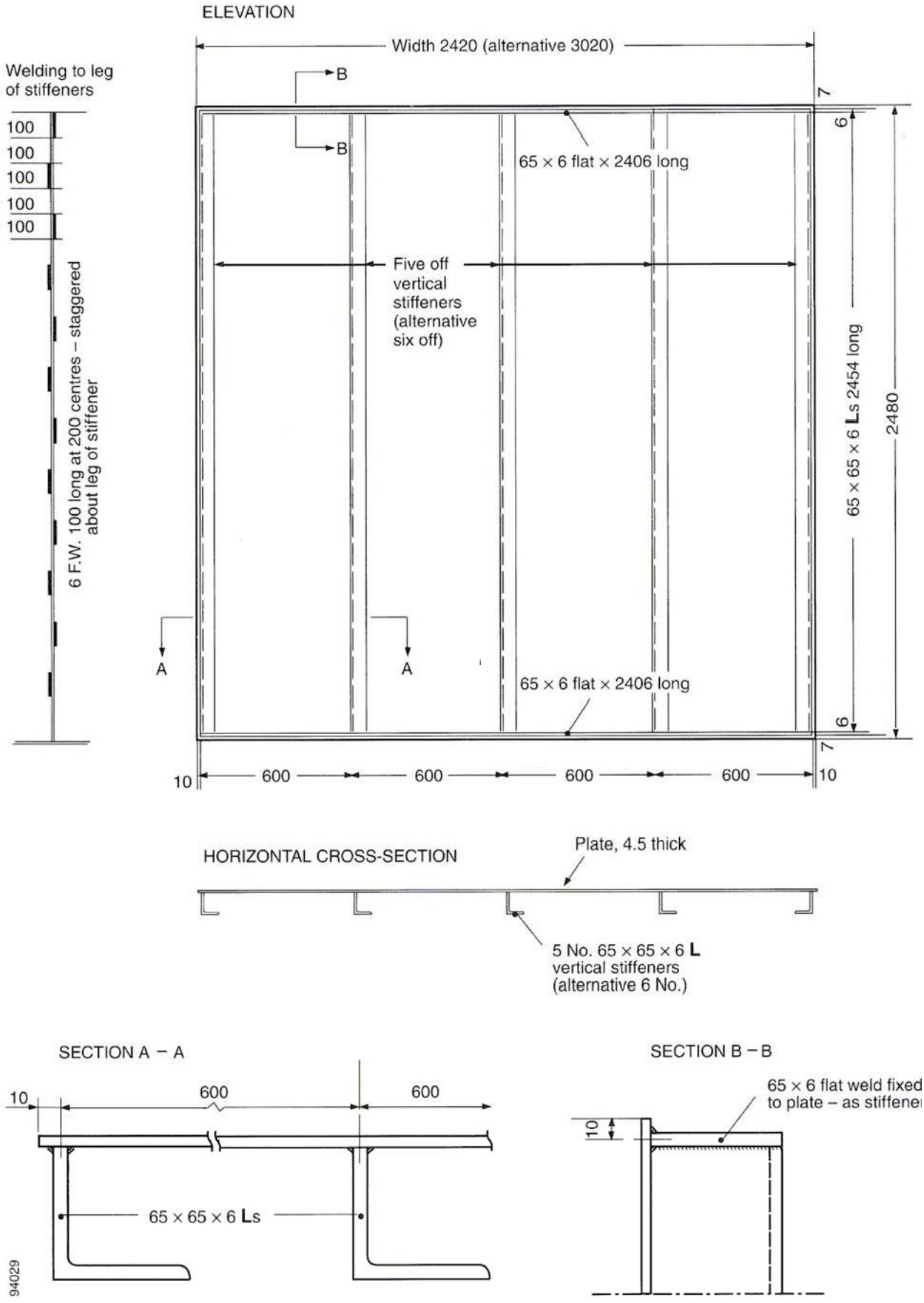


Figure 1 – Structural steel core for "A" class bulkhead and "B" class lining

2.2 "A" class decks

2.2.1 *Dimensions*

2.2.1.1 The minimum overall dimensions of the test specimen, including the perimeter details at all the edges, are 2,440 mm width and 3,040 mm length.

2.2.1.2 The overall dimensions of the structural core shall be 20 mm less in both the width and length than the overall dimensions of the specimen, and the other dimensions of the structural core shall be as follows:

– thickness of plating:	steel	4.5 ± 0.5 mm
	aluminium	6 ± 0.5 mm
– stiffeners spaced at 600 mm:	steel	(100 ± 5) x (70 ± 5) x (8 ± 1) mm
	aluminium	(150 ± 5) x (100 ± 5) x (9 ± 1) mm

2.2.1.3 The width of the structural core may be greater than the specified dimensions providing that the additional width is in increments of 600 mm to maintain the stiffener centres and the relationship between the stiffeners and the perimeter detail.

2.2.1.4 Any joints in the plating shall be fully welded, at least from one side.

2.2.1.5 The construction of a structural steel core having the recommended dimensions is shown in figure 2; the thickness of the plating and dimensions of the stiffeners shown are nominal dimensions. Irrespective of the dimensions of the structural core and the material of manufacture, the details around the perimeter shall be as illustrated in figure 3.

2.2.2 *Design*

2.2.2.1 Where insulation is provided by panels (e.g., a "B" class ceiling), then the test specimen shall be designed such that at least one of the panels is of full width and this, or these, shall be positioned such that both its/their longitudinal edges are jointed to an adjacent panel and are not secured to the restraint frame. The overall dimensions of the panel insulation system, including the perimeter details at all the edges, shall be 20 mm greater in each direction than the equivalent dimensions of the structural core.

2.2.2.2 If the ceiling incorporates panels, the specimen shall include examples of both the lateral and longitudinal joints between the panels. If the specimen is to simulate a ceiling where the maximum length of the panels is greater than the length of the specimen, then a joint shall be positioned at a distance of approximately 600 mm from one of the shorter ends of the test specimen.

2.2.2.3 If the insulation system is a ceiling which may incorporate electrical fittings, e.g., light fittings and/or ventilation units, it is necessary that initially a test is performed on a specimen of the ceiling itself, without the incorporation of these units, to establish the basic performance. A separate test(s) may be performed on a specimen(s) with the units incorporated to ascertain their influence on the performance of the ceiling.

2.2.2.4 Where the insulation consists of blankets, the blankets shall be arranged so that not less than two transverse joints between blankets are included. The joints shall be located not less than 600 mm from the edges of the deck.

2.2.3 ***Description***

2.2.3.1 The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details of the thicknesses of insulation used in way of the plating and the stiffeners, the method of securing the insulation system and details of the components used for this purpose, details of joints, connections, air gaps and all other details.

2.2.3.2 Where insulation is provided by panels, the manufacturer shall provide the information required in paragraph 2.8.3 (ceilings). The distance between the steel deck and the insulating membrane shall be stated.

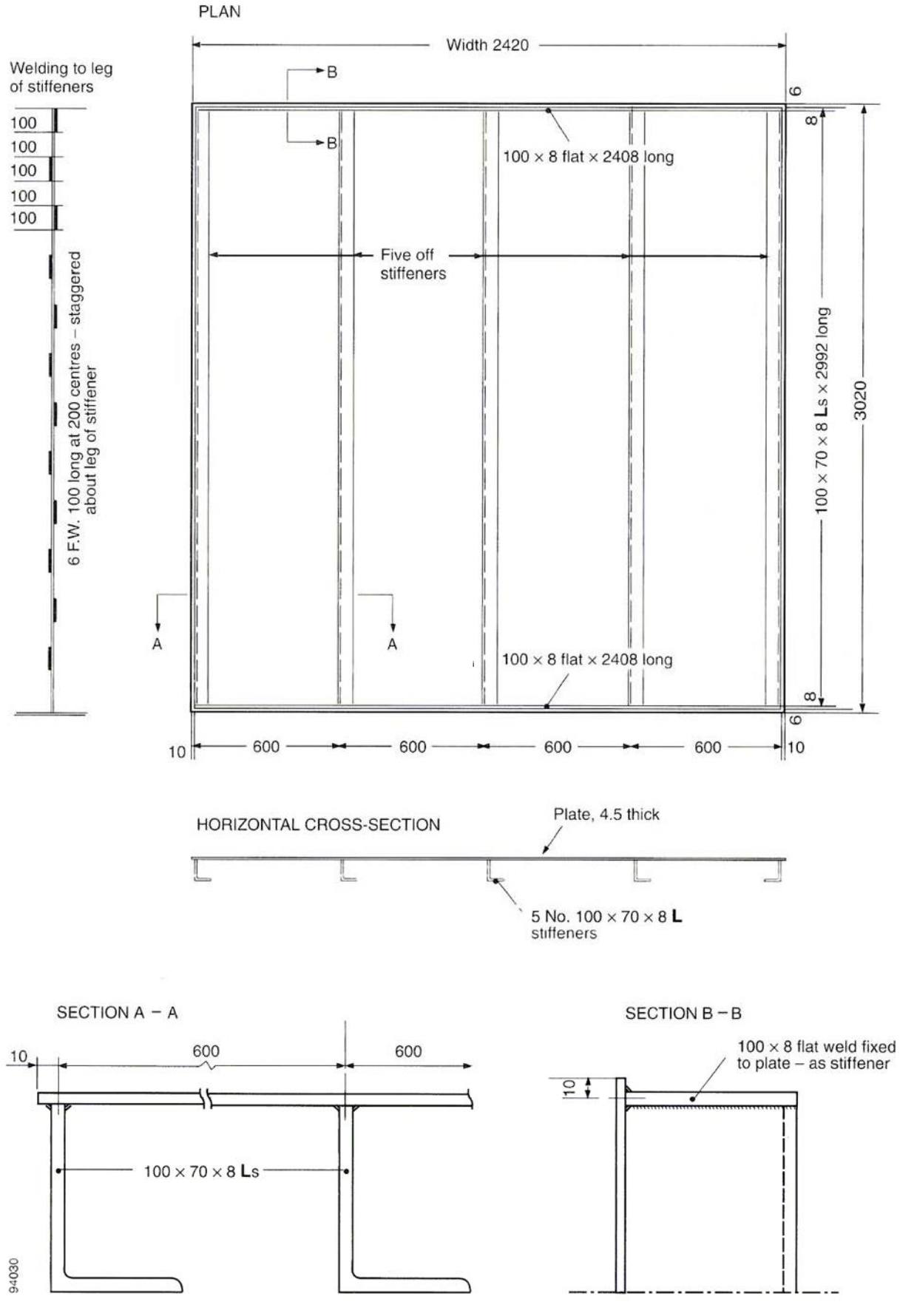
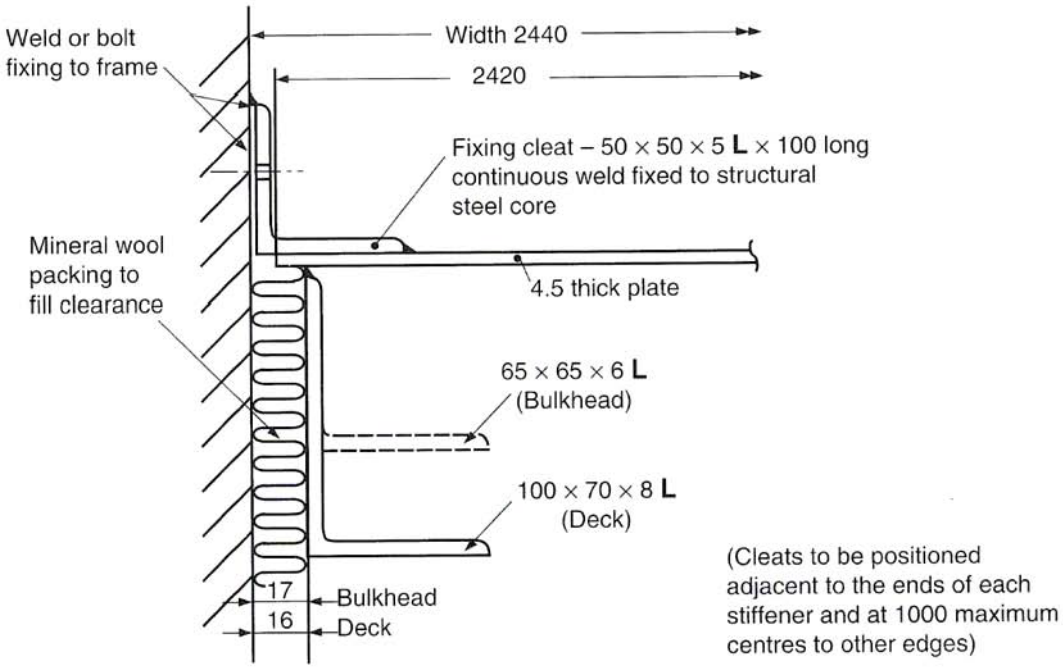


Figure 2 – Structural steel core for "A" class deck and "B" class ceiling

SECTION A – A (see figures 1 and 2)



SECTION B – B (see figures 1 and 2)

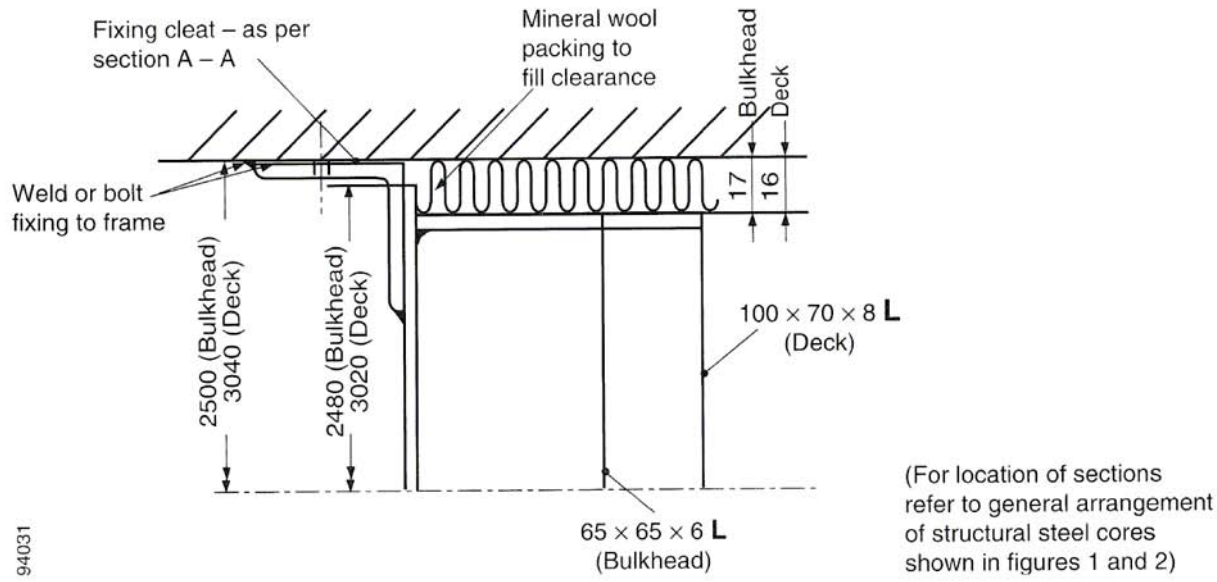


Figure 3 – Connection between restraint frame and structural steel core

2.3 "A" class doors

2.3.1 *Dimensions*

The test specimen shall incorporate the maximum size (in terms of both the width and the height) of door leaf or leaves for which approval is to be sought. The maximum size of a door which can be tested will be determined by the requirement to retain certain dimensions of the structural core (see paragraph 2.3.2.4 below).

2.3.2 *Design*

2.3.2.1 The door leaf and frame shall be constructed of steel or other equivalent material and insulated as necessary to achieve the desired standard of insulation.

2.3.2.2 Door furniture such as hinges, locks, latches, shoot bolts, handles, etc., shall be constructed of materials having melting points of not less than 950°C unless it can be shown by the fire test that materials having melting points below 950°C do not adversely affect the performance of the door.

2.3.2.3 The door leaf and frame shall be mounted into a structural core constructed in accordance with paragraph 2.1.1.

2.3.2.4 An opening to accommodate the door assembly shall be provided in the structural core; the maximum dimensions of the opening will be determined by a requirement to retain a minimum width of the structural core of 300 mm to each vertical side of the opening and a minimum distance of 100 mm from the top edge of the structural core.

2.3.2.5 No additional stiffening shall be provided to the structural core unless provided as part of the door frame.

2.3.2.6 The method of fixing the door frame into the opening in the structural core shall be as used in practice. If the method of fixing the door frame in a test is made by bolts, the Administration may also accept welding as a method of fixing the door frame without further tests.

2.3.2.7 For doors mounted in a three-sided frame, the door shall be mounted with a bottom gap of between 12 mm and 25 mm between the bottom of the door and the test frame.

2.3.2.8 The structural core shall be mounted such that the stiffeners are on the unexposed face and the insulating system shall be on the exposed face.

2.3.2.9 The insulation system shall be approved by the Administration to at least the same standard as that which the door is intended to achieve. If the insulation performance of the door is unknown the structural core shall be insulated to "A-60" standard. The insulation of the structural core shall not be extended beyond the outer web of the door frame.

2.3.2.10 The door shall be mounted into the structural core such that the side expected to give the inferior performance will be exposed to the heating conditions of the test.

2.3.2.11 A hinged door shall be tested with the door leaf opening away from the heating conditions unless the Administration deems otherwise.

2.3.2.12 For sliding doors it is not possible to state generally from which side the door shall be tested to give the inferior performance. It will, therefore, be necessary to conduct two separate tests, one with the door mounted to the exposed face and one with the door mounted to the unexposed face of the bulkhead. If, for practical reasons, a sliding door cannot be fixed to the stiffened face of the structural core, then, subject to the agreement of the Administration, the stiffeners may be positioned on the exposed face.

2.3.2.13 Lift landing doors can be expected to be exposed to fire from the corridor side only, and they shall be exposed to fire test heating conditions from that side only.

2.3.2.14 Tests performed with double leaf doors will not be accepted as approval documentation for single leaf doors.

2.3.2.15 Double leaf doors should be tested with equally sized door leaves unless the door is intended to have unequally sized leaves.

2.3.3 ***Description***

The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details of the following:

.1 the bulkhead;

.2 the door leaf and frame construction, including the clearances between the door leaf and the frame;

.3 the connection of the door frame to the bulkhead;

.4 the method of securing insulation and details of components used for this purpose (e.g., the type and rate of application of any adhesive); and

.5 fittings such as hinges, shoot bolts, latches, locks, etc.

2.4 "B" and "F" class bulkheads

2.4.1 ***Dimensions***

2.4.1.1 The minimum overall dimensions of the test specimen, including the perimeter details at the top, bottom and vertical edges, are 2,440 mm width and 2,500 mm height. When the maximum overall height in practice is to be less than that given above, then the test specimen shall be of the maximum height to be used in practice.

2.4.1.2 The minimum bulkhead panel height shall be a standard height of the manufactured panel with a dimension of 2,400 mm.

2.4.2 ***Design***

2.4.2.1 Where the construction incorporates panels, the specimen shall be constructed such that at least one of the panels is of full width and this, or these, shall be positioned such that both its/their longitudinal edges are jointed to an adjacent panel and are not secured to the restraint frame.

2.4.2.2 If the bulkhead may incorporate electrical fittings, e.g., light fittings and/or ventilation units, it is necessary that initially a test is performed on a specimen of the bulkhead itself, without the incorporation of these units, to establish the basic performance. A separate test(s) shall be performed on a specimen(s) with the units incorporated to ascertain their influence on the performance of the bulkhead.

2.4.3 ***Description***

The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details of the thicknesses of materials used in the insulation system (e.g., of any panels), the method of securing the panels and details of the components used for this purpose, details of joints, connections, air gaps and all other details.

2.5 "B" and "F" class decks

2.5.1 ***Dimensions***

2.5.1.1 The minimum overall dimensions of the test specimen, including the perimeter details at all the edges, are 2,440 mm width and 3,040 mm length.

2.5.1.2 When the maximum dimensions in practice are less than that given above, the test specimen shall be of the maximum size to be used in practice and the tested width shall be reported.

2.5.2 ***Design***

Where the construction incorporates panels, the specimen shall be constructed such that at least one of the panels is of full width and this, or these, shall be positioned such that both its/their longitudinal edges are jointed to an adjacent panel and are not secured to the restraint frame.

2.5.3 ***Description***

The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details of the thicknesses of materials used in the insulation system (e.g., of any panels), the method of securing the insulation system and details of the components used for this purpose, details of joints, connections, air gaps and all other details.

2.6 "B" and "F" class doors

2.6.1 ***Dimensions***

The test specimen shall incorporate the maximum size (in terms of both the width and the height) of the door leaf or leaves for which approval is to be sought. The maximum size of a door which can be tested will be determined by the requirement to retain certain dimensions of the bulkhead (see paragraph 2.6.2.6).

2.6.2 ***Design***

2.6.2.1 Door furniture such as hinges, locks, latches, shoot bolts, handles, etc., shall be constructed of materials having melting points of not less than 850°C unless it can be shown by the fire test that materials having melting points below 850°C do not adversely affect the performance of the door.

2.6.2.2 The door leaf and frame shall be mounted as appropriate into a "B" or "F" class bulkhead of compatible construction, thereby reflecting an actual end-use situation. The bulkhead shall have dimensions as prescribed in paragraph 2.4.1.

2.6.2.3 The bulkhead shall be of a construction approved by the Administration as having at least a similar classification to that required by the door, and approval shall be limited to the type of construction in which the door was tested.

2.6.2.4 The method of fixing the door frame to the bulkhead shall be as used in practice. If the method of fixing the door frame in a test is made by bolts, the Administration may also accept welding as a method of fixing the door frame without further tests.

2.6.2.5 For doors mounted in a three-sided frame, the door shall be mounted with a bottom gap of between 12 mm and 25 mm between the bottom of the door and the test frame.

2.6.2.6 The door shall be positioned such that there is a minimum width of the bulkhead of 300 mm to each vertical side of the door and a minimum distance of 100 mm from the top edge of the bulkhead.

2.6.2.7 The door shall be mounted into the bulkhead such that the side expected to give the inferior performance will be exposed to the heating conditions of the test.

2.6.2.8 A hinged door shall be tested with the door leaf opening away from the heating conditions unless the Administration deems otherwise.

2.6.2.9 For sliding doors it is not possible to state generally from which side the door shall be tested to give the inferior performance. It will, therefore, be necessary to conduct two separate tests, one with the door mounted to the exposed face and one with the door mounted to the unexposed face of the bulkhead.

2.6.2.10 For a door which incorporates a ventilation opening within its construction, the ventilation grille(s) shall be open at the commencement of the test.

2.6.3 ***Description***

The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details as follows:

.1 the bulkhead;

.2 the door leaf and frame construction, including the clearances between the door leaf and the frame;

.3 the connection of the door frame to the bulkhead;

.4 the method of securing insulation and details of components used for this purpose (e.g., the type and rate of application of any adhesive); and

.5 fittings such as hinges, shoot bolts, latches, locks, handles, ventilation louvres, escape panels, etc.

2.7 "B" and "F" class linings

Linings shall be tested as bulkheads and they shall be exposed to the fire test heating conditions from the side intended to face the cabin.

2.7.1 *Dimensions*

2.7.1.1 The minimum overall dimensions of the test specimen, including the perimeter details at the top, bottom and vertical edges, are 2,440 mm width and 2,500 mm height. When the maximum overall height in practice is to be less than that given above, then the test specimen shall be of the maximum height to be used in practice.

2.7.1.2 The minimum bulkhead panel height shall be a standard height of the manufactured panel with a dimension of 2,400 mm.

2.7.2 *Design*

2.7.2.1 The lining shall be positioned alongside a structural core constructed in accordance with paragraph 2.1.1. The design of the lining shall be such that it facilitates its assembly with the limited access provided by the proximity of the structural core, i.e. it shall be mounted with the structural core in place.

Note: Viewing and access openings on an "A" class bulkhead may be provided for the determination of the integrity of the lining, and they should be located corresponding to joints of panels of the lining and away from thermocouples on an "A" class bulkhead. They should normally be sealed with mineral wool insulation slabs except when viewing or access to the lining is needed.

2.7.2.2 During a test on an "A" class bulkhead which utilizes membrane protection along its exposed side, e.g., a "B" class lining, it is possible also to evaluate the performance of the lining with a view to classification providing that the necessary thermocouples are attached to the lining and providing that the necessary integrity measurements are made.

2.7.2.3 The specimen shall be constructed such that at least one of the panels is of full width and this, or these, shall be positioned such that both its/their longitudinal edges are jointed to an adjacent panel and are not secured to the restraint frame.

2.7.2.4 If the lining may incorporate electrical fittings, e.g., light fittings and/or ventilation units, it is necessary that initially a test is performed on a specimen of the lining itself, without the incorporation of these units, to establish the basic performance. A separate test(s) shall be performed on a specimen(s) with the units incorporated to ascertain their influence on the performance of the lining.

2.7.3 *Description*

The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings

and specifications prior to the test. The drawings shall include dimensions and details of the thicknesses of materials used in the insulation system (e.g., of any panels), the method of securing the insulation system and details of the components used for this purpose, details of joints, connections, air gaps and all other details.

2.8 "B" and "F" class ceilings

2.8.1 *Dimensions*

2.8.1.1 The minimum overall dimensions of the test specimen, including the perimeter details at all the edges, are 2,440 mm width and 3,040 mm length.

2.8.1.2 When the maximum dimensions in practice are less than those given above then the test specimen shall be of the maximum size to be used in practice, and the tested width shall be reported.

2.8.2 *Design*

2.8.2.1 The ceiling shall be positioned below a structural core constructed in accordance with paragraph 2.2.1. The design of the ceiling shall be such that it facilitates its assembly with the limited access provided by the proximity of the structural core, i.e. it shall be mounted with the structural core in place.

Note: Viewing and access openings on an "A" class deck may be provided for the determination of the integrity of the ceiling, and they should be located corresponding to joints of panels of the ceiling and away from thermocouples on an "A" class deck. They should normally be sealed with mineral wool insulation slabs except when viewing or access to the ceiling is needed.

2.8.2.2 During a test on an "A" class deck which utilizes membrane protection along its underside, e.g., a "B" class ceiling, it is possible also to evaluate the performance of the ceiling with a view to classification providing that the necessary thermocouples are attached to the ceiling and providing that the necessary integrity measurements are made.

2.8.2.3 If the ceiling incorporates panels, the specimen shall include examples of both the lateral and longitudinal joints between the panels. If the specimen is to simulate a ceiling where the maximum length of the panels is greater than the length of the specimen, then a joint shall be positioned at a distance of approximately 600 mm from one of the shorter ends of the test specimen.

2.8.2.4 The specimen shall be constructed such that at least one of the panels is of full width and this, or these, shall be positioned such that both its/their longitudinal edges are jointed to an adjacent panel and are not secured to the restraint frame.

2.8.2.5 If the ceiling may incorporate electrical fittings, e.g., light fittings and/or ventilation units, it is necessary that initially a test is performed on a specimen of the ceiling itself, without the incorporation of these units, to establish the basic performance. A separate test(s) shall be performed on a specimen(s) with the units incorporated to ascertain their influence on the performance of the ceiling.

2.8.2.6 Where testing is conducted on a perforated ceiling system, equally constructed non-perforated ceilings and ceilings with a lesser degree of perforations (in terms of size, shape, and perforations per unit area) may be approved without further testing.

2.8.3 ***Description***

The applicant shall provide full constructional details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test. The drawings shall include dimensions and details of the thicknesses of materials used in the insulation system (e.g., of any panels), the method of securing the insulation system and all relevant details including, in particular, the components used for this purpose, joints, connections and air gaps.

3 MATERIALS FOR TEST SPECIMENS

3.1 Specifications

Prior to the test, the following information, if applicable, shall be submitted to the laboratory by the applicant for each of the materials used in the construction:

.1 the identification mark and trade name;

.2 principal details of composition;

.3 nominal thickness;

.4 nominal density (for compressible materials this shall be related to the nominal thickness);

.5 nominal equilibrium moisture content (at relative humidity of 50% and a temperature of 23°C);

.6 nominal organic content;

.7 specific heat at ambient temperature; and

.8 thermal conductivity at ambient temperature.

3.2 Control measurements

3.2.1 ***General***

3.2.1.1 The testing laboratory shall take reference specimens of all those materials whose characteristics are important to the performance of the specimen (excluding steel and equivalent material). The reference specimens shall be used for the non-combustibility test, if appropriate, and for the determination of the thickness, the density and, where appropriate, the moisture and/or organic content.

3.2.1.2 The reference specimens for sprayed materials shall be made when the material is sprayed on the structural core and they shall be sprayed in a similar manner and in the same orientation.

3.2.1.3 The laboratory shall conduct the following control tests, as appropriate to the type of material and the proposed classification, on the reference specimens after they have been conditioned as specified in paragraph 4.

3.2.1.4 For the determination of the thickness, the density and the moisture and/or organic content three specimens shall be used, and the value quoted as the mean of the three measurements.

3.2.2 ***Encapsulated materials***

3.2.2.1 When an insulation material is encapsulated within the construction and it is not possible for the laboratory to take specimens of the material prior to the test for conducting the control measurements, the applicant shall be requested to provide the requisite samples of the material. In these cases it shall be clearly stated in the test report that the measured properties were determined from samples of the material provided by the applicant for the test.

3.2.2.2 Notwithstanding the above, the laboratory shall attempt, wherever possible, to verify the properties by using samples which may be cut from the specimen before test or by checking against similar properties determined after test. When samples of the material are cut from the test specimen before test, the specimen shall be repaired in a manner such that its performance in the fire test is not impaired.

3.2.3 ***Non-combustibility***

Where materials used in the construction of the specimen are required to be non-combustible, i.e. for "A" and "B" classes, evidence in the form of test reports in accordance with the test method in part 1 of this annex, and from a testing laboratory recognized by the Administration and independent of the manufacturer of the material shall be provided. These test reports shall indicate that the non-combustibility tests were conducted not more than 24 months prior to the date of the performance of the fire resistance test. If such reports cannot be provided then tests in accordance with part 1 of annex 1 to the Code shall be conducted. When the material has a type approval certificate for non-combustible material valid at the performance of the fire resistance test, non-combustibility test reports may not be required.

3.2.4 ***Low flame-spread characteristics***

3.2.4.1 Where materials used in the construction of the specimen are required to have low flame-spread characteristics, evidence in the form of test reports in accordance with part 5 of this annex, and from a testing laboratory recognized by the Administration and independent of the manufacturer of the material shall be provided. These test reports shall indicate that the low flame-spread tests were conducted not more than 24 months prior to the date of the performance of the fire resistance test. If such reports cannot be provided then tests in accordance with part 5 of this annex shall be conducted. When the material has a type approval certificate for low flame-spread characteristics valid at the performance of the fire resistance test, low flame-spread test reports may not be required.

3.2.4.2 Adhesives used in the construction of the specimen are not required to be non-combustible; however, they shall have low flame-spread characteristics.

3.2.5 ***Thickness***

3.2.5.1 The thickness of each material and combination of materials shall be ± 10% of the value stated as the nominal thickness when measured by using a suitable gauge or callipers.

3.2.5.2 The thickness of a sprayed insulation material shall be measured using a suitable probe at positions adjacent to each of the unexposed-face thermocouples.

3.2.6 ***Density***

3.2.6.1 The density of each material shall be determined from measurement of the weight and the dimensions.

3.2.6.2 The density of mineral wool or any similar compressible material shall be related to the nominal thickness and the density of each material used in the test specimen shall be ± 10% of the value stated as the nominal density.

3.2.7 ***Moisture content***

3.2.7.1 The moisture content (W_1-W_2) of each non-combustible material used in the specimen shall be calculated using the following method, and indicate a percentage of the dry weight (W_2), and which information is required.

3.2.7.2 In the following, W_1, W_2 and W_3 are mean values of three weight measurements. W_1 should be higher than 25 g. Three specimens of each material, taken in the width of the production's direction and measuring width x minimum 20 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 ± 2°C for 24 h and reweighed when cooled (W_2). However, gypsum-based, cementations and similar materials should be dried at a temperature of 55 ± 5°C to constant weight (W_2).

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

3.2.8 ***Organic content***

3.2.8.1 The information of organic content of non-combustible materials used in the specimen is required. After the percentage moisture contents have been calculated as specified in paragraph 3.2.7, the three specimens should be further heated in an oven at a temperature of 500 ± 20°C for 2 h and again weighed (W_3). The organic content (W_2-W_3) shall be calculated as a percentage of the dry weight (W_2).

Note: A bigger tolerance can be accepted as long as the tested specimen represents the upper limit of the tolerance. In this case, it should be specified in the test report and in the type approval certificate.

3.2.8.2 The organic content of each material used in the test specimen should be within ± 0.3% absolute of the value stated as the nominal organic content.

4 CONDITIONING OF THE TEST SPECIMENS

4.1 General

4.1.1 The test specimen should be protected against adverse environmental conditions until the time of the test. The test specimen shall not be tested until it has reached an equilibrium (constant weight), air-dry condition under the laboratory's normal ambient condition. The equilibrium condition shall be obtained according to paragraph 4.2 below.

4.1.2 Accelerated conditioning is permissible provided the method does not alter the properties of component materials. In general, high-temperature conditioning shall be below temperatures critical for the materials.

4.2 Verification

4.2.1 The condition of the test specimen can be monitored and verified by use of special samples for the determination of moisture content of constituent materials, as appropriate. These samples shall be so constructed as to represent the loss of water vapour from the specimen by having similar thicknesses and exposed faces. They shall have minimum linear dimensions of 300 mm by 300 mm and a minimum mass of 100 g. Constant weight shall be considered to be reached when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0.3% of the mass of the reference specimen or 0.3 g, whichever is the greater.

4.2.2 Other reliable methods of verifying that the material has reached equilibrium moisture content may be used by the testing laboratory.

4.3 Encapsulated materials

4.3.1 When the test specimen incorporates encapsulated materials it is important to ensure that these materials have reached an equilibrium moisture content prior to assembly, and special arrangements shall be made with the applicant for the test to ensure that this is so.

4.3.2 When the test specimen, such as doors, incorporates encapsulated materials, the requirement relevant to equilibrium moisture in paragraph 4.2 shall apply.

5 MOUNTING OF THE TEST SPECIMENS

5.1 Restraint and support frames

5.1.1 All test specimens shall be mounted within substantial concrete, or concrete- or masonry-lined frames, which are capable of providing a high degree of restraint to the expansion forces generated during the tests. The concrete or the masonry shall have a density between 1,600 kg/m^3 and 2,400 kg/m^3. The concrete or masonry lining to a steel frame shall have a thickness of at least 50 mm.

5.1.2 The rigidity of the restraint frames shall be evaluated by applying an expansion force of 100 kN within the frame at mid-width between two opposite members of the frame and measuring the increase in the internal dimensions at these positions. This evaluation shall be conducted in the direction of the bulkhead or deck stiffeners, and the increase of the internal dimension shall not exceed 2 mm.

5.1.3 For frames which are to be used to evaluate "A" class divisions which incorporate "B" class ceilings or linings, the frames shall be provided with at least four viewing and access openings, notionally one to each quarter of the test specimen. These openings shall facilitate access to the cavity for the determination of the integrity of the ceiling or lining during the test on the deck or bulkhead. The access/viewing openings shall normally be sealed with mineral wool insulation slabs except when viewing or accessing to the ceiling or lining is needed.

5.2 "A" class divisions

5.2.1 The structural core to an "A" class division shall be fixed into the restraint frame and sealed around its perimeter as shown in figure 3. Steel spacers, with an approximate thickness of 5 mm, may be inserted between the fixing cleats and the restraint frame if the laboratory finds this necessary.

5.2.2 When the structural core of an "A" class division is to be exposed to the heating conditions of the test, i.e. when the fixing cleats are on the exposed side of the structural core, then a 100 mm wide perimeter margin adjacent to the restraint frame shall be insulated such that the fixing cleats and the edges of the structural core are protected from direct exposure to the heating conditions. In no other situations, irrespective of the type of test specimen, shall the perimeter edges be protected from direct exposure to the heating conditions.

5.3 "B" and "F" class divisions

5.3.1 For a "B" or "F" class bulkhead or lining, the specimen shall be supported at the top and secured on the vertical sides and at the bottom in a manner representative of the conditions in service. The support provided at the top of a bulkhead or lining shall allow for the appropriate expansion or clearance to be used as in practice. At the vertical edges lateral expansion towards the vertical edges of the restraint frame shall be prevented by ensuring a tight fit of the specimen within the frame which may be achieved by inserting a rigid packing between the vertical edges and the frame. If provision for movement at the edges of a bulkhead or lining is made for a particular construction in service, the specimen shall simulate these conditions.

5.3.2 For a "B" or "F" class ceiling, expansion of the ceiling members shall be prevented at the perimeter edges since the specimen is intended to simulate a part of a ceiling removed from a much greater area. Expansion shall be prevented by ensuring a tight fit of the specimen within the frame which may be achieved by inserting a rigid packing between the ends or edges of ceiling members and the restraint frame. Only if the ceiling is being tested at full size in one or more directions is it allowed to incorporate the expansion allowance at the perimeter edges in the appropriate direction or directions.

6 EXAMINATION OF THE TEST SPECIMENS

6.1 Conformity

6.1.1 The laboratory shall verify the conformity of the test specimen with the drawings and method of assembly provided by the applicant (see paragraph 2), and any area of discrepancy shall be resolved prior to commencement of the test.

6.1.2 On occasion it may not be possible to verify the conformity of all aspects of the specimen construction prior to the test and adequate evidence may not be available after test. When it is necessary to rely on information provided by the applicant then this shall be clearly stated in the test report. The laboratory shall nevertheless ensure that it fully appreciates the design of the test specimen and shall be confident that it is able to accurately record the constructional details in the test report.

6.2 Door clearances

Following mounting of the door and immediately prior to test, the laboratory shall measure the actual clearances between the door leaf and the door frame, and additionally for a double leaf door between the adjacent door leaves. The clearances shall be measured for each door leaf at two positions along the top and bottom edges and at three positions along each vertical edge.

6.3 Door operation

Similarly, immediately prior to test, the laboratory shall check the operability of the door by opening the door leaf by a distance of at least 300 mm. The door leaf shall then be closed, either automatically, if such a closing device is provided, or manually. The door may be latched for the test but shall not be locked, and no devices for latching or locking shall be included which are not normally incorporated in practice.

7 INSTRUMENTATION

7.1 General

7.1.1 *The furnace*

The instrumentation of the furnace and the instrumentation of the test specimen shall generally be in accordance with the standard ISO 834-1, Fire resistance tests – Elements of building construction – Part 1: General requirements; except where amended by this section. The details given in the following paragraphs are supplementary to, an elaboration of, or a deviation from the ISO requirements.

7.2 Ambient temperature thermocouple

A thermocouple shall be used to indicate the ambient temperature within the laboratory in the vicinity of the test specimen both prior to and during the test period. The thermocouple shall be nominally of 3 mm diameter, mineral insulated, stainless steel type K. The measuring junction shall be protected from radiated heat and draught. The ambient temperature shall be monitored at a distance of between 1 m and 3 m horizontally away from the unexposed face of the test specimen.

7.3 Furnace temperature thermocouples

7.3.1 *Design*

7.3.1.1 The furnace thermocouples shall be plate thermometers, which comprise an assembly of a folded steel plate, a thermocouple fixed to it and containing insulation material as described in standard ISO 834-1.

7.3.1.2 The plate part shall be constructed from 150 ± 1 mm long by 100 ± 1 mm wide by 0.7 ± 0.1 mm thick nickel alloy sheet strips folded to the design as shown in figure 4.

7.3.1.3 The measuring junction shall consist of nickel chromium/nickel aluminium (type K) wire as defined in standard IEC 60584-1, contained within mineral insulation in a heat-resisting steel alloy sheath of nominal diameter 1 mm, the hot junctions being electrically insulated from the sheath. The thermocouple hot junction shall be fixed to the geometric centre of the plate in the position shown in figure 4 by a small steel strip made from the same material as the plate. The steel strip can be welded to the plate or may be screwed to it to facilitate replacement of the thermocouple. The strip shall be approximately 18 mm by 6 mm if it is spot welded to the plate, and nominally 25 mm by 6 mm if it is to be screwed to the plate. The screws shall be 2 mm in diameter.

7.3.1.4 The assembly of plate and thermocouple shall be fitted with a pad of inorganic insulation material nominally 97 ± 1 mm by 97 ± 1 mm by 10 ± 1 mm thick, density 280 ± 30 kg/m^3.

7.3.1.5 Before the plate thermometers are first used, the complete plate thermometer shall be aged by immersing in a pre-heated oven at 1,000°C for 1 h.

Note: Exposure in a fire-resistance test furnace for 90 min under the standard temperature/time curve is considered to be an acceptable alternative to using an oven.

7.3.1.6 When a plate thermometer is used more than once, a log of its use shall be maintained indicating, for each use, the checks made and duration of use. The thermocouple and the insulation pad shall be replaced after 50 h exposure in the furnace.

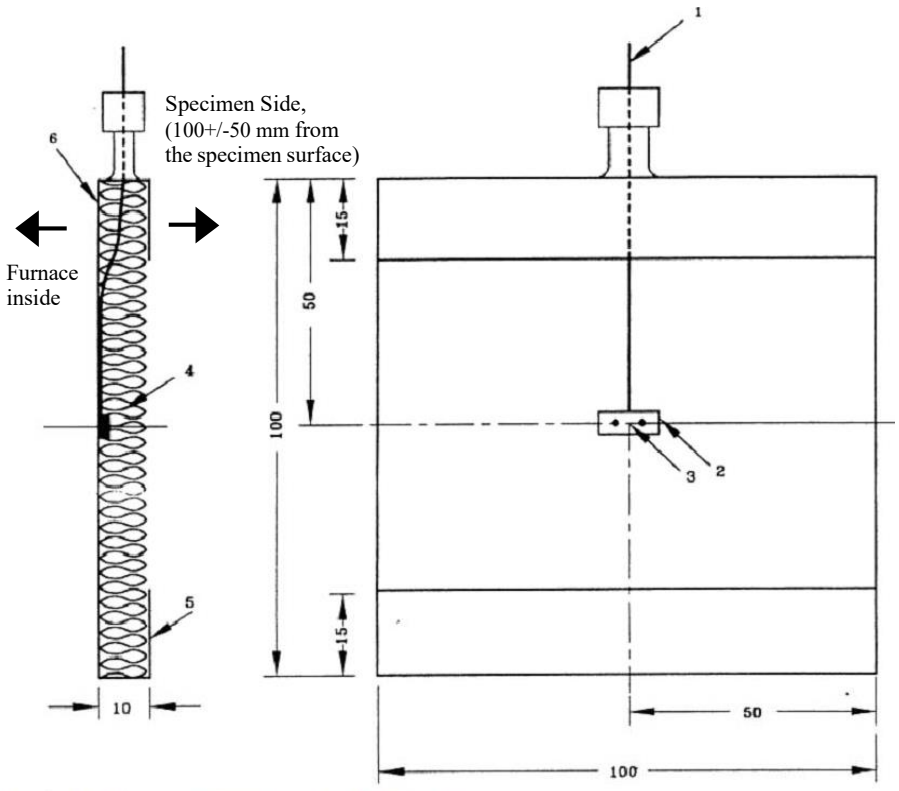
7.3.2 ***Number***

At least six furnace thermocouples shall be provided for the specimens given in paragraph 2. For specimens larger than those specified in paragraph 2, additional thermocouples shall be provided in the proportion of one per 1.5 m^2 of the specimen area. In case of a door assembly, specimen area refers to the entire bulkhead construction with the door fitted. This principle shall be used also for the other assemblies (e.g., windows, ducts and penetrations) installed in bulkheads or decks.

7.3.3 ***Positioning***

7.3.3.1 The thermocouples employed to measure the temperature of the furnace shall be uniformly distributed so as to give a reliable indication of the average temperature in the vicinity of the specimen. At the commencement of the test the measuring junctions shall be 100 mm from the face of the specimen and they shall be maintained at a distance of 50 mm to 150 mm during the test. The method of support shall ensure that thermocouples do not fall away or become dislodged during the test. Where it is convenient to pass thermocouple wires through the test construction, then the steel support tube shall not be used. The plate thermometers shall not be located at positions within the furnace where they are subject to direct flame impingement.

7.3.3.2 The plate thermometer shall be orientated so that side A faces the back wall of the wall furnace and the floor of the horizontal furnace.



1 sheathed thermocouple with insulated hot junction
2 spot welded or screwed steel strip
3 hot junction of thermocouple
4 insulation material
5 nickel alloy strip (0,7 ± 0,1) mm thick
6 face 'A'

Figure 4 – Furnace thermocouple assembly

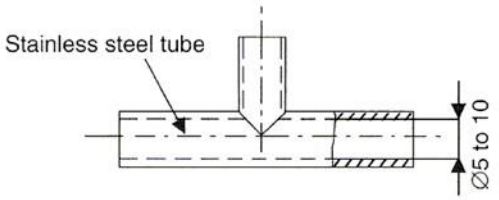
7.3.4 ***Connection***

The thermocouple wire shall be either continuous to the recording instrument or suitable compensating wire shall be used with all junctions maintained as near as possible at ambient temperature conditions.

7.4 Furnace pressure sensors

The mean value of the furnace pressure shall be measured using one of the designs of sensing heads described in figure 5.

Type 1 – 'T' shaped sensor



Note: Tee branches shall be horizontally oriented

Type 2 – tube sensor

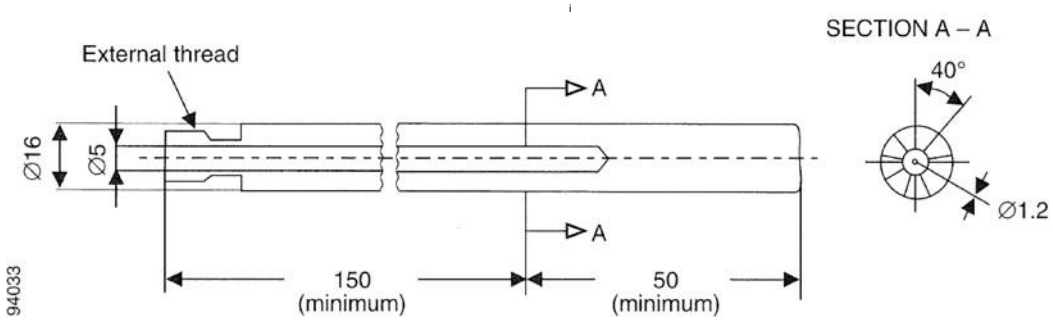


Figure 5 – Pressure-sensing heads

7.5 Unexposed-face temperature thermocouples

7.5.1 ***Design***

The temperature of the unexposed surface shall be measured by means of disc thermocouples of the type shown in figure 6. Thermocouple wires, 0.5 mm in diameter, shall be soldered to a 0.2 mm thick by 12 mm diameter copper disc. Each thermocouple shall be covered with a 30 mm square x 2.0 ± 0.5 mm thick non-combustible insulating pad. The pad material shall have a density of 900 ± 100 kg/m^3.

7.5.2 ***Connection***

Connection to the recording instrument shall be by wires of similar or appropriate compensating type.

7.5.3 ***Preparation of surfaces to receive thermocouples***

7.5.3.1 Steel – Surface finishes shall be removed and the surface cleaned with a solvent. Loose rust and scale shall be removed by wire brush.

7.5.3.2 Irregular surfaces – A smooth surface, not greater than 2,500 mm^2, to provide adequate adhesive bond shall be made for each thermocouple by smoothing the existing surface with a suitable abrasive paper. The material removed shall be the minimum to provide an adequate bonding surface. Where the surface cannot be smoothed, fillings shall be used of minimum quantity to provide a suitable surface. The filling shall comprise a ceramic cement and when the filled surface is dry it shall be smoothed, if necessary, with abrasive paper.

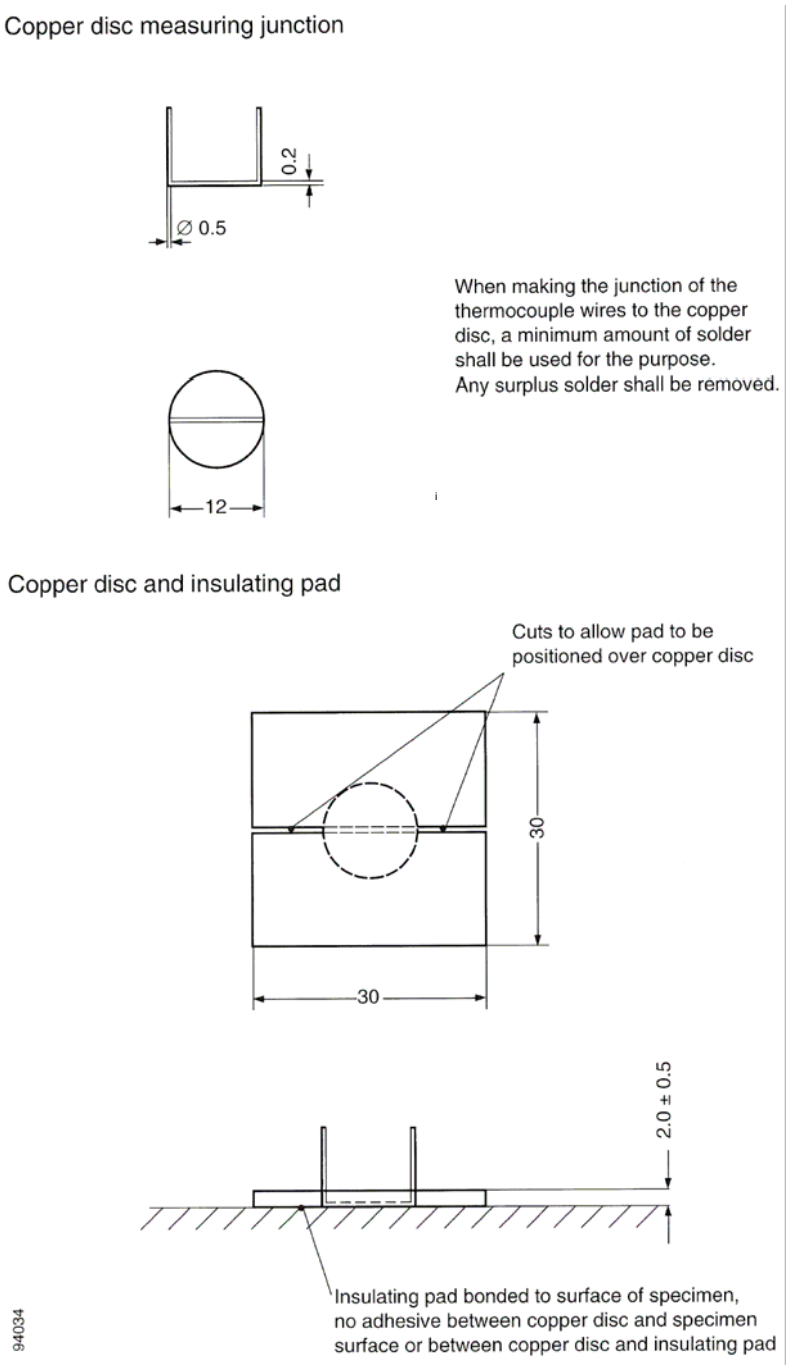


Figure 6 – Unexposed-surface thermocouple junction and insulating pad

7.5.4 ***Fixing of thermocouples***

7.5.4.1 Steel – The insulating pad with the thermocouple fitted shall 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 shall 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 insulating pad is not damaged. If the thermocouple pad is damaged when the tape is removed then the thermocouple shall be replaced.

7.5.4.2 Mineral wool – The thermocouples with insulating pads fitted shall 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 shall 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.

7.5.4.3 Where gluing is not possible, pins, screws or clips which are only in contact with those parts of the pad which are not over the (copper) disc shall be used. (Example: U-shaped clips approximately 30 x 15 x 30 x 0.5 mm, which are in contact only with the extreme corners of the pad. Heat transfer to the copper disc is negligible.)

7.5.4.4 Mineral fibre spray – Thermocouples shall not be fitted until the insulation has reached a stable moisture condition. In all cases the bonding technique for steel shall be used and where a surface wire mesh is present the thermocouples shall be affixed to the insulation in such a way that the wire mesh aids retention.

7.5.4.5 Vermiculite/cement type spray – The technique specified for wet fibrous spray shall be employed.

7.5.4.6 Boards of fibrous or mineral aggregate composition – The bonding technique for steel shall be used.

7.5.4.7 In all cases of adhesive bonding, the adhesive shall be applied in a thin film sufficient to give an adequate bond and there shall 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 "contact adhesive".

7.5.4.8 For "A" and "B" class divisions the insulation performance of a construction shall be given by that part of the construction which is manufactured from non-combustible materials only. However, if a material or panel is only produced with a superimposed finish, or if the Administration considers that the addition of a superimposed finish may be detrimental to the performance of the division, the Administration may allow, or may require, the finish to be incorporated during the test. In these cases, the superimposed finish shall be removed locally over an area as small as possible to allow fixing of the thermocouples to the non-combustible part, e.g., a deck provided with overlaid non-combustible insulation (a floating floor) shall have any combustible top surface finish removed locally to the thermocouples to allow them to be fixed to the insulation material.

7.6 Positioning of thermocouples on the specimen

7.6.1 *"A" class divisions, excluding doors*

The surface temperatures on the unexposed face of the test specimen shall be measured by thermocouples located as shown in figures 7 and 8:

.1 five thermocouples, one at the centre of the test specimen and one at the centre of each of the four quarters, all positioned at least 100 mm away from the nearest part of any joints and/or at least 100 mm away from the welds to any stiffeners;

.2 two thermocouples, one placed over each of the central stiffeners and for a bulkhead at 0.75 height of the specimen and for a deck at mid-length of the deck;

.3 two thermocouples, each placed over a vertical (longitudinal) joint, if any, in the insulation system and positioned for a bulkhead at 0.75 height of the specimen and for a deck at mid-length of the deck;

.4 when a construction has two differently orientated joint details, for example normal to each other, then two thermocouples additional to those already described in paragraph 7.6.1.3 above shall be used, one on each of two intersections;

.5 when a construction has two different types of joint detail, then two thermocouples shall be used for each type of joint;

.6 additional thermocouples, at the discretion of the testing laboratory or Administration, may be fixed over special features or specific construction details if it is considered that temperatures higher than those measured by the thermocouples listed above may result; and

.7 the thermocouples specified in subparagraphs .4 to .6 above for measurements on bulkheads, e.g., over different joint types or over joint intersections, shall, where possible, be positioned in the upper half of the specimen.

7.6.2 *"B" and "F" class divisions, excluding doors*

The surface temperatures on the unexposed face of the test specimen shall be measured by thermocouples located as shown in figure 9:

.1 five thermocouples, one at the centre of the test specimen and one at the centre of each of the four quarters, all positioned at least 100 mm away from the nearest part of any joints;

.2 two thermocouples, each placed over a vertical (longitudinal) joint, if any, in the division/insulation system and positioned for a bulkhead at 0.75 height of the specimen and for a deck/ceiling at mid-length of the deck/ceiling; and

.3 additional thermocouples, as required by paragraphs 7.6.1.4 to 7.6.1.7 above.

7.6.3 ***"A", "B" and "F" class doors***

The surface temperatures on the unexposed face of the test specimen shall be measured by:

.1 five thermocouples, one at the centre of the door leaf and one at the centre of each of the four quarters of the door leaf, all positioned at least 100 mm away from the edge of the door leaf, from any stiffeners, from any door furniture and from any special features or specific constructional details;

.2 if the door leaf incorporates stiffeners, two additional thermocouples, one placed over each of two stiffeners in the central portion of the door;

.3 additional thermocouples, at the discretion of the testing laboratory or Administration, may be fixed over special features or specific constructional details if it is considered that temperatures higher than those measured by the thermocouples listed above may result. Any additional thermocouples fixed to the door frame, or to any part of the door leaf, which is closer than a distance of 100 mm from the gap between the edge of the door leaf and the frame shall not be used for the purpose of classification of the test specimen, and if provided are for information only;

.4 the thermocouples specified in paragraphs 7.6.3.2 and 7.6.3.3 above shall, where possible, be positioned in the upper half of the specimen;

.5 additional thermocouples on the grille of a "B" class door are not to be placed over the perforated area and in a 100 mm wide zone around it;

.6 temperature measurements on a door which incorporates a ventilation opening within its construction shall not be made over the face of the ventilation grille(s);

.7 the door constructions, which incorporate a top panel, shall always be tested with thermocouples on the unexposed face of the top panel and on the joints and/or joining profiles at a level 125 mm above the top of the door leaf. Height of the top panel in the test specimen should be equal or greater than 225 mm; and

.8 when testing double-leaf door assemblies, the requirements shall be applied to each door leaf separately.

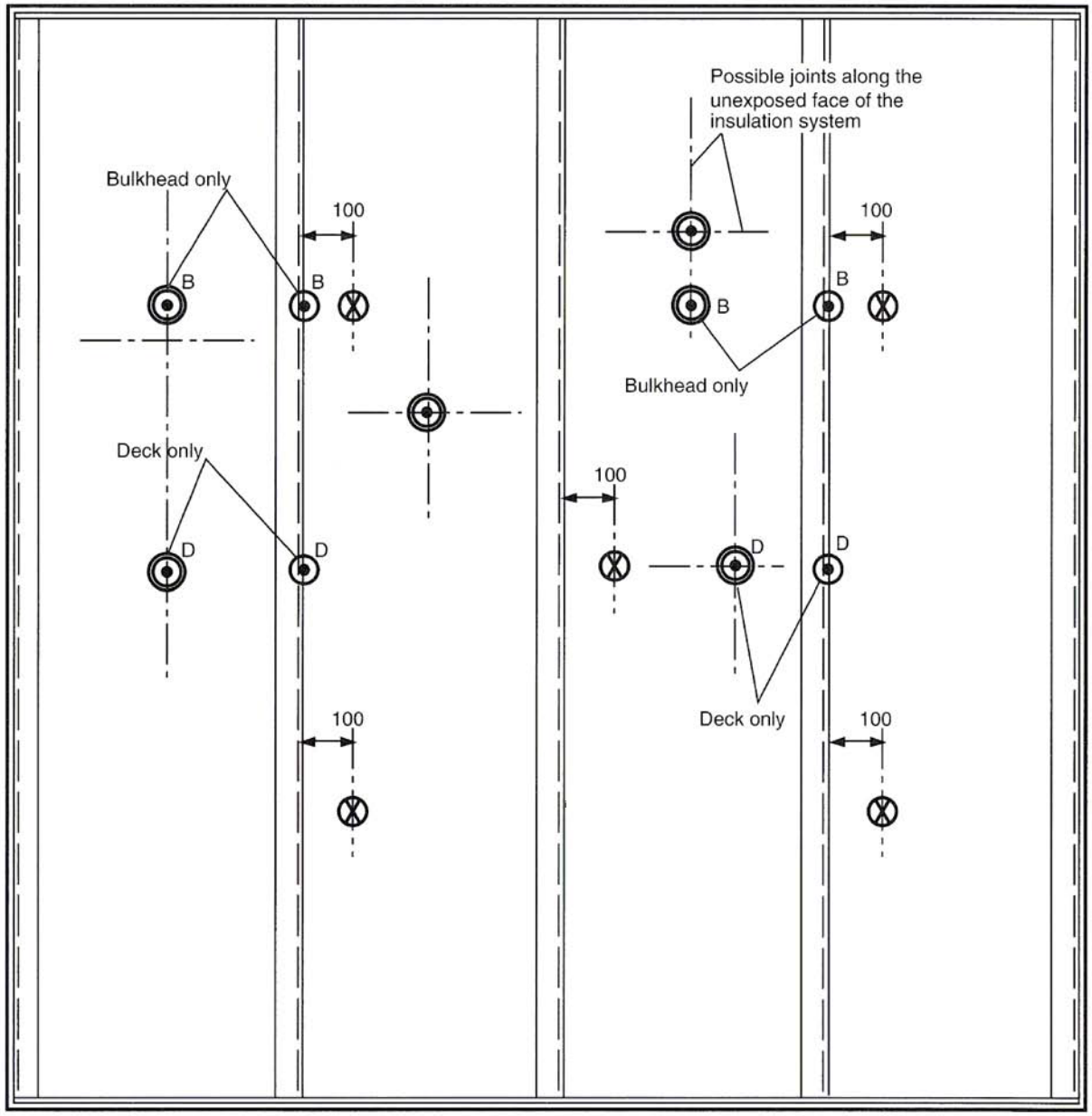


Figure 7 – Position of unexposed-face thermocouples for "A" class division: insulated face to the laboratory

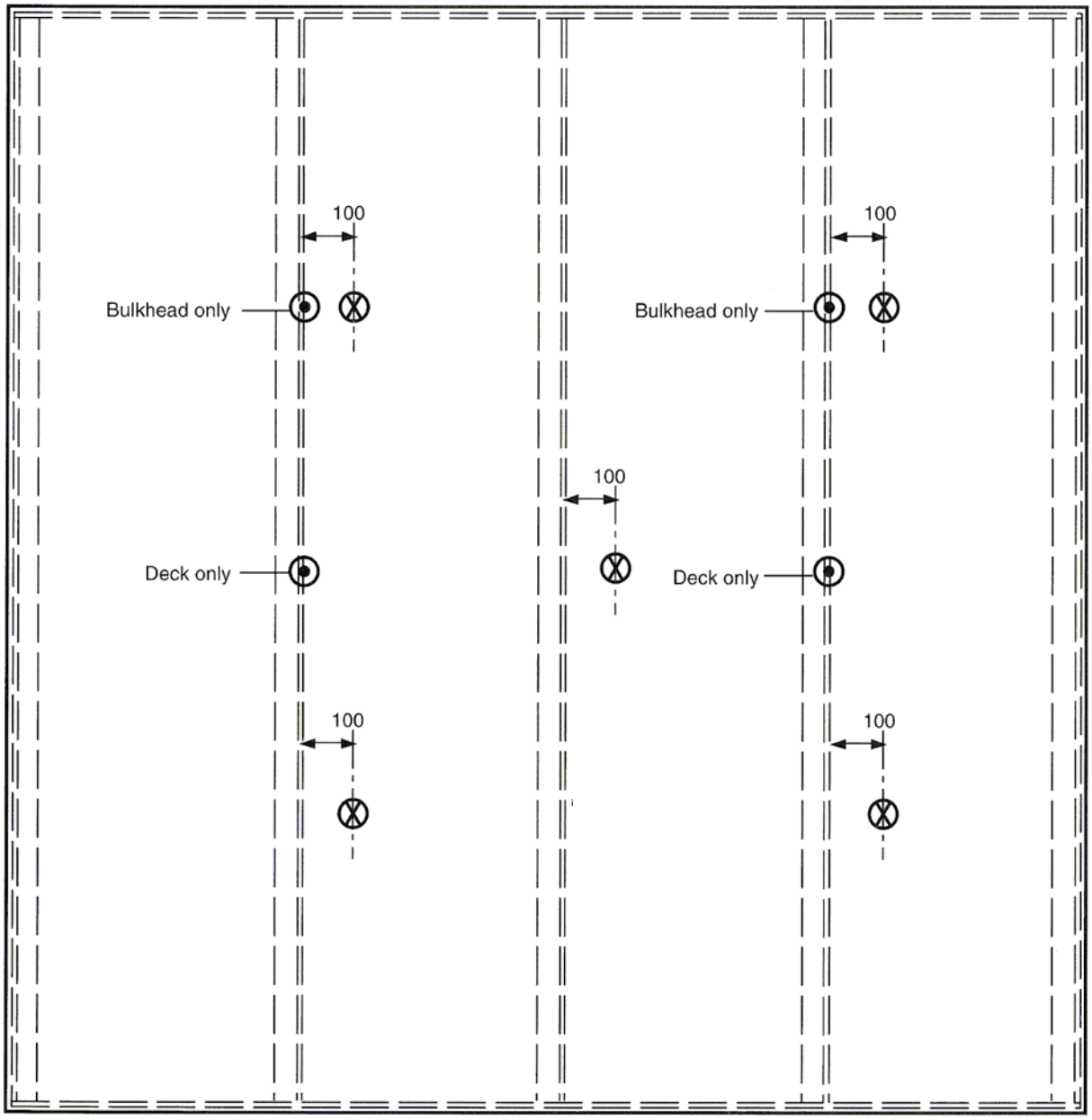


Figure 8 – Position of unexposed-face thermocouples for "A" class division: flat face of structural steel core to the laboratory

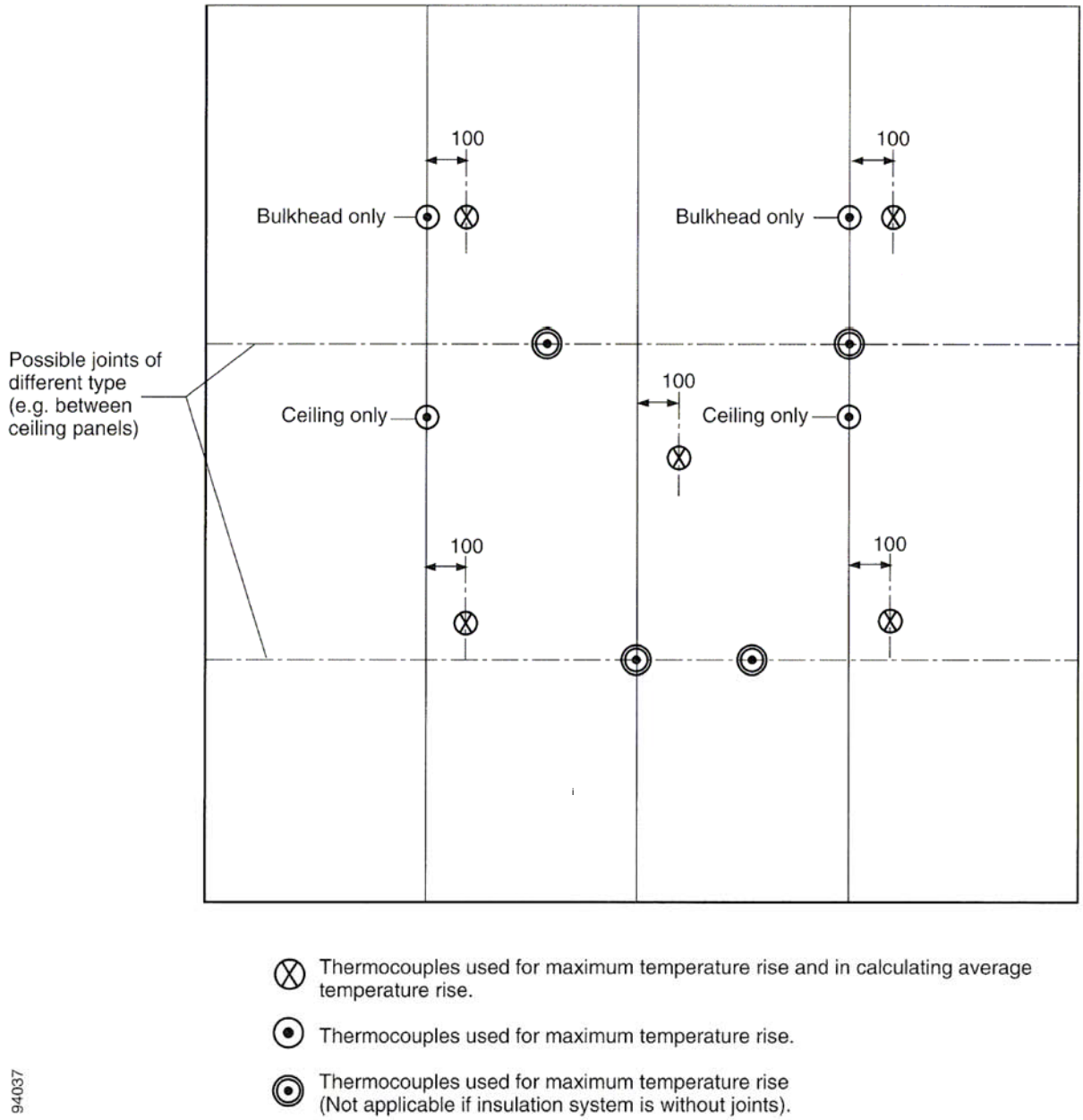


Figure 9 – Position of unexposed-face thermocouples for "B" and "F" class divisions

7.7 Structural core temperature thermocouples

7.7.1 When testing a specimen with a structural core other than steel, thermocouples shall be fixed to the core material in positions corresponding to the surface thermocouples mentioned in paragraph 7.6.1.1.

7.7.2 The thermocouples shall be fixed so that their hot junctions are attached to the appropriate positions by suitable means, including peening into the structural core. The wires shall be prevented from becoming hotter than the junction. The first 50 mm shall be in an isothermal plane.

7.8 Measuring and recording equipment for thermocouples

The measuring and recording equipment shall be capable of operating within the limits specified in standard ISO 834-1.

7.9 Cotton-wool pads

The cotton-wool pad employed in the measurement of integrity shall consist of new, undyed and soft cotton fibres, 20 mm thick x 100 mm square, and shall weigh between 3 g and 4 g. It shall be conditioned prior to use by drying in an oven at 100 ± 5°C for at least 30 min. After drying, it shall be allowed to cool to ambient temperature within a desiccator, where it may be stored until needed to be used. For use it shall be mounted in a wire frame, as shown in figure 10, provided with a handle.

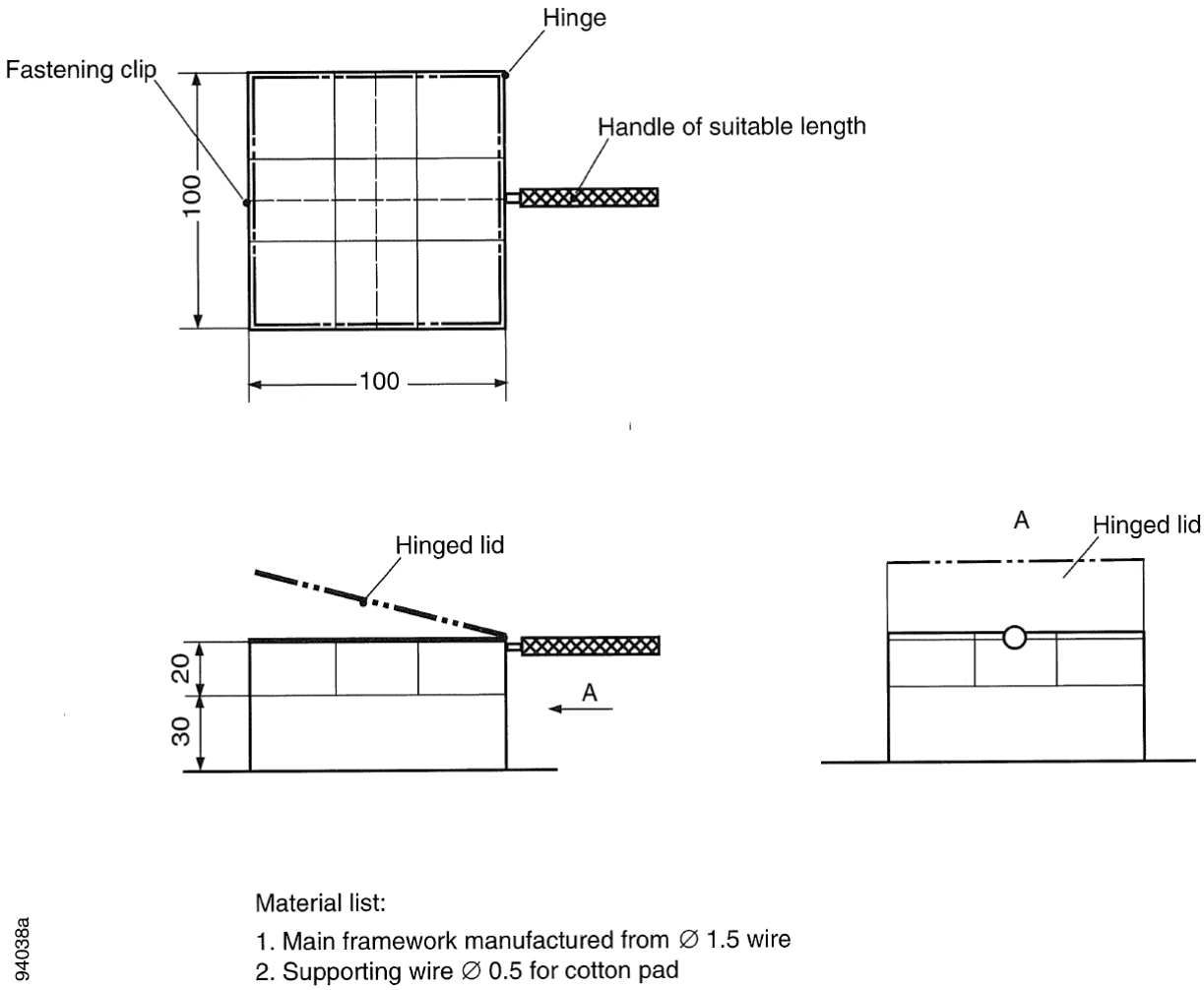
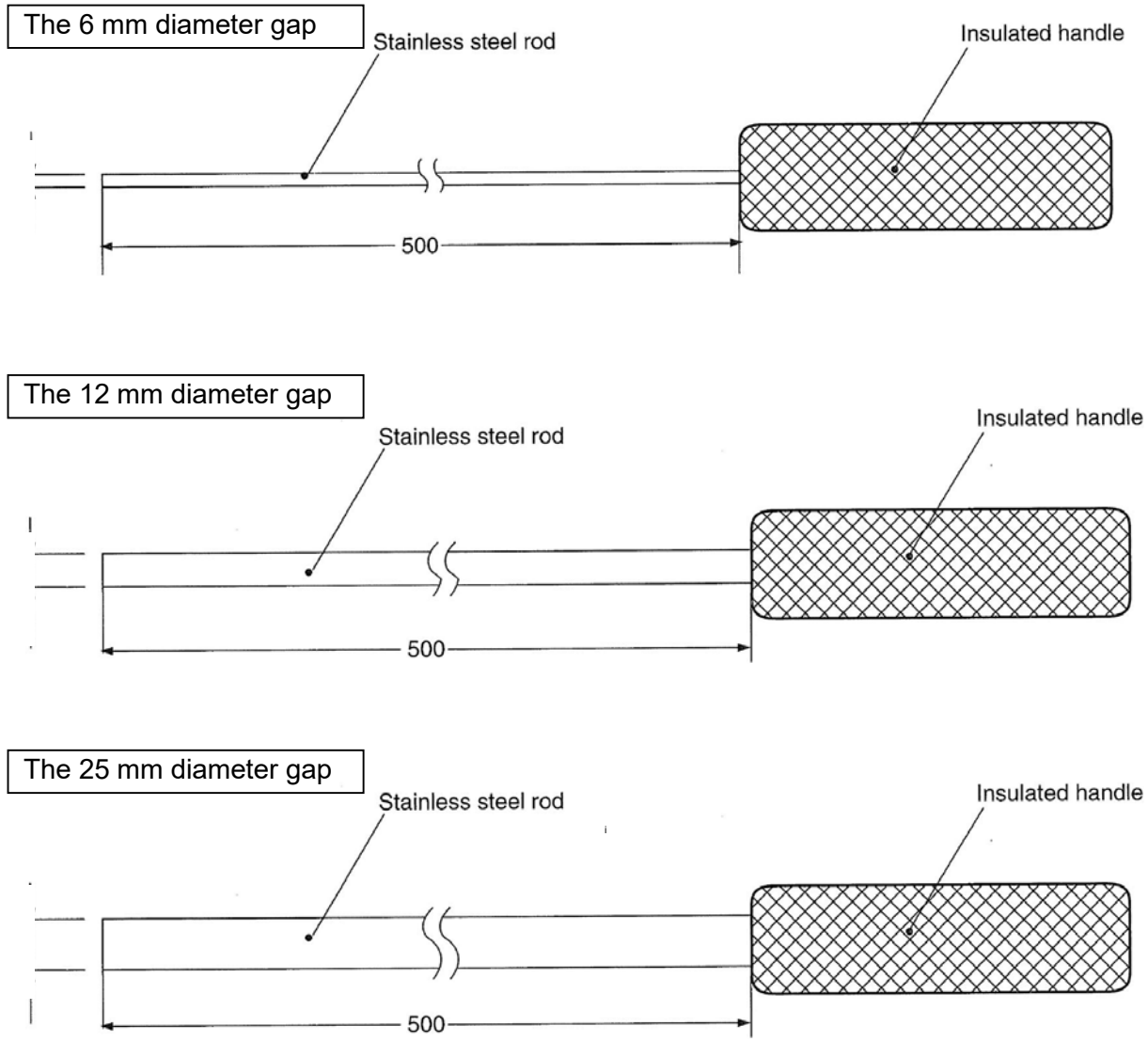


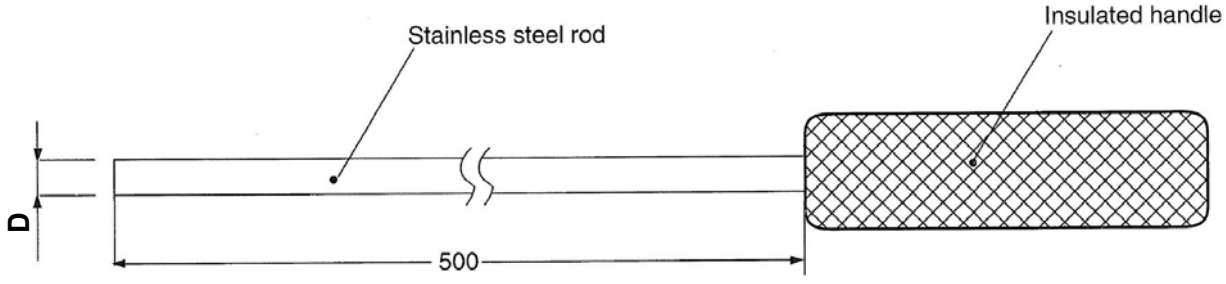
Figure 10 – Cotton-wool pad holder

7.10 Gap gauges

Three types of gap gauge, as shown in figure 11, shall be available for the measurement of integrity. They shall be made of stainless steel of the diameter specified to an accuracy of ± 0.5 mm. They shall be provided with appropriate handles.



Three types of Gap gauges



No.	Gap gauge	Steel rod diameter (D) mm
1	ϕ 6 mm	6 ± 0.5
2	ϕ 12 mm	12 ± 0.5
3	ϕ 25 mm	25 ± 0.5

Figure 11 – Gap gauges

8 METHOD OF TEST

8.1 General

The test shall be carried out generally in accordance with the standard ISO 834-1, except where amended by this section. The procedures given in the following sections are supplementary to, an elaboration of, or a deviation from the ISO requirements.

8.2 Commencement of test

8.2.1 Not more than 5 min before the commencement of the test, the initial temperatures recorded by all thermocouples shall be checked to ensure consistency and the datum values shall be noted. Similar datum values shall be obtained for deformation, and the initial condition of the test specimen shall be noted.

8.2.2 At the time of the test, the initial average internal temperature and unexposed surface temperature of the specimen shall be from 10°C to 35°C and shall be within 5°C of the initial ambient temperature.

8.2.3 Prior to the commencement of the test the furnace temperature shall be less than 50°C. The commencement of the test shall be considered to be the moment when the programme to follow the standard heating curve has been initiated.

8.2.4 ***Ambient conditions***

The laboratory shall be virtually draught free during the test. The ambient temperature shall be from 10°C to 35°C at the commencement of the test and during the test the temperature shall not decrease more than 5°C or increase more than 20°C for all insulated separating elements while they are still satisfying the insulation criterion.

8.3 Furnace control

8.3.1 ***Furnace temperature***

8.3.1.1 The average temperature of the furnace as derived from the furnace thermocouples specified in paragraph 7.3 shall be monitored and controlled such that it follows the relationship (i.e. the standard heating curve):

$$T = 345 \log_{10}(8t+1) + 20$$

where:

T is the average furnace temperature (°C),
t is the time (min).

8.3.1.2 The following points are defined by the above relationship:

.1 at the end of the first 5 min 576°C;

.2 at the end of the first 10 min 679°C;

.3 at the end of the first 15 min 738°C;

.4 at the end of the first 30 min 841°C; and

.5 at the end of the first 60 min 945°C.

8.3.1.3 The percentage deviation '*d*' in the area of the curve of the average temperature recorded by the specified furnace thermocouples versus time from the area of the standard heating curve shall be within:

± 15%	from t = 0 to 10	(1)
± (15-0.5(t-10))%	from t = 10 to 30	(2)
± (5-0.083(t-30))%	from t = 30 to 60	(3)
± 2.5%	from t = 60 and over	(4)

where:

$d = (A - As) \times 1/As \times 100$, and

A is the area under the actual average furnace time-temperature curve; and
As is the area under the standard time-temperature curve.

All areas shall be computed by the same method, i.e. by the summation of areas at intervals not exceeding 1 min.

8.3.1.4 At any time after the first 10 min of test, the temperature recorded by any thermocouple shall not differ from the corresponding temperature of the standard time-temperature curve by more than ± 100°C.

8.3.2 ***Furnace pressure***

8.3.2.1 A linear pressure gradient exists over the height of a furnace, and although the gradient will vary slightly as a function of the furnace temperature, a mean value of 8 Pa per metre height may be assumed in assessing the furnace pressure conditions. The value of the furnace pressure shall be the nominal mean value, disregarding rapid fluctuations of pressure associated with turbulence, etc., and shall be established relative to the pressure outside the furnace at the same height. It shall be monitored and controlled continuously and by 5 min from the commencement of the test shall be achieved within ± 5 Pa and by 10 min from the commencement of the test shall be achieved and maintained within ± 3 Pa.

8.3.2.2 For vertically orientated specimens the furnace shall be operated such that a pressure of zero is established at a height of 500 mm above the notional floor level to the test specimen. However, for specimens with a height greater than 3 m, the pressure at the top of the test specimen shall not be greater than 20 Pa, and the height of the neutral pressure axis shall be adjusted accordingly.

8.3.2.3 For horizontally orientated specimens the furnace shall be operated such that a pressure of 20 Pa is established at a position 100 mm below the underside of the specimen.

8.4 Measurements and observations on the test specimen

8.4.1 ***Temperature***

8.4.1.1 All temperature measurements shall be recorded at intervals not exceeding 1 min.

8.4.1.2 When calculating temperature rise on the unexposed surface of the test specimen, this shall be done on an individual thermocouple-by-thermocouple basis. The average temperature rise on the unexposed surface shall be calculated as the average of the rises recorded by the individual thermocouples used to determine the average temperature.

8.4.1.3 For "A" class divisions, excluding doors, the average temperature rise on the unexposed face of the specimen shall be calculated from the thermocouples specified in paragraph 7.6.1.1 only.

8.4.1.4 For "B" and "F" class divisions, excluding doors, the average temperature rise on the unexposed face of the specimen shall be calculated from the thermocouples specified in paragraph 7.6.2.1 only.

8.4.1.5 For "A", "B" and "F" class doors, the average temperature rise on the unexposed face of the specimen shall be calculated from the thermocouples specified in paragraph 7.6.3.1 only. For a double-leaf door, all ten thermocouples used on both door leaves shall be used for this calculation.

8.4.2 ***Flaming on unexposed face***

The occurrence and duration of any flaming on the unexposed surface, together with the location of the flaming, shall be recorded. In cases where it is difficult to identify whether or not there are flames then the cotton-wool pad shall be applied to the area of such disputed flaming to establish whether ignition of the pad can be initiated.

8.4.3 ***Cotton-wool pad***

8.4.3.1 Tests with the cotton-wool pad are used to indicate whether cracks and openings in the test specimen are such that they could lead to the passage of hot gases sufficient to cause ignition of combustible materials.

8.4.3.2 A cotton-wool pad is employed by placing the frame within which it is mounted against the surface of the test specimen, adjacent to the opening or flaming under examination, for a period of 30 s, or until ignition (defined as glowing or flaming) of the cotton-wool pad occurs (if this happens before the elapse of the 30 s period). Small adjustments in position may be made so as to achieve the maximum effect from the hot gases. A cotton-wool pad shall be used only once.

8.4.3.3 The cotton-wool pad need not be used on the unexposed face after the period relevant to the insulation classification of the product.

8.4.3.4 Where there are irregularities in the surface of the test specimen in the area of the opening, care shall be taken to ensure that the legs of the support frame are placed so that clearance between the pad and any part of the test specimen surface is maintained during the measurements.

8.4.3.5 The cotton-wool pad shall be applied freely and not necessarily parallel to the surface of the specimen, and not always such that the crack or opening is central to the pad. The pad shall be positioned in the flow of hot gases but shall never be positioned such that any part of the pad is closer than approximately 25 mm from any point of the test specimen. For example, to adequately evaluate the hot gas leakage around a door it may be necessary to use the pad both parallel and normal to the face of the door or possibly at an oblique angle within the confines of the door frame.

8.4.3.6 The operator may make "screening tests" to evaluate the integrity of the test specimen. Such screening may involve selective short duration applications of the cotton-wool pad to areas of potential failure and/or the movement of a single pad over and around such areas. Charring of the pad may provide an indication of imminent failure, but an unused pad shall be employed in the prescribed manner for an integrity failure to be confirmed.

8.4.4 ***Gap gauges***

8.4.4.1 Tests with the gap gauges are used to indicate whether cracks and openings in the test specimen are of such dimensions that they could lead to the passage of hot gases sufficient to cause ignition of combustible materials.

8.4.4.2 The gap gauges shall be used at intervals which will be determined by the apparent rate of the specimen deterioration. Two gap gauges shall be employed, in turn, and without undue force to determine:

.1 whether the 6 mm gap gauge can be passed through the specimen such that the gauge projects into the furnace, and can be moved a distance of 150 mm along the gap; or

.2 whether the 25 mm gap gauge can be passed through the specimen such that the gauge projects into the furnace.

Any small interruption to the passage of the gauge that would have little or no effect upon the transmission of hot gases through the opening shall not be taken into account, e.g., small fastening across a construction joint that has opened up due to distortion.

8.4.4.3 If gaps in "A" or "B" class divisions are fully or partly sealed by intumescent materials, the gap gauge test shall be performed as if no intumescent material is present.

8.4.4.4 For doors mounted in a three-sided frame, the change of gap at the bottom of the door as measured by a horizontally-held gap gauge shall not increase by more than 12 mm along the bottom edge of the door. 12 mm gap gauge can be used for the purpose of examining the increase of such gap. The edges of the door above the horizontal plane along the bottom of the door should be checked in the same manner as the four-sided framed door.

Note: If the door is mounted with a 13 mm gap, the 25 mm gap gauge may be used to determine an unacceptable change in gap.

8.4.5 ***Deformation***

The 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 leaf relative to the door frame, shall be recorded during the test. These deflections and displacements shall be measured with an accuracy of ± 2 mm.

8.4.6 ***General behaviour***

Observations shall be made of the general behaviour of the specimen during the course of the test and notes concerning the phenomena such as cracking, melting or softening of the materials, spalling or charring, etc., of materials of construction of the test specimen shall be made. If quantities of smoke are emitted from the unexposed face this shall be noted in the report. However, the test is not designed to indicate the possible extent of hazard due to these factors.

8.5 Duration of testing

8.5.1 *"A" class divisions*

For all "A" class divisions, including those with doors, the test shall continue for a minimum of 60 min. However, when the specimen is of an "A" class division, with a structural steel core which is imperforate (e.g., without a door), and where insulation is provided to the exposed face only (i.e. the structural steel core is the unexposed face of the construction), it is permitted to terminate the test prior to 60 min once the unexposed-face temperature-rise limits have been exceeded.

8.5.2 *"B" and "F" class divisions*

For all "B" and "F" class divisions, including those with doors, the test shall continue for a minimum of 30 min.

8.5.3 *Termination of the test*

The test may be terminated for one or more of the following reasons:

.1 safety of personnel or impending damage to equipment;

.2 attainment of selected criteria; or

.3 request of the sponsor.

The test may be continued after failure under subparagraph .2 above to obtain additional data.

9 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and the data determined by the test:

.1 reference that the test was carried out in accordance with part 3 of the 2010 FTP Code (see also subparagraph .2 below);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and/or identification of the product tested;

.7 the name of the manufacturer of the test specimen and of the products and components used in the construction;

.8 type of the product, e.g., bulkhead, ceiling, door, window, duct penetration, etc.;

.9 fire-resistant class of the test, e.g., "A" class, "B" class, "F" class;

.10 the constructional details of the test specimen, including description and drawing and principal details of components. All the details requested in paragraph 2 shall be given. The description and the drawings which are included in the test report shall, as far as practicable, be based on information derived from a survey of the test specimen. When full and detailed drawings are not included in the report, then the applicant's drawing(s) of the test specimen shall be authenticated by the laboratory and at least one copy of the authenticated drawing(s) shall be retained by the laboratory; in this case reference to the applicant's drawing(s) shall be given in the report together with a statement indicating the method of endorsing the drawings;

.11 all properties of materials used that have a bearing on the fire performance of the test specimen together with measurements of thickness, density and, where applicable, the moisture and/or organic content of the insulation material(s) as determined by the test laboratory;

.12 date of the test specimen arrival;

.13 details of specimen conditioning;

.14 date of test;

.15 test results:

.1 information concerning the location of all thermocouples fixed to the specimen, together with tabulated data obtained from each thermocouple during the test. Additionally, a graphical depiction of the data obtained may be included. A drawing shall be included which clearly illustrates the positions of the various thermocouples and identifies them relative to the temperature-time data;

.2 the average and the maximum temperature rises and the average core temperature rise, when applicable, recorded at the end of the period of time appropriate to the insulation performance criteria for the relevant classification (see paragraph 3 of part 3) or, if the test is terminated due to the insulation criteria having been exceeded, the times at which limiting temperatures were exceeded; and

.3 the maximum deflection of the specimen. In case of doors, the maximum deflection at the centre of the door specimen and the maximum displacement of each corner of the door leaf relative to the door frame;

.16 the classification attained by the test specimen shall be expressed in the form of "class "A-60" deck", i.e. including the qualification on orientation of the division.

The result shall be presented in the test report in the following manner, which includes provision regarding non-combustibility, under the heading "Classification":

"A deck constructed as described in this report may be regarded as an "A-60" class deck according to part 3 of annex 1 to the FTP Code if all the materials comply with paragraph 3.5.1 of part 3 of annex 1 to the 2010 FTP Code.";

.17 the name of the representative of the Administration present at the test. If the Administration requires prior notification of test and a representative does not witness the test, a note to this effect shall be made in the report in the following form:

"The … (name of the Administration) … was notified of the intention to conduct the test detailed in this report and did not consider it necessary to send a representative to witness it."; and

.18 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

APPENDIX 2

TESTING OF WINDOWS, FIRE DAMPERS, PIPE AND DUCT PENETRATIONS AND CABLE TRANSITS

INTRODUCTION

This appendix covers the testing of windows, fire dampers, pipe penetrations and cable transits, all of which may be incorporated within "A" class divisions.

Irrespective of the fact that this appendix is written only for "A" class divisions, the prescriptions given can be used by analogy when testing windows, fire dampers, pipe and duct penetrations and cable transits incorporated in "B" class divisions, where appropriate.

The testing and reporting of these components shall be generally in accordance with the requirements given in appendix 1 to this part. Where additional interpretation, adoption and/or supplementary requirements may be necessary, these are detailed in this appendix.

Since it is not possible to introduce the distortions which are experienced by the structural core during tests corresponding to procedures given in this appendix, into specimens of smaller scale, all the tests of the components covered by this appendix shall be undertaken with those components installed in full-size dimensioned structural cores as specified in appendix 1.

A.I – WINDOWS

1 GENERAL

1.1 The term window is taken to include windows, sidescuttles and any other glazed opening provided for light transmission or vision purposes in "A" class bulkheads. Windows in "A" class doors are considered to be part of the door and they shall be tested within the appropriate door.

1.2 The approach adopted for testing windows shall generally follow the requirements for testing "A" class doors where relevant and appropriate.

2 NATURE OF TEST SPECIMENS

2.1 Dimensions

2.1.1 The test shall be conducted on the window of the maximum size (in terms of both the width and the height) for which approval is sought.

2.1.2 The test shall be conducted on a window of the maximum size (in terms of both the height and the width) and the type of the glass pane and/or the minimum thickness of the glass pane or panes and gaps, if appropriate, for which approval is sought. Test results obtained on this configuration shall, by analogy, allow approval of windows of the same type, with lesser dimensions in terms of height and width and with the same or greater thickness.

2.2 Design

2.2.1 The bulkhead which includes the window shall be insulated to class "A-60" on the stiffened face, which shall be the face exposed to the heating conditions of the test. This is considered to be most typical of the use of windows on board ships. There may be special applications of windows where the Administration considers it appropriate to test the window with the insulation of the bulkhead to the unexposed face of the structural core, such as the window on front bulkhead of the tanker, or within bulkheads other than class "A-60".

2.2.2 The window shall be positioned within the bulkhead, shown in figure 1 of appendix 1, at that height which is intended for practical application. When this is not known, the window shall be positioned with the top of its frame as close as possible, but not closer than 300 mm, to the top of the bulkhead.

3 INSTRUMENTATION

When a window is required by the Administration to be of a classification other than class "A-0", thermocouples shall be fixed to the window pane as specified for the leaf of a door. In addition, thermocouples shall be provided to the window frame, one at mid-length of each perimeter edge. When windows are fitted with transoms and/or mullions, five thermocouples shall be fixed to each window pane as specified for the leaf of a door, and, in addition to the thermocouples fixed to the window frame, a single thermocouple shall be fixed at mid-length of each transom or mullion member.

4 METHOD OF TEST

4.1 Temperature

For the calculation of the average temperature rise on the unexposed face, only those thermocouples fixed to the face of the window pane(s) shall be used.

4.2 Cotton-wool pad and gap gauges

For windows which are to be of a classification "A-0", the cotton-wool pad test need not be used to evaluate the integrity of a window since radiation through the window pane could be sufficient to cause ignition of the cotton-wool pad. In such cases cracks or openings in windows shall not be such as to allow the gap gauges to enter in the manner described in paragraph 8.4.4 of appendix 1.

5 HOSE-STREAM TEST

5.1 General

This procedure is an optional requirement and may be requested by some Administrations for windows used in specific areas of a ship. The window is subjected to the impact, erosion and cooling effects of a hose stream.

5.2 Method of test

5.2.1 The hose-stream test shall be applied to the exposed face of the specimen immediately, but at least within not more than 1.5 min following the termination of the heating period.

5.2.2 The water stream is delivered through a standard fire hose and discharged through a 19 mm nozzle of tapered smooth-bore pattern without shoulder at the orifice. The nozzle orifice shall be 6 m from the centre and normal to the exposed face of the specimen.

5.2.3 The water pressure at the nozzle shall be 310 kPa when measured with the water flow in progress.

5.2.4 The duration of application of the hose stream to the surface of the specimen shall be 0.65 min for each square metre of the exposed area of the specimen. The stream shall be directed firstly at the centre and then at all parts of the exposed face, changes in direction being made slowly.

5.3 Performance criteria

5.3.1 For the calculation of the average temperature rise on the unexposed face, only those thermocouples fixed to the face of the window pane(s) shall be used.

5.3.2 For the judgment of the maximum temperature rise on the unexposed face, all the thermocouples fixed to the face of the window pane(s), window frame, transoms and mullions shall be used.

5.3.3 The specimen is considered to have satisfied the criteria of the hose-stream test if no openings develop during the application of the stream which allow water to pass to the unexposed face.

5.3.4 The window shall be considered to have failed the hose-stream test if an opening develops that allows an observable projection of water from the stream beyond the unexposed surface during the hose-stream test. Gap gauges need not be applied during or after the hose stream test.

A.II – FIRE DAMPERS

1 GENERAL

1.1 "A" class divisions may have to be pierced for the passage of ventilation ducting, and arrangements shall be made to ensure that the effectiveness of the division in relation to the criterion for integrity, as specified in paragraph 3 of Part 3 , is not impaired. Provisions shall also be made to ensure that, shall a fire be initiated within, or gain access to, ventilation ductwork, such a fire does not pass through the division within the ductwork.

1.2 To provide for both these requirements, fire dampers are provided within or fixed to spigots or coamings which are welded to the structural core and are insulated to the same standard as the division.

2 NATURE OF THE TEST SPECIMEN

2.1 Dimensions

The maximum sizes (in terms of both the width and the height, or the diameter) of each type of fire damper for which approval is sought shall be tested in both vertical and horizontal orientation.

2.2 Design

2.2.1 A bulkhead which includes the damper shall be constructed in accordance with paragraph 2.1 of appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is not exposed to the heating conditions of the test. A deck which includes the damper shall be constructed in accordance with paragraph 2.2 of appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is exposed to the heating conditions of the test.

2.2.2 Fire dampers shall be incorporated into or fixed to coamings or a spigot, which shall be welded or bolted into the structural core.

The length on the unexposed side = (450 mm or a needed insulation length for a damper under test) (Lunexp) + 50 mm.

The thickness of the coaming or spigot shall be as follows:

Width* or diameter of the duct	**Minimum thickness of coaming**
Up to and including 300 mm	3 mm
760 mm and over	5 mm

For widths or diameters of ducts in excess of 300 mm but less than 760 mm, the thickness of the coaming or spigot shall be obtained by interpolation

The coaming or spigot shall be insulated as shown in figure A1.

* Width means the greater of the two cross-sectional dimensions.

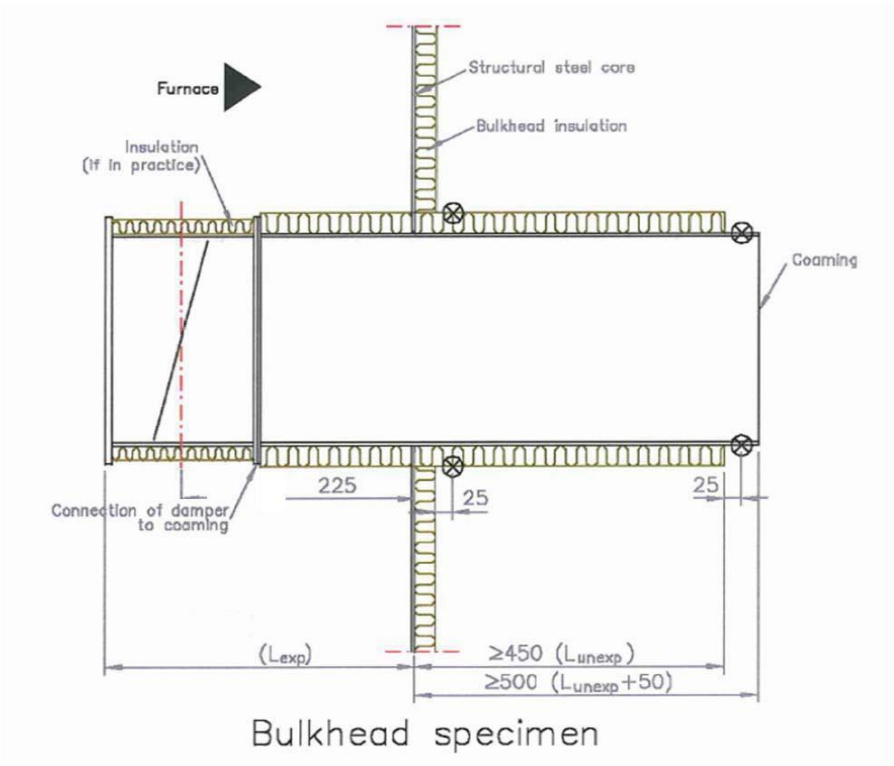


Figure A1 – Fire dampers: insulation on test specimens and position of unexposed-face thermocouples

2.2.3 The coamings or spigots (including insulation) shall be positioned only in the top half of a bulkhead. Where more than one damper is included in a bulkhead, the top edges of all dampers should be, as far as possible, at the same height. These shall be no closer than 200 mm from the edges of a bulkhead or deck. Where more than one damper is to be tested simultaneously in a division, the distance between adjacent coamings or spigots (including insulation) shall not be less than 200 mm.

2.2.4 The fire dampers shall be positioned on the exposed face of the bulkhead or deck. The distance between the fire damper centre and the structural core shall be at least 225 mm.

The operative control of a damper is positioned on the exposed side of the division. When a damper is mounted in the bulkhead the fuse element should be situated at the lowest level of the damper as in practice.

2.2.5 Fire dampers which are operated automatically shall be in the open position at the start of the test and shall be closed by an automatic device. The damper shall be in the closed position within 2 min after the commencement of the test. If the fire damper fails to close after 2 min from the start of the test, the fire damper shall be deemed to have failed and the test shall be discontinued.

2.2.6 Fire dampers which are operated with a manual system shall be closed at the test time of 1 min.

3 INSTRUMENTATION

3.1 Positioning of thermocouples on the specimen

3.1.1 For each fire damper, two thermocouples where the width* or diameter of a damper is not more than 200 mm and four thermocouples when that is over 200 mm shall be fixed to the unexposed face at each of the following locations:

.1 on the surface of the insulation provided to the coaming or spigot at a distance of 25 mm from the unexposed surface of the divisions; and

.2 on the surface of the coaming or spigot at a distance of 25 mm from where the coaming or spigot emerges from its insulation.

3.1.2 In the damper where the size exceeds 200 mm, four thermocouples, for each of the positions indicated in paragraphs 3.1.1.1 and 3.1.1.2, shall be fixed. One of the thermocouples shall be fixed at the centre of each side of the coaming or spigot.

3.1.3 In the damper where the size is not more than 200 mm, two thermocouples, for each of the positions indicated in paragraphs 3.1.1.1 and 3.1.1.2, shall be fixed. One of the thermocouples shall be fixed at the centre of opposing sides of the coaming or spigot and for dampers in bulkheads situated on the top and bottom surface of the coaming or spigot.

4 PERFORMANCE CRITERIA

4.1 It will not always be possible to utilize the cotton-wool-pad test to evaluate the integrity of a fire damper since radiation through the damper could be sufficient to cause ignition of the cotton-wool pad. In such cases, cracks or openings in fire dampers shall not be such as to allow the gap gauges to enter in the manner described in paragraph 8.4.4 of appendix 1.

* Width means the greater of the two cross-sectional dimensions.

4.2 The performance of fire dampers may be related to their ability to satisfy both the insulation and the integrity criteria or may be related only to the requirements for integrity, depending on the requirements of the Administration.

4.3 If evaluation of insulation is required, it shall prevent a temperature rise at any point on the surface not exceeding 180°C above the initial temperature. The average temperature rise is not relevant.

A.III – PIPE AND DUCT PENETRATIONS

1 GENERAL

1.1 "A" class divisions may have to be provided with apertures to allow them to be penetrated by service pipes and ducts, and it is necessary to reinstate the insulation and/or integrity performance of the division at the position where it has been penetrated.

1.2 Administrations may have different requirements relating to the need to classify pipe and/or duct penetrations, e.g., related to the pipes' diameter and their direct attachment or not to the structural core.

1.3 This section refers from here on to pipe penetrations but may be read as equally applicable to duct penetrations.

2 NATURE OF THE TEST SPECIMEN

2.1 Dimensions

The maximum and minimum sizes (in terms of both the width and the height, or diameter) of each type of pipe penetration for which approval is sought shall be tested in both vertical and horizontal orientation.

2.2 Design

2.2.1 A bulkhead which includes the pipe penetration shall be constructed in accordance with paragraph 2.1.1 of appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is not exposed to the heating conditions of the test. A deck which includes the pipe penetration shall be constructed in accordance with paragraph 2.2.1 of appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is exposed to the heating conditions of the test.

2.2.1.1 "A-0" class pipe penetrations are recommended to be performed in an uninsulated ("A-0") bulkhead/deck. If the pipe penetrations are tested as an "A-60" class penetration, any insulation fitted (on the penetration itself and 200 mm around) will be required to be fitted also for class "A-0".

2.2.1.2 "A-0" penetrations shall not be approved without an "A-0" test although tested and approved as "A-60".

2.2.2 The pipe penetrations shall be positioned only in the top half of a bulkhead but shall not be closer than 200 mm from the edges of a bulkhead or a deck. Where more than one pipe penetration is to be tested simultaneously in a division, the separation between adjacent penetrations shall not be less than 200 mm. Both measurements shall relate to the distance to the nearest part of the penetration system, including any insulation which is part of the system.

2.2.3 Each pipe passing through a penetration shall project 500 ± 50 mm beyond the exposed end of the penetration and 500 ± 50 mm beyond the unexposed end of the penetration. The exposed end of the pipe shall be blanked off, using an appropriate methodology to ensure that any fire penetration into the pipe does not occur via the end of the pipe in advance of it occurring through the exposed perimeter of the pipe.

2.2.4 Each pipe shall be firmly supported and fixed independent of the bulkhead or deck on the unexposed side of the test specimen, e.g., by a framework mounted from the restraint frame. The support and fixing of the pipe shall restrain it from movement during the test.

2.2.5 When the deck penetration is fitted on an exposed side or is fitted symmetrically, general application will be given. When the deck penetration is fitted on an unexposed side, the approval will limit the penetration to the tested orientation.

2.2.5.1 When the bulkhead penetration is fitted symmetrically, approval would be given for general application. For bulkhead penetrations with an exposed or unexposed fitted frame, one test for each fitting is required in order for obtaining approval for general application.

2.2.6 Sealing of pipe and duct penetrations: there shall be no visible openings before the start of the fire test.

2.2.7.1 In cases where a test specimen (deck) which includes the prototype penetration(s) is not mounted within a rigid restraint frame but is connected to the furnace roof by side wall coamings, the rigidity of the coamings is to be equivalent to that of a restraint frame and evaluated in accordance with paragraph 5.1 of appendix 1.

2.2.7.2 In cases where insulation is fitted to the test pipe(s), the distance(s) of 500 ± 50 mm required in paragraph 2.2.3 to which the pipe should project is to be taken from the end of the insulation as this is considered an integral part of the penetration(s) being tested and it is necessary that a length of unprotected pipe is exposed to the furnace.

2.2.7.3 In all cases, the support and fixing of the test pipe(s) is to be by a framework mounted from the restraint frame such that any movement of the bulkhead or deck relative to the pipe(s) will be experienced by the penetration(s) being tested.

3 INSTRUMENTATION

3.1 Positioning of thermocouples on the specimen

3.1.1 For each pipe penetration, two thermocouples shall be fixed on the unexposed face at each of the following locations:

.1 on the surface of the pipe at a distance of 25 mm from the centre of the thermocouples to the position where the pipe emerges from the penetration seal;

.2 on the pipe penetration at a distance of 25 mm from the centre of the thermocouples to the face of the insulation on the unexposed side of the test specimen; and

.3 on the surface of any insulation or filling material used between the pipe and any coaming or spigot fixed to the division (provided that the gap between the pipe or any such coaming or spigot is greater than 30 mm), or on the surface of any collar or shroud used between the pipe and the division (e.g., vapour barrier).

3.1.2 For pipe penetrations in bulkheads, for each of the positions indicated above, one of the thermocouples shall be fixed directly above the centre of the pipe and the other thermocouple shall be fixed directly below the centre of the pipe.

3.1.3 Additional thermocouples may be required to be fitted, dependent upon the complexity of the pipe penetration.

4 PERFORMANCE CRITERIA

4.1 General

4.1.1 The performance of pipe penetrations may be related to their ability to satisfy both the insulation and the integrity criteria or may be related only to the requirements for integrity, depending on the requirements of the Administration.

4.1.2 Duct penetrations shall meet both integrity and insulation criteria.

4.2 Insulation

Since the pipe penetration is a local weakness in the division it shall be capable of preventing a temperature rise exceeding l80°C above the initial temperature. The average temperature rise is not relevant.

A.IV – CABLE TRANSITS

1 GENERAL

"A" class divisions may have to be provided with apertures to allow them to be penetrated by cables, and it is necessary to reinstate the insulation and integrity performance of the division at the position where it has been penetrated. A cable transit consists of a metal frame, box or coaming, a sealant system or material and the cables, and it may be uninsulated, partially insulated or fully insulated.

2 NATURE OF THE TEST SPECIMEN

2.1 Dimensions

The maximum and minimum sizes (in terms of both the height and the width) of each type of cable transit for which approval is sought shall be tested in both vertical and horizontal orientation.

2.2 Design

2.2.1 A bulkhead which includes the cable transit shall be constructed in accordance with paragraph 2.1.1 of appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is not exposed to the heating conditions of the test. A deck which includes the cable transit shall be constructed in accordance with paragraph 2.2.1 of appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is exposed to the heating conditions of the test.

2.2.1.1 "A-0" class cable transits are recommended to be performed in an uninsulated ("A-0") bulkhead/deck. If the cable transits are tested as "A-60" penetration, any insulation fitted on an exposed side (on the cable transits itself and 200 mm around) will be required to be fitted also for "A-0".

2.2.1.2 "A-0" cable transits shall not be approved without an "A-0" test although tested and approved as "A-60".

2.2.2 The cable transits shall be positioned only in the top half of a bulkhead but shall not be closer than 200 mm from the edges of a bulkhead or a deck. Where more than one cable transit is to be tested simultaneously in a division, the separation between adjacent transits shall not be less than 200 mm. Both measurements shall relate to the distance to the nearest part of the transit system, including any insulation which is part of the system.

2.2.3 Notwithstanding the above, the distance between transits shall be sufficient to ensure that the transits do not influence each other during the test, except that this requirement does not apply to multi-transits which are intended to be positioned adjacent to one another.

2.2.4 The cables shall project 500 ± 50 mm beyond the transit on the exposed side of the division and 500 ± 50 mm on the unexposed side.

2.2.4.1 Each cable shall be firmly supported and fixed independent of the bulkhead or deck on the unexposed side of the test specimen, e.g., by a framework mounted from the restraint frame. The support and fixing of the cables shall restrain them from movement during the test.

2.2.5 Cable transits shall be fitted to the bulkhead or deck in accordance with the manufacturer's specifications. The cables and sealing compounds or blocks shall be incorporated into the transits with the bulkhead and deck panels placed respectively in vertical and horizontal positions. Any insulation shall be applied to the cables and transits with the panels in the same respective positions.

2.2.6 The transit(s) shall be tested incorporating a range of different types of cables (e.g., in terms of number and type of conductor, type of sheathing, type of insulation material, size) and shall provide an assembly which represents a practical situation which may be found on ships. An individual Administration may have its own specification for a "standard" configuration of penetrating cables which it may use as a basis of its approvals.

2.2.6.1 The test results obtained from a given configuration are generally valid for the tested types of cables of size equal to or smaller than tested.

2.2.7 Tests shall be conducted for the maximum and minimum fill based on the inside cross-sectional area at each transit. The distance between the adjacent cables shall be the minimum specified by the manufacturer, and the cables should be placed close to the centre of the transit.

2.2.8 When the deck cable transit is fitted on an exposed side or is fitted symmetrically, general application will be given. When the deck cable transit is fitted on the unexposed side, the approval will limit the penetration to the tested orientation.

2.2.8.1 When the bulkhead cable transit is fitted symmetrically, approval would be given for general application. For bulkhead cable transit with exposed or unexposed fitted frame, one test for each fitting is required in order for obtaining approval for general application.

2.2.9 Sealing of cable transits shall have no visible openings before the start of the fire test.

3 INSTRUMENTATION

3.1 Positioning of thermocouples on the specimen

3.1.1 For each uninsulated cable transit, thermocouples shall be fixed on the unexposed face at each of the following locations:

.1 at two positions on the surface of the frame, box or coaming at a distance of 25 mm from the unexposed surface of the division. When the penetration does not extend a minimum of 25 mm beyond the bulkhead or deck plate on the unexposed side of the assembly, these thermocouples shall be placed at the end of the frame, box or coaming;

.2 at two positions at the end of the transit, on the face of the sealant system or material at a distance of 25 mm from a cable. If there is insufficient area to affix the thermocouples as described, one or both may be placed within a distance of 25 mm from a cable; and

.3 on the surface of each type of cable included in the cable transit, at a distance of 25 mm from the face of the sealant system or material. In case of a group or bunch of cables, the group shall be treated as a single cable. In case of horizontal cables, the thermocouples shall be mounted on the uppermost surface of the cables. These thermocouples may be excluded if the diameters of the cables are too small to effectively affix the thermocouples to the cables. This shall be at the discretion of the Administration.

3.1.2 For those thermocouples placed on the outer perimeter of the frame, box or coaming, one thermocouple shall be fixed on each of two opposite faces, which in the case of bulkheads shall be the top and bottom faces.

3.1.3 For each partially insulated or fully insulated cable transit, thermocouples shall be fixed on the unexposed face at equivalent positions to those specified for an uninsulated transit as illustrated in figure A2.

3.1.4 Additional thermocouples may be required to be fixed, dependent upon the complexity of the cable transit.

3.1.5 When fixing thermocouples to the unexposed surface of the cables, the copper disc and the insulating pad shall be formed over the surface to provide good contact with the surface of the cable. The copper disc and the pad shall be retained in position by some mechanical means, e.g., wiring or spring clips, such that they do not become detached during the test. The mechanical retention shall not provide any significant heat-sink effect to the unexposed face of the thermocouple.

4 PERFORMANCE CRITERIA

4.1 General

Cable transits shall meet both integrity and insulation criteria.

4.2 Insulation

Since the cable transit is a local weakness in the division it shall be capable of preventing a temperature rise at any point on the surface not exceeding l80°C above the initial temperature. The average temperature rise is not relevant.

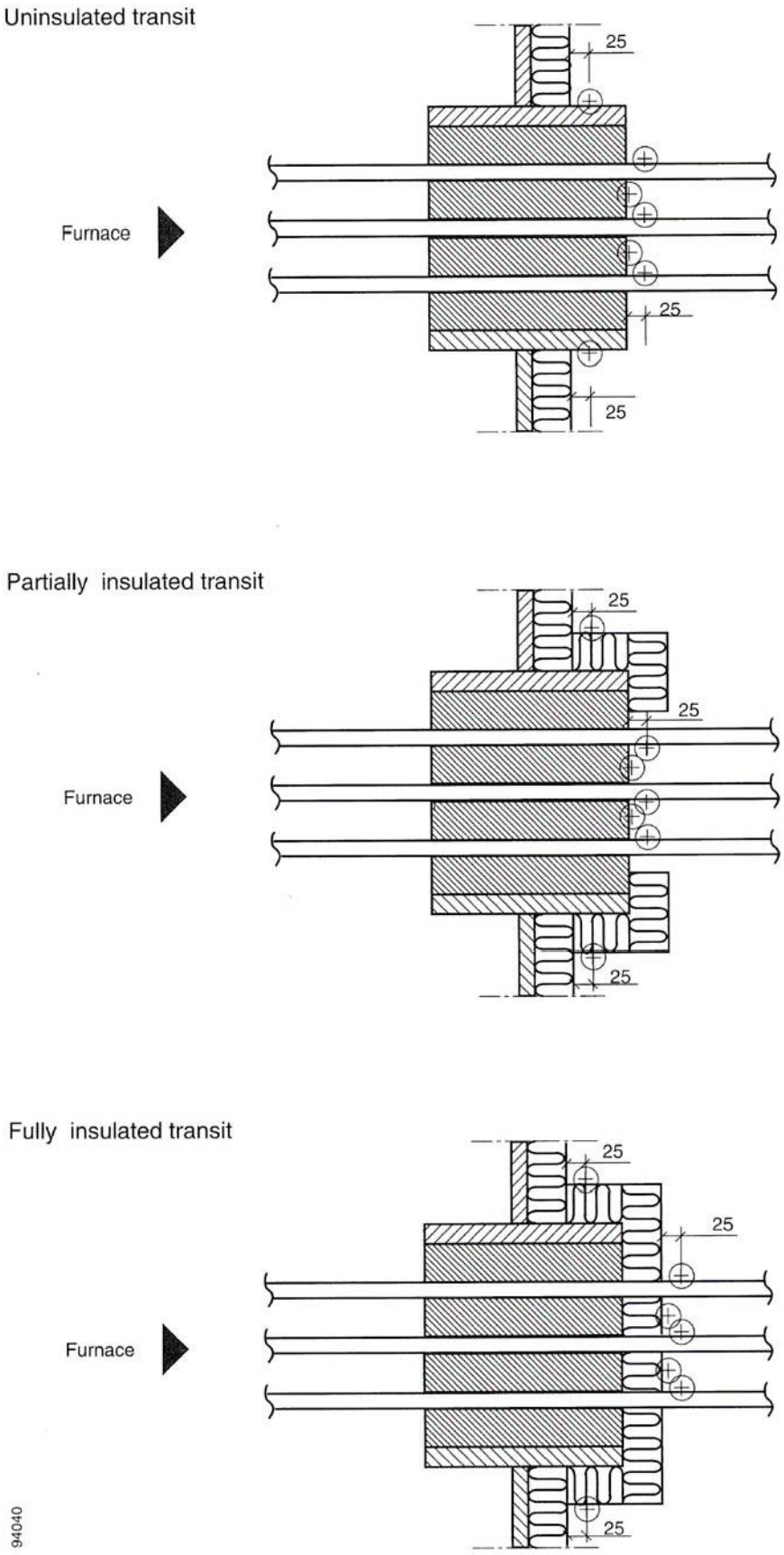


Figure A2 – Cable transits: position of unexposed-face thermocouples
(shown for bulkhead)

APPENDIX 3

THERMAL RADIATION TEST SUPPLEMENT TO FIRE RESISTANCE TEST PROCEDURES FOR WINDOWS IN "A", "B" AND "F" CLASS DIVISIONS

1 SCOPE

1.1 This appendix specifies a procedure for measuring heat flux through windows as a basis for characterizing their ability to limit the heat radiation in order to prevent the spread of fire and to enable escape routes to pass near the windows.

1.2 This procedure is an optional requirement and may be requested by some Administrations for windows in specific areas of a ship.

2 TEST PROCEDURES

2.1 The window shall be tested in accordance with appendix 2 of this part using the additional instrumentation as described below.

2.2 The term "window" includes windows, side scuttles and any other glazed opening provided for light transmission or vision purposes in a fire resistant division. The term "fire resistant division" includes bulkheads and doors.

3 ADDITIONAL INSTRUMENTATION

3.1 Additional instrumentation consists of a restricted-view total-heat flux meter calibrated with the restricted view to indicate incident heat flux. The flux meter shall be water-cooled and capable of measuring heat flux 0 kW/m^2 to 60 kW/m^2. The flux meter should be calibrated at least once a year against a standard device.

3.2 The flux meter should be placed perpendicular to the centre of the window being tested, and in a position such that the centre of the flux meter's view coincides with the centre of the window* (see figure). The flux meter should be located at a distance greater than 0.5 m from the window, such that the view of the flux meter just includes part of the frame. However, the flux meter should not be located more than 2.5 m from the window. The dimension of the boundary and window frame seen by the flux meter, which remains outside the window, should not exceed 10% of the total width seen by the flux meter on the surface of the sample. It should be calculated on the basis of restricted view angle of the flux meter and its distance to the sample surface.

3.3 For windows whose greater dimension is less than 1.57 times the smaller dimension, only one flux meter is needed.

3.4 For oblong windows whose greater dimension is more than 1.57 times the smaller dimension, additional flux meters should be provided. The distance of the flux meters from the window should be adjusted such that the flux meters' view covers at least 50% of the window. However, the flux meters should not be located less than 0.5 m nor more than 2.5 m from the window.

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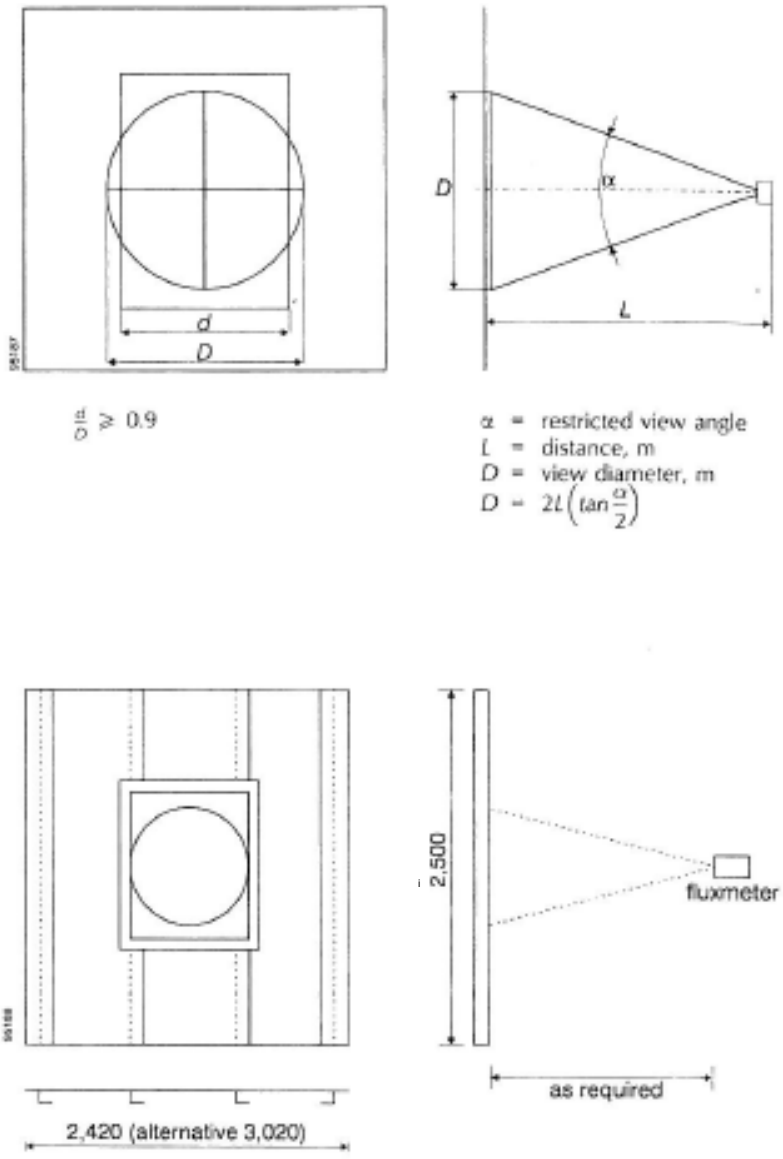
* A satisfactory method of placing, mounting, and aiming the fluxmeter is as follows: A metal stand constructed of a pipe mounted on a sturdy base serves as an instrument tree to locate the fluxmeter at the required distance from the test specimen. A suitable holder for the fluxmeter is constructed by mounting a gun-sight mount on a lockable ball and socket joint. This joint provides flexibility for aiming the meter. The fluxmeter holder is mounted on the instrument tree at the appropriate height. A laser pointer is placed in the gun-sight mount and the mount is oriented such that the dot is in the centre of the window. The laser pointer is slipped out of the holder and replaced by the fluxmeter.



Figure

4 PERFORMANCE CRITERIA

4.1 The peak heat flux (E_w) should be measured for the first 15 min of the test, for the first 30 min of the test, and for the entire duration of the test (i.e. 60 min for class "A" and 30 min for class "B" boundaries).

4.2 The peak heat fluxes (E_w) measured in accordance with paragraph 4.1 should be compared against the reference value (E_c) from table 1 below.

4.3 If (E_w) is less than (E_c), the window is acceptable for installation in a boundary of the corresponding fire resistant classification.

Table 1 – Criteria for heat flux

Fire resistant division classification	Time period from beginning of test to	Heat flux E_c (kW/m^2)
"A-0"	60 min	56.5
"A-15"	15 min 60 min	2.34 8
"A-30"	30 min 60 min	2.34 6.4
"A-60"	60 min	2.34
"B-0"	30 min	36.9
"B-15"	15 min 30 min	2.34 4.3

APPENDIX 4

CONTINUOUS "B" CLASS DIVISIONS

1 SCOPE

1.1 This appendix specifies the procedure for testing linings and ceilings for verifying that they are "continuous 'B' class linings" and "continuous 'B' class ceilings" and for evaluating full constructions to be "continuous 'B' class constructions".

1.2 This procedure is an optional requirement and may be requested by some Administrations for continuous "B" class divisions.

2 TEST PROCEDURES AND EVALUATION

2.1 The linings, ceilings and constructions should be evaluated in accordance with this part using the arrangements described below.

2.2 The ceilings should be tested in accordance with paragraph 2.8 of the appendix 1 except that the ceiling should be mounted on the horizontal furnace so that at least 150 mm high "B" class bulkheads are mounted on the furnace and the ceiling is fixed to these partial bulkheads by using the joining method as is intended to be used in practice. Such ceilings and the joining methods should be evaluated as required for ceilings in accordance with appendix 1 of this part and accordingly they should be classified as "continuous 'B' ("B-0" or "B-15", as applicable) class ceilings".

2.3 A lining which has been evaluated in accordance with this part to be a "B" ("B-0" or "B-15", as applicable on basis of the lining test) class lining may be considered as forming a "continuous 'B' ("B-0" or "B-15", as applicable) class lining" in conjunction with a "continuous 'B' ("B-0" or "B-15", as applicable) class ceiling" and with the joining method used in the test (see paragraph 2.2 above) without further testing the lining.

2.4 An enclosed construction installed on an "A" class deck and formed by "continuous 'B' ("B-0" or "B-15", as applicable) class linings" and "continuous 'B' ("B-0" or "B-15", as applicable) class ceiling" should be considered as forming a "continuous 'B' class construction".

PART 4 – TEST FOR FIRE DOOR CONTROL SYSTEMS

1 APPLICATION

Where a control system of fire doors is required to be able to operate in case of fire, the system shall comply with this part.

2 FIRE TEST PROCEDURE

The fire door control systems shall be tested and evaluated in accordance with the test procedure presented in the appendix to this part.

3 ADDITIONAL REQUIREMENTS

Part 1 of this annex is also applicable to insulation materials used in connection with a fire door control system. Part 5 of this annex is applicable to adhesives used in connection with a fire door control system.

APPENDIX

FIRE TEST PROCEDURES FOR FIRE DOOR CONTROL SYSTEMS

1 GENERAL

1.1 Fire door control systems which are intended to be used for fire doors capable of operating in case of fire shall be tested in accordance with the fire test procedure described in this appendix independent of its power supply (pneumatic, hydraulic or electrical).

1.2 The fire tests shall be a prototype test and be carried out with the complete control system in a furnace specified in appendix 1 of part 3 of this Code.

1.3 The construction to be tested shall be, as far as practicable, representative of that to be used on board ships, including the materials and method of assembly.

1.4 The functions of the control system including its closing mechanism shall be tested, i.e. normal functions of and, if required, emergency function, including switchover functions, if this is a basis of the manufacturer's design. The required kind of installation and functions shall be evident from a detailed function description.

2 NATURE OF PROTOTYPE CONTROL SYSTEMS

2.1 The installation of the prototype control system shall fully comply with the manufacturer's installation manual.

2.2 The prototype control system shall include a typical door arrangement connected to the closing mechanism. For the purpose of the test a door model shall be used. In case of sliding doors, the model door shall run in original door tracks with original supporting and guide rollers. The model door shall have the weight of the largest door to be actuated by this control system.

2.3 In case of pneumatic or hydraulic systems, the actuator (cylinder) shall have the maximum length allowed by the furnace.

3 MATERIALS FOR PROTOTYPE CONTROL SYSTEMS

3.1 Specifications

Prior to the test, drawings and the list of materials of the test arrangement shall be submitted to the laboratory by the applicant.

3.2 Control measurements

3.2.1 The testing laboratory shall take reference specimens of all those materials whose characteristics are important to the performance of the prototype control system (excluding steel and equivalent material).

3.2.2 If necessary, non-combustibility tests of insulation material in accordance with part 1 shall be conducted. Adhesives used in the construction of the specimen are not required to be non-combustible, however, they shall have low flame-spread characteristics.

3.2.3 The density of each insulation material shall be determined. The density of mineral wool or any similar compressible material shall be related to the nominal thickness.

3.2.4 The thickness of each insulation material and combination of materials shall be measured by using a suitable gauge or calipers.

4 CONDITIONING

4.1 Conditioning of the prototype control system (except insulation) is not necessary.

4.2 If insulation material is used in the construction, the prototype control system shall not be tested until the insulation has reached an air-dry condition. This condition is designed as an equilibrium (constant weight per paragraph 4 of appendix 1 to part 3) with an ambient atmosphere of 50% relative humidity at 23°C.

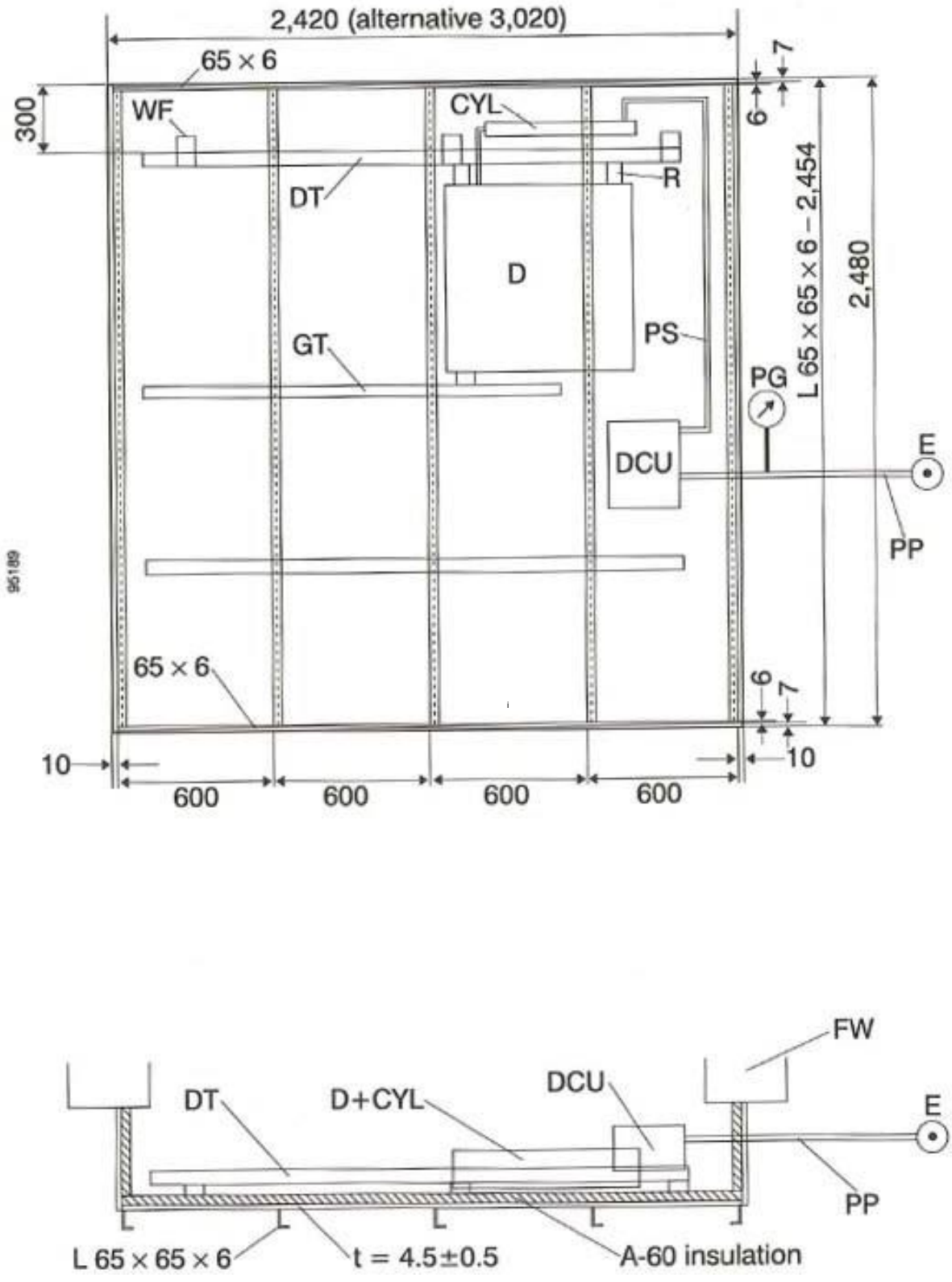
4.3 Accelerated conditioning is permissible provided the method does not alter the properties of component materials. High-temperature conditioning shall be below temperatures critical for the materials.

5 MOUNTING

5.1 The prototype fire door control system and the insulation, if used for protection of the system or parts of it, shall be mounted at the bulkhead plate as shown in figure 1.

5.2 The structural core shall be mounted at the furnace in accordance with the principles for "A" class divisions in paragraph 5 of appendix 1 of part 3 of this Code.

5.3 The door model shall be arranged within the furnace. The structural core to which the system and the door model are fitted shall have no door opening. However, small openings for the release mechanism of the control systems are allowed.



D = door model, DCU = door control unit, DT = door track, WF = weld fastening, GT = guide track, CYL = door cylinder, R = supporting roller, PS = piping systems, PG = pressure gauge, PP = pressure pipe, E = Energy, FW = furnace wall.

Figure 1 – **Structural core for fitting the prototype fire control systems**

6 EXAMINATION

6.1 Conformity

The laboratory shall verify the conformity of the prototype control system with the drawings and method of assembly provided by the applicant (see paragraph 2), and any area of discrepancy shall be resolved prior to commencement of the test.

6.2 Operation of the prototype control system

Immediately prior to the test, the laboratory shall check the operability of the system by opening the door model by a distance of at least 300 mm. The door model shall then be closed.

7 INSTRUMENTATION

The furnace and the instrumentation of the furnace shall be in accordance with paragraph 7 of appendix 1 to part 3 of this Code.

8 TEST PROCEDURE

8.1 Commencement of test

8.1.1 Not more than 5 min before the commencement of the test, the initial temperatures recorded by all thermocouples shall be checked to ensure consistency and the datum values shall be noted. Similar datum values shall be obtained for deformation, and initial condition of the prototype control system shall be noted.

8.1.2 At the time of the test, the initial average internal temperature shall be 20 ± 10°C and shall be within 5°C of the initial ambient temperature.

8.1.3 Prior to the test, the door shall be at open position. At the start of the test, the door control system shall show its capability to close the door.

8.1.4 The door control system shall be installed in a representative way with all its units and be powered for the entire test period.

8.2 Furnace control

The furnace control shall be in accordance with paragraph 8.3 of appendix 1 to part 3 of this Code.

8.3 Temperatures, duration of testing and actions during test

8.3.1 The average furnace temperature shall be increased and stabilized at 200 ± 50°C within 5 min and kept at the level of 200 ± 50°C up to the end of the first 60 min. Then the average furnace temperature shall be increased according to the standard time-temperature curve beginning with the level of 200°C up to 945°C.

8.3.2 The opening and closing function of the door control mechanism shall be activated every 5 min from the beginning of the test for the duration of 60 min.

8.3.3 The automatic switchover shall isolate the door control system from the power supply at the average furnace temperature of up to 300°C and shall be able to keep the door closed at least up to 945°C.

8.4 Measurements and observations on the prototype control system

In case of pneumatic or hydraulic systems, the input pressure which shall be identical with the approved system pressure shall be recorded. Due to a high input pressure, necessary safety precautions shall be taken when the test is carried out.

9 CLASSIFICATION CRITERIA

9.1 During the first 60 min of the test, a prototype fire door control system shall not fail.

9.2 During the period from the end of the first 60 min until the end of the test, the door shall remain closed.

10 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and the data determined by the test.

.1 reference that the test was carried out in accordance with part 4 of the 2010 FTP Code (see also subparagraph .2 below);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and/or identification of the prototype control system tested;

.7 the name of the manufacturer of the prototype control system and of the products and components used in the construction;

.8 the constructional details of the prototype control system, including description and drawings and principal details of components. All the details requested in paragraph 2 shall be given. The description and the drawings which are included in the test report shall, as far as practicable, be based on information derived from a survey of the prototype control system. When full and detailed drawings are not included in the report, then the applicant's drawing(s) of the prototype control system shall be authenticated by the laboratory and at least one copy of the authenticated drawing(s) shall be retained by the laboratory; in this case reference to the applicant's drawing(s) shall be given in the report together with a statement indicating the method of endorsing the drawings;

.9 all the properties of materials used that have a bearing on the fire performance of the prototype control system together with measurements thickness, density and, where applicable, the moisture and/or organic content of the insulation material(s) as determined by the test laboratory;

.10 date of the test specimen arrival;

.11 details of specimen conditioning;

.12 date of test;

.13 test results:

.1 information concerning the location of the pressure gauges or other devices together with tabulated data obtained during the test;

.2 observations of significant behaviour of the prototype control system during test and photographs, if any; and

.3 a statement that the prototype fire door control system has passed the test and complies with the classification criteria;

.14 the classification attained by the test specimen should be expressed in the form of "Door control system", i.e. including the qualification on orientation of the division.

The result shall be presented in the test report in the following manner, which includes a proviso regarding non-combustibility, under the heading "Classification":

"A fire door control system constructed as described in this report may be regarded as a Fire door control system according to part 4 in annex 1 to the 2010 FTP Code."; and

.15 the name of the representative of the Administration present at the test. If the Administration requires prior notification of the test and a representative does not witness the test, a note to this effect shall be made in the report in the following form:

"The ... (name of the Administration) ... was notified of the intention to conduct the test detailed in this report and did not consider it necessary to send a representative to witness it.".

PART 5 – TEST FOR SURFACE FLAMMABILITY (TEST FOR SURFACE MATERIALS AND PRIMARY DECK COVERINGS)

1 APPLICATION

1.1 Where a product is required to have a surface with low flame-spread characteristics, the product shall comply with this part.

1.2 Where the primary deck coverings are required to be not readily ignitable, they shall comply with this part.

1.3 Where a product of surface material is approved based on a test of a specimen applied on a non-combustible and non-metallic substrate, that product shall be approved for application to any non-combustible and non-metallic substrate with similar or higher density (similar density may be defined as a density equal to or greater than 0.75 times the density used during testing) or with a greater thickness if the density is more than 400 kg/m^3. Where a product is approved on the basis of a test result obtained after application on a metallic substrate (e.g., thin film of paints or plastic films on steel plates), such a product shall be approved for application to any metallic base of similar or higher thickness (similar thickness is obtained as a thickness equal to or greater than 0.75 times the thickness of metallic substrate used during testing).

2 FIRE TEST PROCEDURE

2.1 The surface materials and primary deck coverings shall be tested and evaluated in accordance with the test procedure specified in appendix 1 to this part. The test may be terminated after 40 min.

2.2 During fire tests for bulkhead, ceiling and deck finish materials and primary deck coverings, there are those specimens which exhibit various phenomena which cause difficulties in classification of the materials. Appendix 3 to this part provides guidance on the uniform interpretation of such results.

2.3 For preparation of the test specimen, refer to appendix 4 to this part, which provides guidelines for the specimen of the FTP Code, parts 2 and 5, and the type approval of those products (Range of approval and restriction in use).

3 PERFORMANCE CRITERIA

3.1 Surface flammability criteria

Materials having average values for all of the surface flammability criteria that comply with the values as listed in table 1, are considered to meet the requirement for low flame-spread in compliance with the relevant regulations in chapter II-2 of the Convention.

3.2 Burning droplets during the test

Materials for bulkhead, wall and ceiling linings and primary deck coverings shall not produce burning droplets during the test. It shall be considered as a reject material regardless of the surface flammability criteria. For floor coverings, no more than 10 burning drops are acceptable.

Table 1 – Surface flammability criteria

	Bulkhead, wall and ceiling linings	Floor coverings	Primary deck coverings
CFE (kW/m^2)	≥ 20.0	≥ 7.0	≥ 7.0
Qsb (MJ/m^2)	≥ 1.5	≥ 0.25	≥ 0.25
Qt (MJ)	≤ 0.7	≤ 2.0	≤ 2.0
Qp (kW)	≤ 4.0	≤ 10.0	≤ 10.0
Burning droplets	Not produced	No more than 10 burning drops	Not produced

Where:

CFE = Critical flux at extinguishment
Qsb = Heat for sustained burning
Qt = Total heat release
Qp = Peak heat release rate

Note: *Qsb* means an average of heat for sustained burning, as defined in paragraph 9.3 of appendix 1.

4 ADDITIONAL REQUIREMENTS

4.1 Surface materials for bulkheads and ceilings and similar exposed surfaces

In case that the requirement of maximum gross calorific value (e.g., 45 MJ/m^2) applies for a product, the test method specified in the standard ISO 1716 shall be used for determining the gross calorific value.

4.2 Floor coverings and primary deck coverings

4.2.1 A "primary deck covering" is the first layer of a floor construction which is applied directly on top of the deck plating and is inclusive of any primary coat, anti-corrosive compound or adhesive which is necessary to provide protection or adhesion to the deck plating. Other layers in the floor construction above the deck plating are "floor coverings".

4.2.2 When the product that is the first layer of a floor construction which is applied directly on top of the deck plating and is also the exposed surface (i.e. no other layer applied on it), it shall be considered as the "floor covering", and shall comply with the requirements of "floor covering".

4.2.3 Where a floor covering is required to be low flame-spread, all layers shall comply with this part. If the floor covering has a multilayer construction, the Administration may require the tests to be conducted for each layer or for combinations of some layers of the floor coverings. Each layer separately, or a combination of layers (i.e. the test and approval are applicable only to this combination), of the floor covering shall comply with this part.

4.2.4 Primer or similar thin film of paint on deck plating need not comply with the above requirements.

4.3 Combustible ventilation ducts

Where combustible ventilation ducts are required to be of material which has low flame-spread characteristics, the surface flammability test procedure and criteria for lining

and ceiling finishes of this part shall be applied for such ducts. In case homogeneous materials are used for the ducts, the test shall apply to outside surface of the duct, whilst both sides of the ducts of composite materials shall be tested.

4.4 Insulation materials for cold service systems

Where the exposed surfaces of vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings for cold service systems are required to have low flame-spread characteristics, the surface flammability test procedure and criteria for linings and ceilings of this part shall be applied for such exposed surfaces.

4.5 Adhesives used for "A", "B" and "F" class divisions

Adhesives used for "A", "B" and "F" class divisions are required to be of material which has low flame-spread characteristics. The surface flammability test procedure and acceptance criteria for linings and ceilings, according to appendix 1 to this part, shall apply to the adhesive as the exposed surface. The calcium silicate board described as a dummy specimen specified in paragraph 3.5 of appendix 1 to this part shall be used as a standard substrate for adhesives.

5 TEST REPORT

The test report shall include the information contained in paragraph 10 of appendix 1.

6 REFERENCE DOCUMENTS

ISO 5658-2, Reaction to fire tests – Spread of Flame – Part 2: Lateral spread on building and transport products in vertical configuration.

ISO 13943, Fire safety – Vocabulary.

ISO 14934-3, Fire tests – Calibration and use of heat flux meters – Part 3: Secondary calibration method.

APPENDIX 1

FIRE TEST PROCEDURES FOR SURFACE FLAMMABILITY OF BULKHEAD, CEILING, DECK FINISH MATERIALS AND PRIMARY DECK COVERINGS

WARNING

Ignition hazards

The use of this test method involves the generation of very high-heat flux levels which are capable of causing ignition of some materials such as clothing following even brief exposures. Precautions shall be taken to avoid accidental ignitions of this type.

Toxic fume hazards

The attention of the user of this test is drawn to the fact that the fumes from burning materials often include carbon monoxide. Other more toxic products may in many instances be produced. Suitable precautions shall be taken to avoid any extended exposure to these fumes.

1 SCOPE

This appendix specifies a procedure for measuring fire characteristics of bulkhead, ceiling, deck finish materials and primary deck coverings as a basis for characterizing their flammability and thus their suitability for use in marine construction.

2 NORMATIVE REFERENCES

The following normative documents contain provisions which constitute provisions of this appendix:

.1 ISO 13943, Fire safety – Vocabulary; and

.2 ISO 5658-2, Reaction to fire tests – Spread of Flame – Part 2: Lateral spread on building and transport products in vertical configuration.

3 DEFINITIONS

For the purposes of this appendix 1, the terms and definitions given in standards ISO 13943 and ISO 5658-2 and the following apply.

3.1 *Backing board* is a non-combustible board with the same width and length as the test specimen and 12.5 ± 3 mm thick and having the density of 950 ± 100 kg/m^3, used to back the specimen.

3.2 C*alibration board* is a dummy specimen as defined by figure 11 of appendix 2, intended only for use in calibration of heat flux gradient along with specimen.

3.3 *Compensating thermocouple* is a thermocouple for the purpose of generating an electrical signal representing long-term changes in stack metal temperatures. A fraction of the signal generated is subtracted from the signal developed by the stack gas thermocouples.

3.4 *Critical flux at extinguishment* is an incident heat flux level at the surface of a specimen at the point along its horizontal centreline where the flame ceases to advance and may subsequently go out.

Note: The heat flux value reported is based on interpolations of measurements with a non-combustible calibration board.

3.5 *Dummy specimen* is a specimen used for standardizing the operating condition of the equipment. It shall be a non-combustible board (for example, calcium silicate board) of oven-dry density of 950 ± 100 kg/m^3 and shall measure from 795 mm to 800 mm long, from 150 mm to 155 mm wide and 25 ± 2 mm thick.

3.6 *Fume stack* is a box-like duct with thermocouples and baffles through which flames and hot fumes from a burning specimen pass. Its purpose is to permit measurement of the heat release from the burning specimen.

3.7 *Heat for ignition* is the product of the time from initial specimen exposure until the flame front reaches the 150 mm position and the flux level at this position; this latter obtained in prior calibration of the apparatus.

3.8 *Heat release of specimen* is the observed heat release under the variable flux field imposed on the specimen and measured as defined by the test method.

3.9 *Heat for sustained burning* is the product of time from the start of exposure of a specimen to the arrival of the flame front at a specified position and the incident flux corresponding to that position measured on a non-combustible calibration board. This shall be calculated for each station starting at the 150 mm station, but it shall not be calculated for a given station unless the flame propagates more than halfway to the next station as viewed along the centreline of the specimen.

3.10 *Reverberatory wires* is a wire mesh located in front of, but close to, the radiating surface of the panel heat source. This serves to enhance the combustion efficiency and increase the radiance of the panel.

3.11 *Viewing rakes* is a set of bars with wires spaced at 50 mm intervals for the purpose of increasing the precision of timing flame front progress along the specimen.

4 PRINCIPLE OF THE TEST

4.1 This test provides methods for evaluating flammability characteristics of 155 mm x 800 mm specimens in vertical orientation.

4.2 The specimens are exposed to a graded radiant flux field supplied by a gas-fired radiant panel. Means are provided for observing the times to ignition, spread and extinguishment of flame along the length of the specimen as well as for measuring the compensated millivolt signal of the stack gas thermocouples as the burning progresses. Experimental results are reported in terms of: heat for ignition, heat for sustained burning, critical flux at extinguishment and heat release of specimen during burning.

5 FACILITY AND APPARATUS REQUIREMENTS

5.1 General

The test apparatus, except the equipment for measurement of heat release (i.e. fume stack and thermocouples for it), is specified in standard ISO 5658-2. A detailed description of the facility and apparatus required for conduct of this test is included in appendix 2 to this part. Compliance with the appendix forms an essential requirement of the test method. The equipment needed may be summarized as follows.

5.1.1 Special test room fitted with fume exhaust system as well as fresh air inlet.

5.1.2 Radiant panel frame fitted with blower or other source of combustion air, a methane* or natural gas supply system with suitable safety controls, and a radiant panel heat source, with reverberatory wires, arranged to radiate on a vertical specimen. Alternatively, an electrically-heated radiant source of the same dimensions may be used provided it can expose the specimen to the heat flux distribution shown in table 1 of appendix 2. The effective source temperature of any radiant panel is not greater than 1,000°C.

5.1.3 The specimen holder frame, three specimen holders, a pilot burner, specimen holder guides, viewing rakes and a viewing mirror.

5.1.4 A specimen fume stack with both stack gas and stack temperature compensating thermocouples together with a means for adjusting the magnitude of the compensation signal.

5.1.5 Instrumentation comprising a chronograph, digital or sweep second electric clock, a digital millivoltmeter, a two-channel millivolt recorder, gas-flowmeter, heat flux meters, a wide angle total radiation pyrometer and a stopwatch. Use of a data acquisition system to record both panel radiance and the heat release stack signal during test will facilitate data reduction.

6 CALIBRATION

Mechanical, electrical and thermal calibrations shall be performed as described in appendix 2. These adjustments and calibrations shall be performed following initial installation of the apparatus and at other times as the need arises.

6.1 Monthly verification

The calibration of the flux distribution on the specimen and the proper operation of the fume stack with its thermocouple system shall be confirmed by monthly tests, or at more frequent intervals if this is found necessary (see paragraphs 4.3 and 4.6 of appendix 2).

6.2 Daily verification

As a means of assuring continued proper adjustment of the apparatus, the following tests shall be performed on a daily basis or more frequently if the nature of the specimens makes this necessary.

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* The use of gases other than methane or natural gas is not recommended although with changes in panel-specimen spacing it has been reported possible to use the equipment with propane up to flux levels of 50 kW/m^2.

6.2.1 ***Adjustment of the pilot burner***

6.2.1.1 Adjust the propane gas and air flow rates to about 0.4 l/min and 1 l/min, respectively, to provide a flame length of 230 ± 20 mm in the vertical orientation. When viewed in a darkened room, the flame shall extend about 40 mm above the vertical specimen holder (see figure 6 of appendix 2). Record the flow rates of propane and air to the pilot burner.

6.2.1.2 Adjust the impingement zone of the flame onto the dummy specimen by moving the burner tube towards or away from the plane of the exposed surface of the dummy specimen. Rotate the pilot burner tube in its holder until the flame impinges over the top half of the exposed specimen height.

6.2.1.3 The pilot flame shall be checked and, if necessary, adjusted in the way stated above every day. The nature of some specimens may make this necessary to be done more frequently.

6.2.2 ***Stack gas thermocouples***

The stack gas thermocouples shall be cleaned by light brushing at least daily. This cleaning may be required even more frequently, in some instances before each test, when materials producing heavy soot clouds are tested. These thermocouples shall also be individually checked for electrical continuity to ensure the existence of a useful thermojunction. Following daily cleaning of the parallel connected stack gas thermocouples, both they and the compensating junction shall be checked to verify that the resistance between them and the stack is in excess of 10^6 ohms.

6.3 Continuous monitoring of operation

6.3.1 A dummy specimen shall remain mounted in the position normally occupied by a specimen whenever the equipment is in stand-by operation. This is a necessary condition of the continuous monitoring procedure which is accomplished by measuring:

.1 the millivolt signals from both the stack thermocouples and the total radiation pyrometer mounted securely on the specimen holder frame facing the surface of the radiant panel; or

.2 the millivolt signals from both the stack thermocouples and a heat flux meter positioned at 350 mm from the exposed hot end of a dummy specimen as defined in paragraph 3.5 (see paragraph 4.3.2 of appendix 2).

6.3.2 Either of these measurement methods would be satisfactory for determining that an appropriate thermal operating level has been achieved. The use of the radiation pyrometer is preferable since it permits continuous monitoring of the panel operating level even when tests are in progress. Both signals shall remain essentially constant for 3 min prior to the test. The observed operating level of either the radiation pyrometer or the heat flux meter shall correspond, within 2%, to the similar required level specified in table 1 of appendix 2 and referred to in the calibration procedure mentioned in paragraph 6.1 above.

7 SPECIMENS

7.1 Number required

7.1.1 ***Specimens required***

At least six specimens shall be provided for each different exposed surface.

7.1.2 ***Required number for the test***

Three specimens shall be tested for each different exposed surface of the product evaluated and applied. Condition of retest is described in paragraph 8.3.

7.2 Dimensions

7.2.1 The specimens shall measure from 150 mm to 155 mm wide and from 795 mm to 800 mm long, and shall be representative of the product.

7.2.2 Specimen thickness: materials and composites of normal thickness 50 mm or less shall be tested using their full thickness. For materials and composites of normal thickness greater than 50 mm, the required specimens shall be obtained by cutting away the unexposed face to reduce the thickness between 47 mm and 50 mm.

7.3 Substrate

7.3.1 ***Substrate of surface material and floor coverings***

Materials and composite materials shall be tested using their full thickness, attaching to the substrate to which they will be attached in practice when an adhesive is appropriate. The test specimen shall reflect actual application.

7.3.2 ***Substrate of primary deck covering***

The specimens shall be applied to a steel plate having a thickness of 3 ± 0.3 mm. The specimens shall have a nominal thickness, the components and construction of the primary deck coveringwhich shall reflect actual application.

7.4 Composite materials

7.4.1 Assembly shall be as specified in paragraph 7.2. However, where thin materials or composites are used in the fabrication of an assembly, the presence of an air gap and/or the nature of any underlying construction may significantly affect the flammability characteristics of the exposed surface. The influence of the underlying layers shall be recognized and care taken to ensure that the test result obtained on any assembly is relevant to its use in practice.

7.4.2 Vapour barriers used in conjunction with insulation shall be tested without any other components that will shield the barrier being tested from the radiant panel. The substrate of the specimen shall reflect actual application on ships.

7.5 Metallic facings

If a bright metallic faced specimen is to be tested, it shall be tested as it is.

7.6 Marking specimens

A line shall be marked centrally down the length of the face to be tested of each specimen. Caution shall be exercised to avoid the use of a line which would influence specimen performance.

7.7 Conditioning of specimens

Before test, the specimens shall be conditioned to constant moisture content, at a temperature of 23 ± 2°C, and a relative humidity of 50 ± 5%. Constant moisture content is considered to be reached when, following two successive weighing operations, carried out at an interval of 24 h, the measured masses do not differ by more than 0.1% of the mass of the specimen.

8 TEST PROCEDURE

8.1 General considerations

The test method involves mounting the conditioned specimen in a well-defined flux field and measuring the time of ignition, spread of flame and its final extinguishment, together with a stack thermocouple signal as an indication of heat release by the specimen during burning.

8.1.1 Prepare a properly-conditioned specimen for test in a cool holder away from the heat of the radiant panel. Prior to insertion in the specimen holder, the back and edges of the specimen shall be wrapped in a single sheet of aluminium foil of 0.02 mm thickness and dimensions of 175 + a mm x 820 + a mm where "a" is twice the specimen thickness. When inserted in the specimen holder each specimen shall be backed by a cool backing board. When mounting non-rigid specimens in the holder, shims shall be placed between the specimen and holder flange to ensure that the exposed specimen face remains at the same distance from the pilot flame as a rigid specimen. For such materials, the shims may often only be required for a 100 mm length at the hot end of the specimen.

8.1.2 The dummy specimen in a specimen holder shall be mounted in position facing the radiant panel. The equipment fume exhaust system shall be started.

8.1.3 The radiant panel is operated to realize the test conditions as specified in paragraph 6.3. Start the millivolt recorder recording the output signal of the stack thermocouples, as well as the signal from the total radiation pyrometer or heat flux meter positioned as described in paragraph 6.3.1.2.

8.1.4 When the radiant panel and stack signals have attained equilibrium, after the preheat period, light the pilot flame, adjust its fuel flow rate and observe both signals for at least 3 min and verify continued signal stability.

8.1.5 After both signals reach stable levels, remove the dummy specimen holder and insert the specimen in the test position within 10 s. Immediately start both the clock and chronograph.

8.1.6 Operate the event marker of the chronograph to indicate the time of ignition and arrival of the flame front during the initial rapid involvement of the specimen. The arrival at a given position shall be observed as the time at which the flame front at the longitudinal centreline of the specimen is observed to coincide with the position of two corresponding wires of the viewing rakes. These times are recorded manually both from measurement on the chronograph chart and from observations of the clock. As far as possible, the arrival of the flame front at each 50 mm position along the specimen shall be recorded. Record both the time and the position on the specimen at which the progress of flaming combustion ceases. The panel operating level, as well as stack signals, shall be recorded throughout the test and continued until test termination.

8.1.7 Throughout the conduct of the test, no change shall be made in the fuel supply rate to the radiant panel to compensate for variations in its operating level.

8.2 Duration of test

8.2.1 The test shall be terminated, the specimen removed, and the dummy specimen in its holder reinserted when any one of the following is applicable:

.1 the specimen fails to ignite after a 10 min exposure; or

.2 3 min have passed since all flaming from the specimen ceased or 10 min exposure, whichever is longer.

8.2.2 Operations in paragraphs 8.1.1 to 8.1.7 shall be repeated for two additional specimens (see paragraph 8.3).

8.3 Conditions of retest

8.3.1 In the event of failure, during test of one or more specimens, to secure complete flame spread times or a reasonable heat release curve, the data secured shall be rejected and a new test or tests performed. Such failures might involve, but not be limited to, incomplete observational data or malfunction of data logging equipment. Excessive stack signal baseline drift shall also require further equipment stabilization and retest.

8.3.2 If a specimen shows extensive loss of incompletely burned material during test, at least one additional specimen, restrained in the testing frame by poultry netting, shall be tested and the data secured reported separately.

8.3.3 The following procedures shall be taken in relation to the behaviour of the specimen during the test:

.1 if the pilot flame extinguishes: report occurrence and reject data and repeat test; or

.2 if the specimen breaks up and falls out of the specimen holder, report the behaviour, but classify on basis of worst performance with and without specimen restraint in paragraph 8.3.2.

8.4 Observations

In addition to the recording of the experimental data, observations shall be made and recorded on the behaviour of the specimen including but not limited to flashing, unstable flame front, sparks, glowing, charring, melting, flaming drips, disintegration of the specimen, fissures, fusion, changes in form.

9 DERIVED FIRE CHARACTERISTICS

Experimental results shall be reported in terms of the thermal baseline of the output from the thermocouple circuit and measurements of incident heat flux measured with a dummy specimen in place. The results shall not be adjusted to compensate for changes in the thermal output of the radiant panel and the pilot flame during the conduct of the test. The following data shall be derived from the test results.

9.1 Heat for ignition

As defined in paragraph 3.7.

9.2 Heat for sustained burning

A list of the values of this characteristic as defined in paragraph 3.9.

9.3 Average heat for sustained burning

9.3.1 An average of the values for the characteristic defined in paragraph 3.9 measured at different stations, the first at 150 mm and then at subsequent stations at 50 mm intervals through the final station or the 400 mm station, whichever value is the lower.

9.3.2 For each specimen where the flame front does not reach the 175 mm position, the heat of sustained burning is not defined. If the heat of sustained burning is not defined for one specimen, *Qsb* is calculated using the data from the other two specimens. If the heat of sustained burning is not defined for two specimens, *Qsb* is calculated using the data from the third specimen. If the heat of sustained burning is not defined for all three specimens, *Qsb* is undefined and the criterion of *Qsb* is deemed to have been met.

9.4 Critical flux at extinguishment

A list of the values of this characteristic for the specimens tested and the average of these values (see paragraph 3.4).

9.5 Heat release of the specimen

Both a heat release time curve and a listing of the peak and total integrated heat release shall be secured from the experimental data. They shall be corrected for the non-linearity of the heat release calibration curve. The curve of the millivolt signal from the stack thermocouples shall include at least 30 s of the initial 3 min steady state verification period as well as the starting transient just prior to and following specimen insertion. In converting millivolt signals to heat release rate, the zero release level of the calibration curve shall be set at the level of the initial steady state just prior to test of the specimen involved (see figure 10 of appendix 2).

9.5.1 ***Total heat release***

The total heat release is given by integration of the positive part of the heat release rate during the test period (see figure 10 of appendix 2).

9.5.2 ***Peak heat release rate***

The peak heat release rate is the maximum of the heat release rate during the test period (see figure 10 of appendix 2).

10 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with part 5 of the annex to the 2010 FTP Code (also see subparagraph .2 below);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the material, i.e. surface finish, floor covering, primary deck covering, pipes, etc.;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, together with details of the construction of the product;

.11 description of the specimen including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, orientations tested and face subject to the test, and construction;

.12 date of sample arrival;

.13 details of specimen conditioning;

.14 date of test;

.15 test results:

.1 duration of each test;

.2 derived fire characteristics as described in paragraph 9; and

.3 observations recorded in accordance with paragraph 8.4; and

.16 determination on whether the tested material meets the performance criteria in paragraphs 3 and 4 of this part.

APPENDIX 2

TECHNICAL INFORMATION AND CALIBRATION OF THE PHYSICAL TEST EQUIPMENT

This appendix provides technical information intended to permit construction, erection, alignment and calibration of the physical equipment required for the conduct of tests by this procedure.

1 TEST EQUIPMENT FABRICATION

Figures 1 and 2 show photographs of the equipment as assembled, ready for test. The test apparatus, except the equipment for measurement of heat release (i.e. fume stack and thermocouples for it), is specified in standard ISO 5658-2.

1.1 Brief parts list for the test equipment assembly includes:

.1 the main frame (figure 1) which comprises two separate sections, the burner frame and the specimen support frame. These two units are bolted together with threaded rods permitting flexibility in mechanical alignment;

.2 specimen holders which provide for support of the specimens during test. At least two of these are required. Three prevent delays resulting from required cooling of holders prior to mounting specimens;

.3 a specimen fume stack fabricated of stainless steel sheet of 0.5 ± 0.05 mm thickness complete with gas and stack metal compensating thermocouples;

.4 the radiant panel which has radiating surface dimensions of 280 mm x 483 mm. It has been specially fabricated for use with this equipment through use of commercially-available porous refractory tiles;

.5 the blower for combustion air supply, radiant panel, air flow metering device, gas control valves, pressure reducer and safety controls which are all mounted on the burner frame. Requirements are summarized below:

.1 air supply of about 30 m^3/h at a pressure sufficient to overcome the friction losses through the line, metering device and radiant panel. The radiant panel drop amounts to only a few millimetres of water; and

.2 the gas used may be either natural gas, methane or propane-butane. The use of gas other than methane or natural gas is not recommended*, although with changes in panel-specimen spacing, it is possible to use the equipment with propane at flux levels of 50 kW/m^2. A pressure regulator shall be provided to maintain a constant supply pressure. Gas is controlled by a manually adjusted needle valve. No venturi mixer is necessary. Safety devices include an electrically-operated shutoff valve to prevent gas flow in the event of electric power failure, air pressure failure and loss of heat at the burner surface. The gas flow requirements are roughly 1.0 m^3/h to 3.7 m^3/h for natural gas or methane at a pressure to overcome line pressure losses;

* Flashback limits the maximum operating level with propane.

.6 the specimen holder, pilot flame holder, fume stack, flame front viewing rakes, radiation pyrometer and mirror are all assembled on the specimen support frame. The arrangement of parts on this frame is shown in figures 1 and 2; and

.7 a dummy specimen as defined in paragraph 3.5 of appendix 1 to this part shall be continuously mounted on the apparatus in the position of the specimen during operation of the equipment. This dummy specimen should only be removed when a test specimen is to be inserted.

2 INSTRUMENTATION

2.1 Total radiation pyrometer

This should have a sensitivity substantially constant between the thermal wave lengths of 1 m and 9 m and should view a centrally-located area on the panel of about 150 mm x 300 mm. The instrument should be mounted on the specimen support frame in such a manner that it can view the panel surface.

2.2 Heat flux meters

2.2.1 It is desirable to have at least three heat flux meters for this test method. They should be of the thermopile type with a nominal range of 0 kW/m^2 to 50 kW/m^2 and capable of safe operation at three times this rating.

2.2.2 The heat flux meters shall be calibrated in accordance with standard ISO 14934-3, Fire tests – Calibration and use of heat flux meters – Part 3: Secondary calibration method. Two of these should be retained as a laboratory reference standard. They should have been calibrated to an accuracy of within ± 5%.

2.2.3 The target sensing of the applied flux should occupy an area not more than 80 mm^2 and be located flush with and at the centre of the water-cooled 25 mm circular exposed metallic end of the heat flux meter. If heat flux meters of smaller diameter are to be used, these should be inserted into a copper sleeve of 25 mm outside diameter in such a way that good thermal contact is maintained between the sleeve and water-cooled heat flux meter body. The end of the sleeve and the exposed surface of the heat flux meter should lie in the same plane. Radiation should not pass through any window before reaching the target.

2.3 Timing devices

Both a chronograph and either an electric clock with a sweep second hand or a digital clock should be provided to measure time of ignition and flame advance. The chronograph for timing ignition and initial flame advance may comprise a strip chart recorder with paper speed of at least 5 mm/s and an event marker pen. Both the chronograph paper drive and the electric clock should be operated through a common switch to initiate simultaneous operation when the specimen is exposed. This may be either hand operated or actuated automatically as a result of complete specimen insertion.

2.4 Recording millivoltmeter

A two-channel strip chart recording millivoltmeter having at least one megohm input resistance should be used to record signals from the fume stack thermocouples and the output from the radiation pyrometer. The signal from the fume stack will in most instances be less than 15 mV but in some cases this may be exceeded by a small amount. The sensitivity

of the other channel should be selected to require less than full scale deflection with the total radiation pyrometer or flux meter chosen. The effective operating temperature of the radiant panel should not normally exceed 935°C.

2.5 Digital voltmeter

A small digital millivoltmeter will be found convenient for monitoring changes in operating conditions of the radiant panel. It should be capable of indicating signal changes of 10 μV or less.

3 SPACE FOR CONDUCTING TESTS

3.1 Special room

A special room should be provided for the performance of this test. The dimensions of it are not critical but it may be roughly 45 m^3 volume with a ceiling height of not less than 2.5 m.

3.2 Fume exhaust system

An exhaust system should be installed above the ceiling with a capacity for moving air and combustion products at a rate of 30 m^3/min. The ceiling grille opening to this exhaust system should be surrounded by a 1.3 m x 1.3 m refractory fibre fabric skirt hanging from the ceiling down to 1.7 ± 0.1 m from the floor of the room. The specimen support frame and radiant panel should be located beneath this hood in such a way that all combustion fumes are withdrawn from the room.

3.3 The apparatus

This should be located with a clearance of at least 1 m separation between it and the walls of the test room. No combustible finish material of ceiling, floor or walls should be located within 2 m of the radiant heat source.

3.4 Air supply

Access to an exterior supply of air, to replace that removed by the exhaust system, is required. This should be arranged in such a way that the ambient temperature remains reasonably stable (for example: the air might be taken from an adjoining heated building).

3.5 Room draughts

Measurements should be made of air speeds near a dummy specimen while the fume exhaust system is operating but the radiant panel and its air supply are turned off. At a distance of 100 mm the air flow perpendicular to the lower edge at midlength of the specimen should not exceed 0.2 m/s in any direction.

4 ASSEMBLY AND ADJUSTMENT

4.1 General

The test conditions are essentially defined in terms of the measured heat flux incident on a dummy specimen during calibration. Radiation transfer will predominate, but convection transfer will also play a part. The flux level incident at the specimen surface is a result of the geometrical configuration between the radiant panel and the specimen, as well as the thermal output from the radiant panel.

4.1.1 Both in original adjustment of test operating conditions and periodic verification of this adjustment, the measured heat flux at the surface of the specimen is the controlling criterion. This heat flux is measured by a heat flux meter (see paragraph 2.2 above) mounted in a special dummy specimen (see figure 11).

4.1.2 Between consecutive tests, the operating level should be monitored either by use of a heat flux meter mounted in a dummy specimen as defined in paragraph 3.5 of appendix 1 under "Definitions" or preferably by use of a radiation pyrometer which has been previously periodically calibrated on the basis of the readings of such a heat flux meter. This radiation pyrometer should be rigidly fixed to the specimen-holder frame in such a manner that it continuously views the radiating panel surface (see paragraph 2.1).

4.2 Mechanical alignment

4.2.1 Most of the adjustments of the components of the test apparatus may be conducted in the cold condition. The position of the refractory surface of the radiant panel with respect to the specimen must correspond with the dimensions shown in figure 3.

4.2.2 These relationships can be achieved by appropriate use of shims between the panel and its mounting bracket, adjustment or separation between the two main frames, and adjustment of the position of the specimen holder guides. Detailed procedures for making these adjustments are suggested in paragraph 5.

4.2.3 The fume stack for heat release measurements should be mechanically mounted on the specimen support frame in the position shown in figure 4.

4.2.4 The method of mounting should ensure the relative positions shown and should allow easy stack removal for cleaning and/or repair. The compensating thermocouple should be mounted in such a manner that good thermal contact is achieved while ensuring greater than one megohm electrical resistance from the stack metal wall.

4.3 Thermal adjustment of panel operating level

4.3.1 Thermal adjustment of the panel operating level is achieved by first setting an air flow of about 30 m^3/h through the panel. Gas is then supplied and the panel ignited and allowed to come to thermal equilibrium with a dummy specimen mounted before it. At proper operating condition, there should be no visible flaming from the panel surface except when viewed from one side parallel to the surface plane. From this direction, a thin blue flame very close to the panel surface will be observed. An oblique view of the panel after a 15 min warm-up period should show a bright orange radiating surface.

4.3.2 With a water-cooled heat flux meter mounted in the calibration board, the measured incident heat flux on the specimen should correspond to the values shown in table 1. Compliance with this requirement is achieved by adjustment of the gas flow. If necessary, small changes in air flow can be made to achieve the condition of no significant flaming from the panel surface. Precise duplication of the flux measurements specified in table 1 for the 50 mm and 350 mm positions on the basis of the heat flux meter calibration used will fix the flux at the other stations well within the limits called for. This does not mean that all other flux levels are correct, but it does ensure that a fixed configuration or view geometry between the panel and specimen has been achieved. To meet these requirements, it may be necessary to make small changes in the specimen longitudinal position shown in figure 6. A plot and smooth curve should be developed on the basis of the eight flux measurements required. The shape of the curve should be similar to that defined by the typical data shown in table 1. These measurements are important, since the experimental results are reported on the basis

of these flux measurements. If a total radiation pyrometer is to be used to monitor panel operation, records of its signal should be kept following successful completion of this calibration procedure. If a change in panel-specimen axial position is necessary to meet the requirements for flux at the 50 mm and 350 mm positions, this should be accomplished by adjusting the screws connecting the two frames. In this way, the pilot position with respect to the specimen will remain unchanged. The specimen stop screw adjustment may be changed to meet the flux requirements in the standard and then the position of the pilot burner mount may require adjustment to maintain the 10 ± 2 mm pilot spacing.

4.3.3 Water cooling of the heat flux meter is required to avoid erroneous signals at low flux levels. The temperature of the cooling water should be controlled in such a manner that the heat flux meter body temperature remains within a few degrees of room temperature. If this is not done, correction of the flux measurement should be made for temperature difference between the heat flux meter body and room temperature. Failure to supply water-cooling may result in thermal damage to the thermal sensing surface and loss of calibration of the heat flux meter. In some cases repairs and recalibration are possible.

4.3.4 Once these operating conditions have been achieved, all future panel operation should take place with the established air flow with gas supply as the variable to achieve the specimen flux level as calibrated. This level should be monitored with use of either a radiation pyrometer fixed to view an area of the source surface or a heat flux meter mounted in a dummy specimen, as defined in paragraph 3.5 of appendix 1 – (Definitions), at the 350 mm position. If the latter method is used, the assembly of dummy specimen and heat flux meter should remain in place between tests.

4.4 Adjustments and calibrations – general

The following adjustments and calibrations are to be achieved by burning methane gas from the line heat source located parallel to, and in the same plane as, the centreline of a dummy specimen located in position and without heat flux meters. This line burner comprises a 2 m length of pipe of 9.1 mm internal diameter. One end is closed off with a cap and a line of 15 holes of 3 mm diameter are drilled at 16 mm spacing through the pipe wall. The gas burned as it flows through this line of vertically positioned holes flames up through the stack. The measured flow rate and the net or lower heat of combustion of the gas serve to produce a known heat release rate which can be observed as a compensated stack millivolt signal change. Prior to performing calibration tests, measurements must be conducted to verify that the stack thermocouple compensation has been properly adjusted.

4.5 Compensation adjustment

4.5.1 The fraction of the signal from the compensator thermocouple which is subtracted from the stack thermocouple output should be adjusted by means of the resistance of one leg of the potential divider shown in figure 7.

4.5.2 The purpose of this adjustment is, as far as practical, to eliminate from the stack signal the long-term signal changes resulting from the relatively slow stack metal temperature variations. Figure 8 shows the curves resulting from under-compensation, correct compensation, and over-compensation. These curves were obtained by abruptly placing the lighted gas calibration burner adjacent to the hot end of a dummy specimen and then extinguishing it. For this adjustment, the calibration gas feed rate should be set to correspond to a heat rate of 1 kW. The compensator potential divider should be adjusted to yield curves that show a rapid rise to a steady state signal which is essentially constant over a 5 min period following the first minute of transient signal rise. When the calibration burner is shut off, the signal should rapidly decrease and reach a steady state value within 2 min.

Following this, there should be no long-term rise or fall of the signal. Experience has shown that between 40% and 50% of the compensation thermocouple signal should be included in the output signal to achieve this condition. When properly adjusted, a square thermal pulse of 7 kW should show not more than approximately 7% overshoot shortly after application of the calibration flame (see figure 8).

4.6 Fume stack calibration

With the adjustment described in paragraph 4.5 completed and a steady state base signal having been achieved, stack calibration should be carried out with the radiant panel operating at 50.5 kW/m^2 and the pilot burner not lit. The calibration of the stack millivolt signal rise should be made by introducing and removing the line burner, as described in paragraph 4.4. The flow rate of methane gas of at least 95% purity should be varied over the range of about 0.004 m^3/min to 0.02 m^3/min in sufficient increments to permit plotting the data in a well defined curve of stack compensated millivolt signal rise against the net or lower heat input rate. A similar calibration should be performed with the calibration burner located at the cool end of the specimen. The two curves should show agreement in indicated heat release rate within about 15%. A typical curve is shown in figure 9. The curve for the calibration burner at the hot end of the specimen should be the one used for reporting all heat release measurements. This completes the calibration and the test equipment is ready for use.

5 ASSEMBLY AND MECHANICAL ADJUSTMENT OF THE FLAMMABILITY TEST APPARATUS

The radiant panel subassembly has been completed with the exception of the support brackets and reverberatory screen. The equipment can be assembled to permit test of specimens of thickness up to 50 mm.

5.1 The panel frame should be placed upright on a level floor, preferably in the location in which the equipment will be used.

5.2 The rotating ring should be mounted on its three guide bearings.

5.3 The panel mount frame should be bolted together, and to the ring, by four bolts.

5.4 A check should be made that the ring lies in a vertical plane. If the error is large, an adjustment of the upper ring support-bearing location may be necessary. Prior to making such an adjustment, it should be determined whether the error is due to excessive clearance between the ring and bearing rollers. If this is the case, rollers of a larger diameter may correct the problem.

5.5 The four panel support brackets should be fastened to the radiant panel at the four corners. Do not use too much force in bolting these brackets in place. Prior to mounting these brackets, one 35 mm M9 cap screw is placed in the hole that will be farthest from the panel end. These screws provide a means for mounting the panel.

5.6 Four washers should be placed on each of the panel mounting screws and the panel assembled on the mount bracket.

5.7 The angularity of the radiant panel surface with the plane of the mounting ring should be checked. This can be accomplished by means of a carpenter's square and measurements to the refractory tile surface at both ends of the panel. Any deviation from the required 15° angle may be adjusted by increasing or reducing the number of washers on the mounting screws.

5.8 The radiant panel should be rotated to face a specimen mounted in a vertical plane.

5.9 The panel surface should be checked with a spirit level to ensure that it also lies in a vertical plane.

5.10 The specimen frame with specimen support rails on the side and bottom positions and the pilot burner holder assembled in approximate positions should be brought up to the burner frame and the two frames fastened together with two bolts and six nuts or two threaded rods and eight nuts. The spacing between the frames is roughly 125 mm.

5.11 The spacing of the two sides of the frames is adjusted to ensure that the specimen support frame longitudinal members are at a 15° angle to the radiant panel surface.

5.12 The single specimen holder side guide rail for vertical specimen orientation should be adjusted so that it is at the required 15° angle to the radiant panel surface.

5.13 An empty specimen holder should be slid into position on the rail and the position of the upper guide fork adjusted to ensure that when a specimen is inserted in the holder its surface will lie in a vertical plane.

5.14 The stop screw determining the axial position of the specimen holder should be adjusted to ensure that the axis of the pilot burner is 10 ± 2 mm from the closest exposed edge of the specimen. This adjustment should again be made by use of an empty specimen holder and substitution of a 6 mm steel rod of 250 mm length for the pilot burner ceramic tube. When viewed from the back of the specimen holder, the spacing between rod axis and the edge of the specimen retaining flange of the holder should be 10 ± 2 mm.

5.15 With the specimen holder still in place against the top screw, the spacing between the panel and specimen support frames should be adjusted to make dimension B (see figure 3) equal to approximately 125 mm. This adjustment is made by means of the two screws fastening the frames together. In making this adjustment, it is important to make equal adjustments on each side to maintain the angular relationship called for in adjustments in paragraphs 5.11 and 5.12.

5.16 The nuts supporting the specimen holder side guide rail should be adjusted to ensure that dimension A (see figure 3) is 125 ± 2 mm. Again, equal adjustments to the two mounting points are required. When doing this, a check should be made to ensure that the guide rail and edge of the specimen holder are in a horizontal plane. In making this adjustment, it is important to ensure that the 45 mm stack position dimension, as shown in figure 4, is maintained. Another way of adjustment to dimension A is through changes in the number of washers mentioned in paragraph 5.6.

5.17 If necessary, the procedure described in paragraph 5.13 should be repeated.

5.18 The reverberatory screen should be mounted on the radiant panel. This must be done in such a manner that it is free to expand as it heats up during operation.

5.19 The viewing rake with 50 mm pins is mounted on an angle fastened to the specimen holder guide rail. Its position is adjusted so that pins are located at multiples of 50 mm distance from the closest end of the specimen exposed to the panel. It should be clamped in this position.

Table 1 – Calibration of incident heat flux to the specimen

Distance from exposed end of the specimen (mm)	Typical flux levels at the specimen (kW/m^2)	Calibration position to be used (kW/m^2)
0	49.5	
50	50.5	50.5
100	49.5	
150	47.1	x
200	43.1	
250	37.8	x
300	30.9	
350	23.9	23.9
400	18.2	
450	13.2	x
500	9.2	
550	6.2	x
600	4.3	
650	3.1	x
700	2.2	
750	1.5	x

Typical flux incident on the specimen and specimen positions at which the calibration measurements are to be made. The flux at the 50 mm and 350 mm positions should agree with the typical values within 5%. Calibration data at other positions should agree with typical values within 10%.

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Figure 1 – General view of the apparatus

Figure 2 – View from specimen

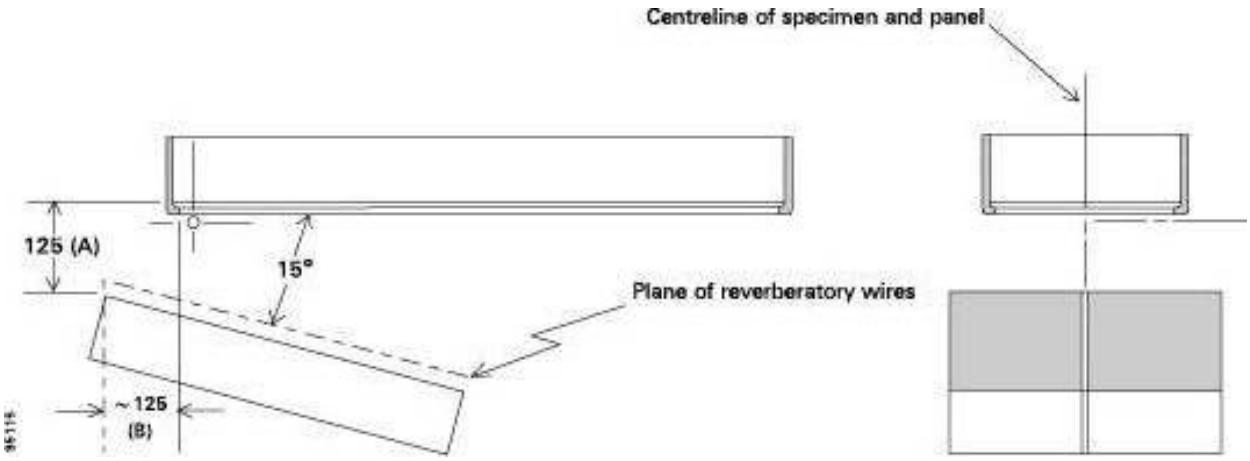


Figure 3 – Specimen – panel arrangement

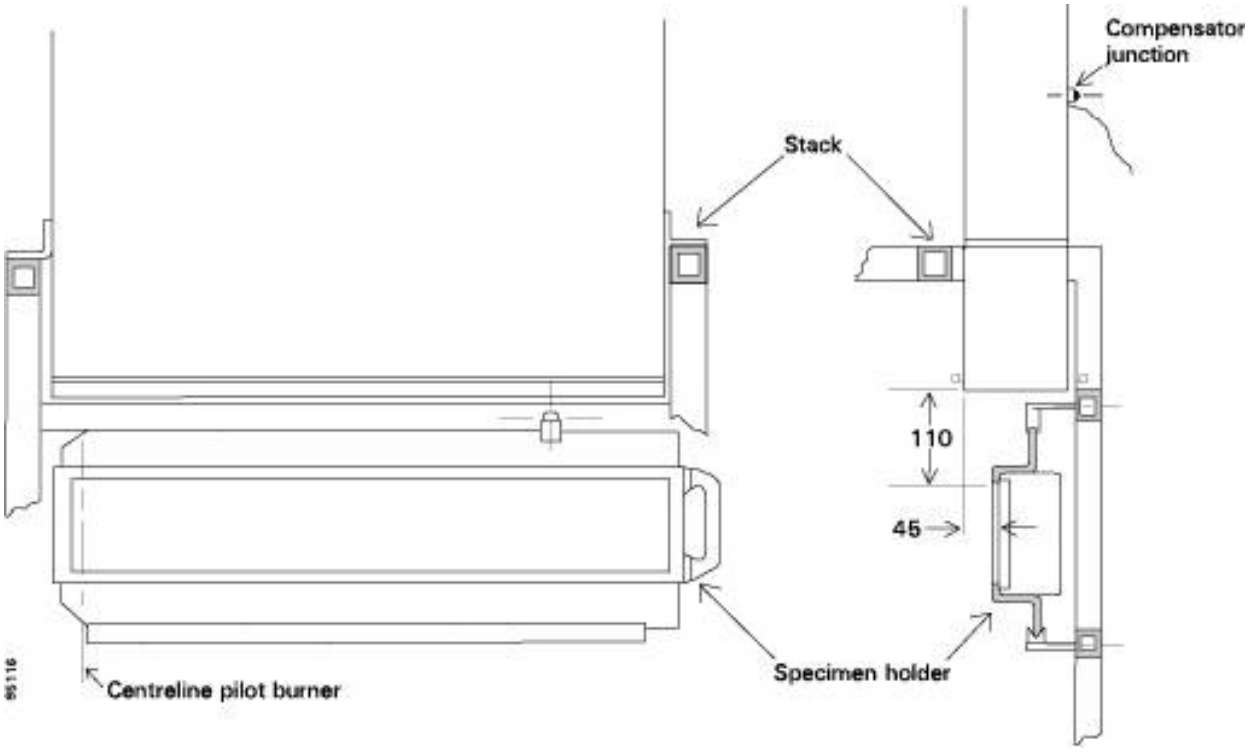
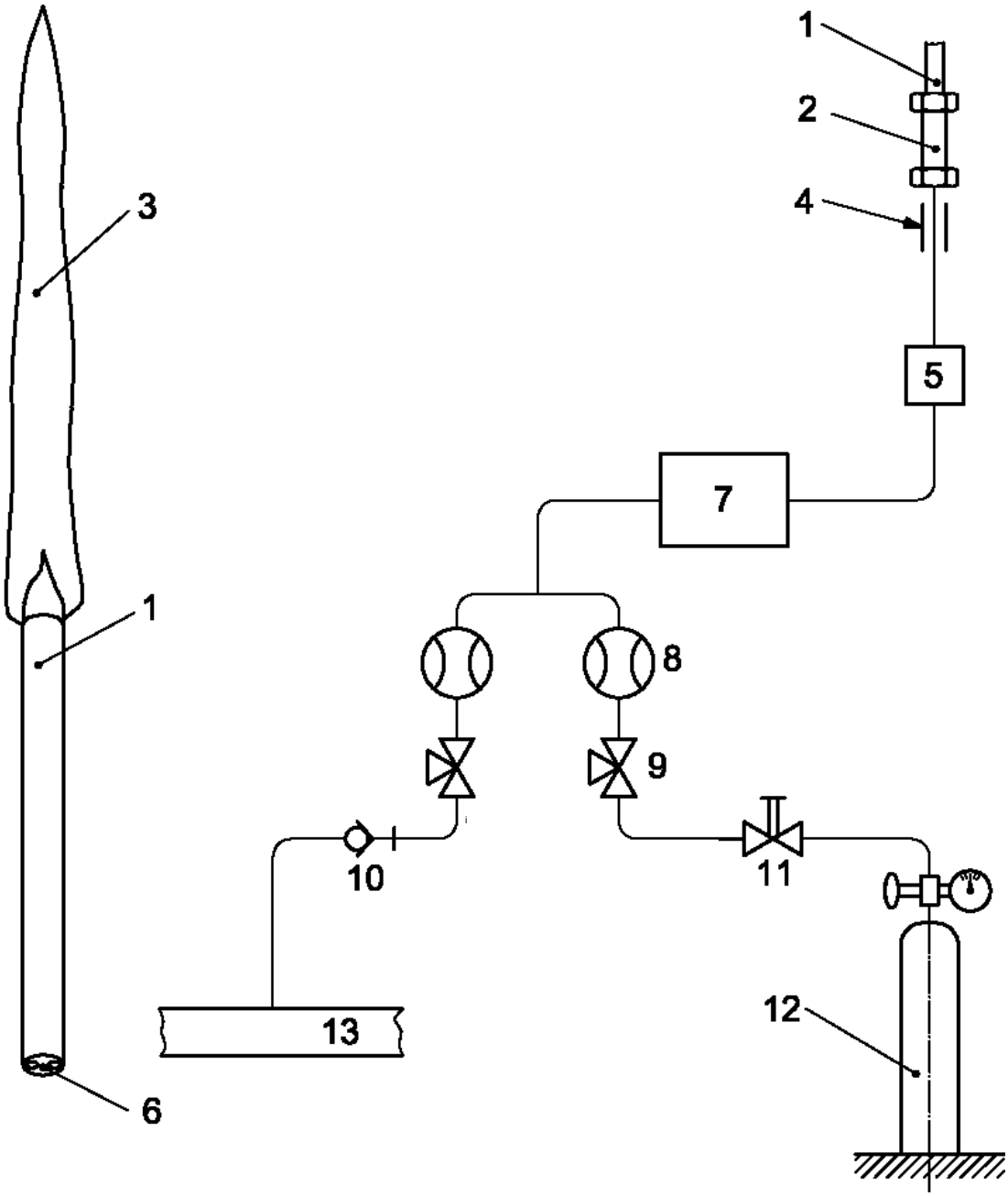


Figure 4 – Position of stack and specimen



Key

1 pilot flame burner
2 connector
3 flame (230 ± 20) mm long
4 location of burner support
5 flame arrester
6 twin-bore porcelain tube (200 ± 10) mm long
7 pressure damping chamber
8 flow meter
9 needle valve
10 non-return valve
11 on-off valve
12 propane gas cylinder
13 air line to panel

Figure 5 – Pilot burner details and connections

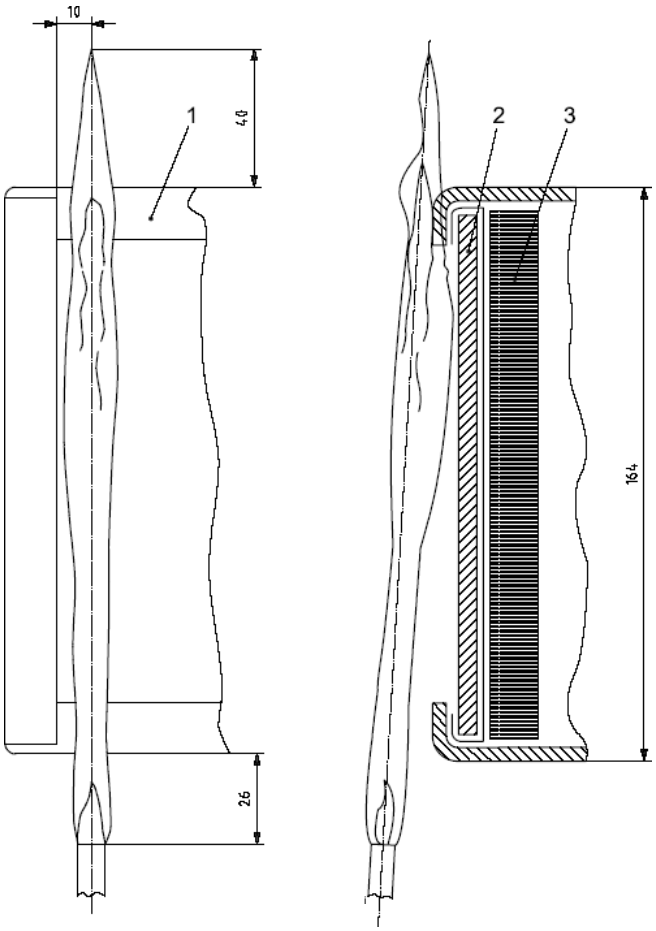


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Figure 6 – Position of pilot flame

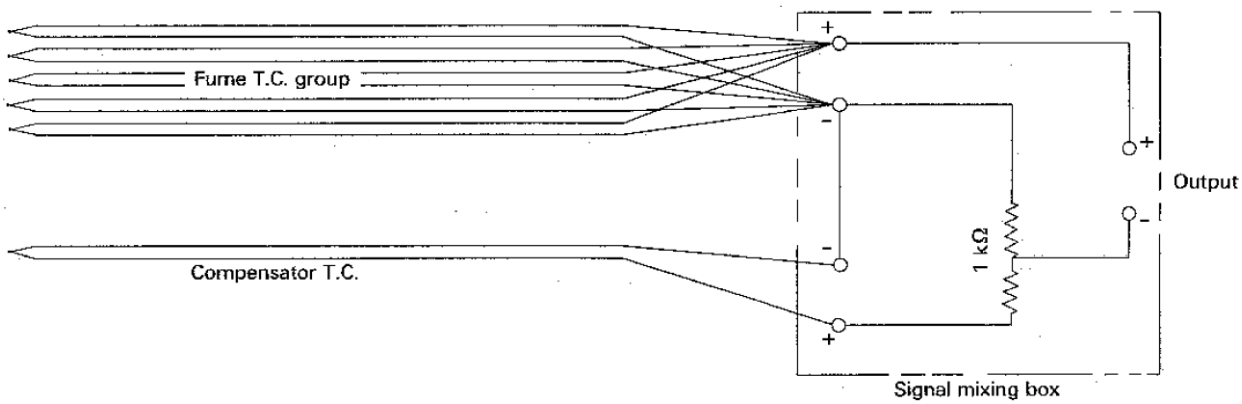


Figure 7 – Diagrammatic sketch of thermocouple circuit

Two sets of thermocouples (T.C.) and lead wires are required. The wire size and lengths within the fume T.C. group must be the same to ensure proper signal averaging. The parallel connection of the couples may be achieved at the mixing box by plug connection of the leads. This allows quick removal and checks for continuity and grounding problems with minimum delay. No cold junction should be used but the signal mixing box should be from panel radiation.

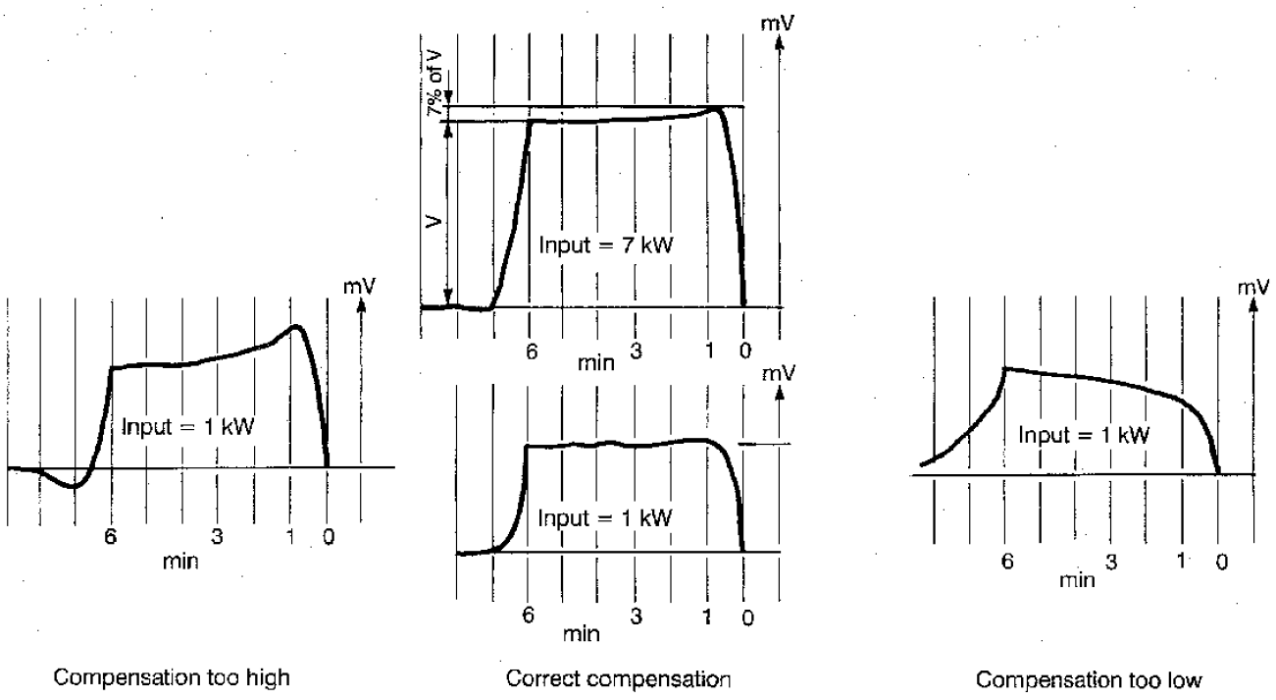


Figure 8 – An example of response behaviour of heat release signal to a square wave thermal pulse

(The four curves show examples of changes in the indicated mV signal rise for three different levels of inverse feedback or compensation level. Response performance in terms of time would be different in each apparatus due to the thickness of wall panel of the stack.)

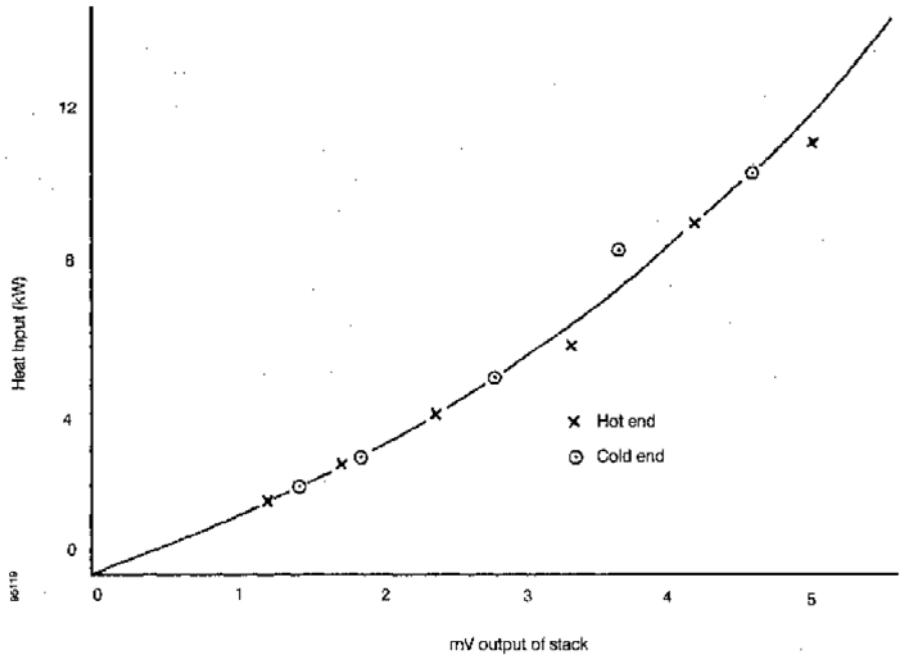


Figure 9 – Example of a typical stack calibration

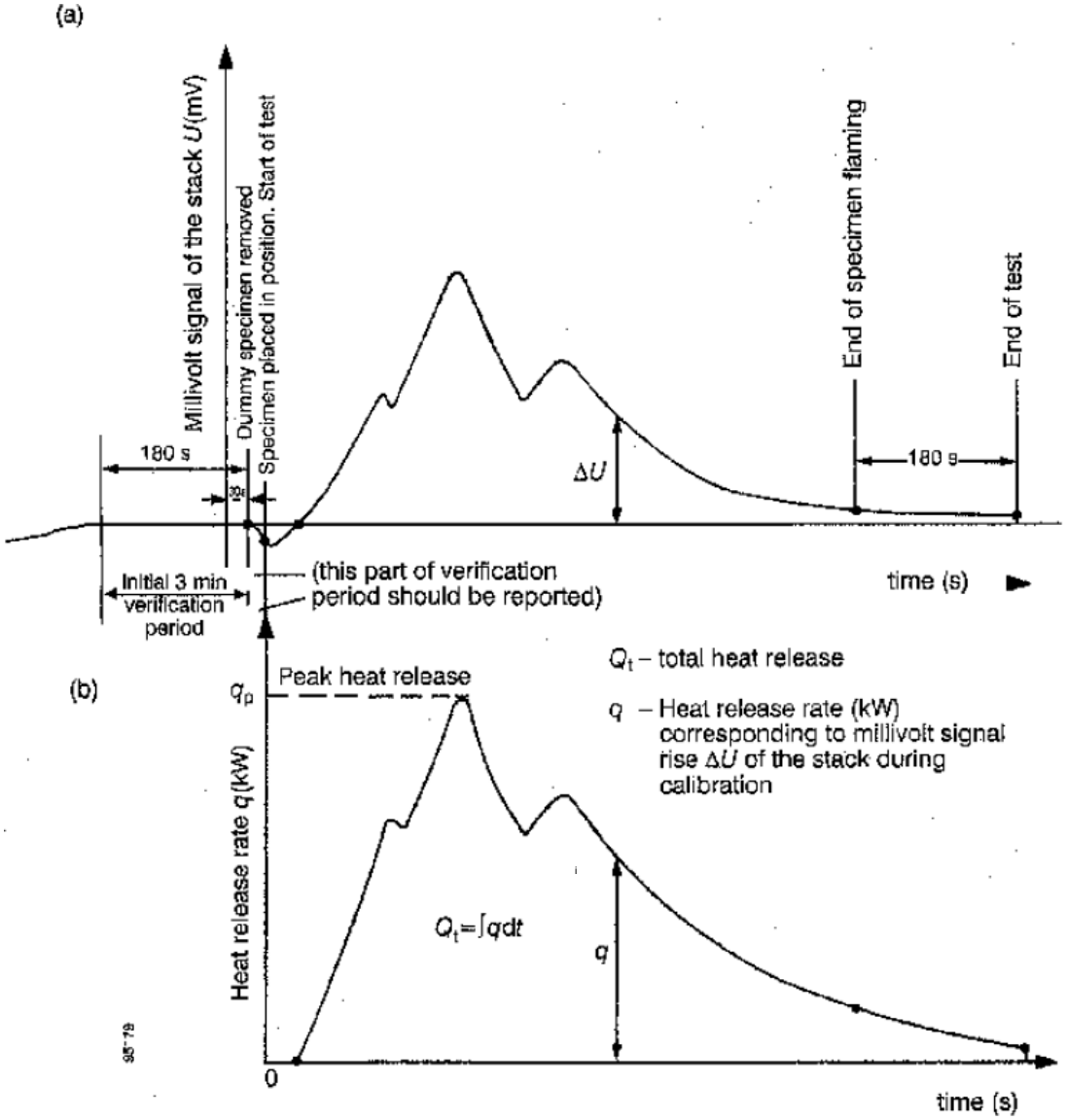
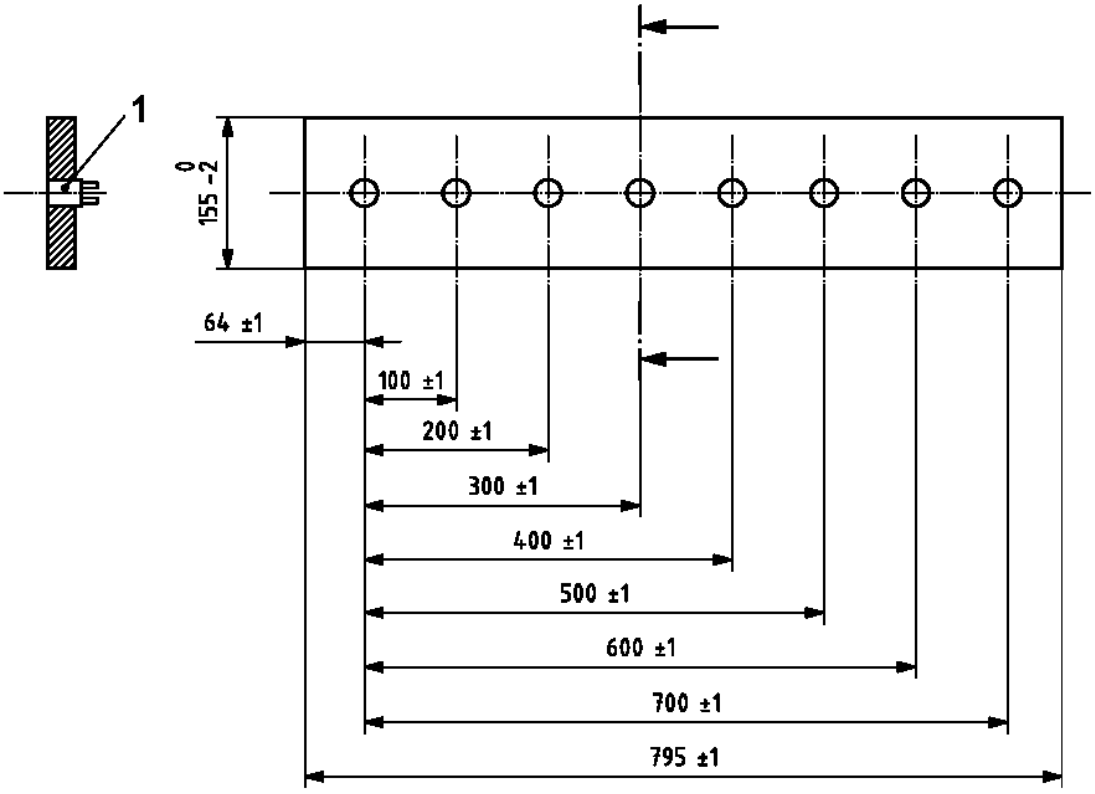


Figure 10 – Example of conversion of the millivolt signal rise ΔU to heat release rate of the specimen

(a) millivolt signal change recorded during test
(b) millivolt signal converted to heat release rate curve

Dimensions in millimetres



Key

1 heat-flux meter fitting closely in 25 mm diameter hole (such as for measurement at 300 mm)

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Figure 11 – Calibration board for incident heat flux gradient calibration

APPENDIX 3

INTERPRETATION OF RESULTS

Evaluating unusual test specimen behaviour (see paragraph 2.2 of this part)

	Unusual behaviour	Guidance on classification
1	Flashing, no steady flame	Report furthest progress of flame and time, and whether or not flash is on centreline. Classify on basis of the data.
2	Explosive spalling, no flashing or flame	Accept material as passing test.
3	Rapid flash over surface, later steady flame progress	Report result for both flame fronts but classify on basis of worst performance for each of the four test parameters in the two burning regimes.
4	Specimen or veneer melts and drips off, no flame	Report behaviour and extent of advance on specimen.
5	Explosive spalling, and flame on exposed part of specimen	Report explosions and classify on basis of flame progress irrespective of whether above or below centreline.
6	Specimen or veneer melts, burns, and drips off	Reject material regardless of criteria. For floor covering, no more than 10 burning drops are acceptable.
7	Pilot flame extinguished	Report occurrence, reject data and repeat test.
8	Specimen breaks up, and falls out of holder	Report behaviour, but classify on basis of worst performance with and without specimen restraint in paragraph 8.3.2 of appendix 1 to this part.
9	Substantial jetting combustible pyrolysis gases from specimen, adhesive or bonding agents	Report that it is not classified as low flame-spread.
10	Small flame remaining along the edge of specimen	Report behaviour and terminate the test 3 min after flaming on exposed surface of specimen ceased.

APPENDIX 4

GUIDELINES FOR THE SPECIMEN OF THE FTP CODE, PARTS 2 AND 5, AND THE TYPE APPROVAL OF THOSE PRODUCTS (RANGE OF APPROVAL AND RESTRICTION IN USE)

1 SCOPE

This appendix provides recommended guidelines for the selection and preparation of the specimen for surface materials for parts 2 and 5 of this Code, including the selection of substrates or backing materials. This appendix also provides the guidelines for the conditions of type approval for such surface materials.

2 BASIC PRINCIPLES FOR SELECTION OF THE TEST SPECIMEN

2.1 Basic principle

The test specimen to be used for the test shall be selected as representative of the characteristics of the product in actual operating conditions in ships. It means that the product which would be expected to have the worst result should be selected. Specimen selection should be concerned with thickness, colour, organic content, substrate of the product, and its combination of a product.

2.2 Specimen thickness

Materials and composites of normal thickness 50 mm or less should be tested using their full thickness, attaching them, by means of an adhesive if appropriate, to the substrate. For materials and composites of normal thickness greater than 50 mm, the required specimens should be obtained by cutting away the unexposed face to reduce the thickness to between 47 mm and 50 mm (part 5, appendix 1, paragraph 7.2.2).

2.3 Substrate

Substrate of surface material and floor coverings: Materials and composites materials should be tested using their full thickness, attaching them to the substrate to which they will be attached in practice when using an adhesive, if appropriate. The test specimen should reflect actual application on ships (part 5, appendix 1, paragraph 7.3.1).

2.4 Composites

Assembly should be as specified in paragraph 7.2 (Dimensions) of appendix 1. However, where thin materials or composites are used in the fabrication of an assembly, the presence of an air gap and/or the nature of any underlying construction may significantly affect the flammability characteristics of the exposed surface. The influence of the underlying layers should be recognized and care taken to ensure that the test result obtained on any assembly is relevant to its use in practice (part 5, appendix 1, paragraph 7.4.1).

2.5 Test for floor covering

2.5.1 Where a floor covering is required to be low flame-spread, all layers shall comply with part 5. If the floor covering has a multilayer construction, the Administration may require the tests to be conducted for each layer or for combinations of some layers of the floor coverings. Each separate layer, or a combination of layers (i.e. the test and approval are applicable only to this combination) of the floor covering shall comply with this part (part 5, paragraph 4.2.3).

2.5.2 Therefore, multilayered floor coverings, such that each layer complies with part 5 (criteria for floor covering), is accepted; or a test of composite condition may be done. This makes it possible to interchange the layers as long as each material used complies with part 5.

2.6 Colour variation and organic contents of the specimen

Usually the influence of the colour and organic content of the specimen have a significant effect on the result of a fire test. The organic content of the specimen is a key factor of the combustion characteristic of the product. The specimen should be selected to have the maximum organic content within the product variation. The colour of the specimen is also a key of it, because the dark colour of specimen that absorbs the radiant heat would extensively affect its flammability. Therefore the test results of the dark colour specimen and the bright colour specimen would be different. In general, at least, the maximum organic content and the dark colour specimen within the product variation should be selected if the product has colour variation.

2.7 Exemption of the test in accordance with part 2

Surface materials and primary deck coverings with both the total heat release (*Qt*) of not more than 0.2 MJ and the peak heat release rate (*Qp*) of not more than 1.0 kW (both values determined in accordance with part 5 of annex 1) are considered to comply with the requirements of part 2 without further testing (see paragraph 2.2 of annex 2).

3 RANGE OF TYPE APPROVAL OF SURFACE MATERIALS

3.1 According to the basic principles for selection of the test specimen described in paragraph 2, the range of type approval would be considered according to its specimen selection including its substrate or backing material.

3.2 Table 1 shows the relationships of the specimen substrate and the range of type approval of surface materials.

Table 1 – Specimen substrate and the type approval of surface materials (Range of approval and restriction in use)

In the following table:

First column: product to be tested.
Second column: substrate.
Third column: range of approval and restriction in use.

Products	Test substrate	Limitation of product application for ships
Paints and surface veneer	Steel (e.g., 1 mm)	1 Products can be applied to any metallic base of similar or thicker substrates (metallic bases such as Steel, Stainless steel or Aluminium alloy). 2 It is not approved to apply to non-metallic non-combustible materials. 3 Limitation, as appropriate, to ensure that the product is covered by the test specimen (such as thickness, adhesive, organic content, density, range of colours). 4 When the products would be applied to the floor covering or primary deck covering that have been approved, no limitation of the base materials would be required.
	Standard calcium silicate board, described as a dummy specimen, specified in paragraph 3.5 of appendix 1	1 Products can be applied to any non-combustible substrate. 2 Limitation, as appropriate, to ensure that the product is covered by the test specimen (such as thickness, adhesive, organic content, density, range of colours).
Surface veneer	No substrate used at the test (The product has enough thickness for testing without substrate)	1 Products may be applied to any metallic base and non-combustible base, if the product would not need any adhesive or combustible material layer. 2 Limitation, as appropriate, to ensure that the product is covered by the test specimen (such as thickness, density, material composition, adhesive and application rate, and range of colours). 3 When the products are to be applied to bulkheads or ceilings by using adhesive, a combination test with adhesive should be required.
Floor covering and primary deck coverings	Thick steel (3 mm)	1 Limitation by the specimen colour and organic contents that was tested. 2 May be applied over any low flame-spread floor covering, steel, or non-combustible material.
	Combination test (combination of layers)	1 Limitation, as appropriate, to ensure that the product is covered by the test specimen (such as thickness, density, material composition, adhesive and application rate, and range of colours). 2 The approval of the products may only apply to this combination. (If the floor covering has a multilayer construction, the Administration may require the tests to be conducted for each layer or for combinations of some layers of the floor coverings.)

4 PREPARATION OF TEST SPECIMEN FOR PARTS 2 AND 5

According to the relationships of the specimen substrate and the range of type approval of surface materials described in paragraph 3, the choice of specimen including substrate should be considered carefully. This section specifies how to make the test specimen for parts 2 and 5 of this Code.

4.1 Test specimen

The test specimen shall be selected as representative of the product. It means that the product which would be expected to have the worst result should be selected.

4.2 Application in ships

The specimen should be tested using the thickness specified in paragraph 2.2. The substrate should be selected taking into consideration the substrates to which they will be attached in ships.

4.3 Exposed surface at the test

Each different exposed surface of the product should be tested (part 5, appendix 1, paragraph 7.1.2). This means each side of the product that may be exposed; it does not refer to colour.

4.4 Specimen size

4.4.1 For part 5: width 150 mm to 155 mm, length 795 mm to 800 mm (part 5, appendix 1, paragraph 7.2.1).

4.4.2 For part 2: width 75 ± 1 mm, length 75 ± 1 mm (part 2, appendix 1, paragraph 4.2.1).

4.5 Specimen thickness

4.5.1 The specimens should be tested using their full thickness (part 5, appendix 1, paragraph 7.2.2).

4.5.2 For part 5: maximum 50 mm (part 5, appendix 1, paragraph 7.2.2).

4.5.3 For part 2: maximum 25 mm (part 2, appendix 1, paragraph 4.2.3).

4.5.4 If the product thickness is greater than in paragraphs 4.5.2 and 4.5.3 above, the specimens should be obtained by cutting away the unexposed face to reduce to the above maximum thickness.

4.6 Colour variation of the paints or surface materials

If the product has some colour variation, the specimen should be carefully selected as representative of the product, in accordance with the following.

4.6.1 ***Organic content***

Carefully select the product with the maximum organic content when applied by maximum thickness shown in paragraph 4.5 above, considered the maximum organic content of the product, when the product would be applied by this maximum thickness.

4.6.2 ***Colour of the specimen***

Black or a dark colour should be selected.

4.6.3 ***Order of priority regarding specimen colour and organic content***

When the product of the darkest colour is different from the product with the maximum organic content, the Administration or the testing laboratory may decide on the specimen. If the amount of organic content between a black or dark specimen and a white or brightly-coloured specimen are similar (difference is within 5%), the black or dark specimen should be chosen. Otherwise, the specimen with the maximum organic content should be selected.

4.6.4 ***Information on colour variation and its organic content***

Applicants or manufacturers who request the type approval should submit information on the colour variation and its organic content to the Administration or testing laboratories. The Administration or testing laboratories may order/advise the applicant on the selection of the test specimens where necessary.

4.6.5 ***Attention regarding the type approval issued***

When approving, if the specimen tested can be considered as a representative specimen (i.e. dark in colour with maximum organic content), all the colour variations of the product may also be approved. If the particular condition of the product was tested, type approval is only available to the same or a similar conditioned product as tested.

4.7 Substrate

The substrate of the specimen should be selected as they are attached in actual ships. The test with metallic substrate is thought to be different from the test with non-combustible substrate (part 5, paragraph 1.3 and part 5, appendix 1, paragraph 7.3).

4.8 Thickness of the substrate

The minimum thickness of the substrate that would be used in actual application should be selected as the test specimen, because the product should be approved for application to a similar or higher thickness of the substrate that was tested provided that the substrate has a density of 400 kg/m^3 or greater (part 5, paragraph 1.3 and part 5, appendix 1, paragraph 7.3).

4.9 Substrate of floor coverings

4.9.1 Primary deck coverings and floor coverings should be applied to a steel plate thickness of 3 ± 0.3 mm.

4.9.2 Primary deck coverings, classified as not readily ignitable in accordance with part 5 of annex 1, are considered to comply with the requirements for floor coverings (annex 2, paragraph 5.2).

4.10 Composite materials (for bulkheads and ceilings)

4.10.1 Assembly should be as specified in paragraph 7.2 of appendix 1 to part 5 (Dimensions). However, where thin materials or composites are used in the fabrication of an assembly, the presence of an air gap and/or the nature of any underlying construction may

significantly affect the flammability characteristics of the exposed surface. The influence of the underlying layers should be recognized and care taken to ensure that the test result obtained on any assembly is relevant to its use in practice.

4.10.2 When the product that has a multilayer construction would be applied to bulkheads and ceilings, the surface flammability test of the combination of each layer should be required to confirm the influence of these underlying constructions (part 5, appendix 1, paragraph 7.4.1).

4.11 Test of adhesives described in part 3 of annex 1 to this Code

The calcium silicate board described as a dummy specimen, specified in paragraph 3.5 of appendix 1 to part 5, should be used as a standard substrate for adhesives.

PART 6 – (BLANK)*

* This part was intentionally left blank. Part 6 of the previous FTP Code, adopted by resolution MSC.61(67), has been incorporated into part 5 of this Code.

PART 7 – TEST FOR VERTICALLY SUPPORTED TEXTILES AND FILMS

1 APPLICATION

Where draperies, curtains and other supported textile materials are required to have qualities of resistance to the propagation of flame, not inferior to those of wool of mass 0.8 kg/m^2, they shall comply with this part.

2 FIRE TEST PROCEDURES

The vertically supported textiles and films shall be tested and evaluated in accordance with the fire test procedure specified in appendix 1 of this part.

3 PERFORMANCE CRITERIA FOR CURTAINS AND DRAPES

3.1 Products which show any of the following characteristics obtained by the fire test in appendix 1, shall be considered unsuitable for use as curtains, draperies, or free-hanging fabric product for use in rooms containing furniture and furnishings of restricted fire risk as defined in the relevant regulations of chapter II-2 of the Convention:

.1 an after-flame time greater than 5 s for any of the 10 or more specimens tested with a surface application of the pilot flame (see also paragraph 3.2 below);

.2 burn through, as determined by appendix 2, to any edge of any of the 10 or more specimens tested with a surface application of the pilot flame (see also paragraph 3.2 below);

.3 ignition of cotton wool below the specimen in any of the 10 or more specimens tested (see also paragraph 3.2 below);

.4 an average char length, as determined by appendix 2, in excess of 150 mm observed in any of the batches of five specimens tested by either surface or edge ignition; and

.5 the occurrence of a surface flash propagating more than 100 mm from the point of ignition with or without charring of the base fabric (see also paragraph 3.2 below).

3.2 If, following analysis of the experimental data from tests of a fabric, it is found that either or both of the batches of five specimens cut in both warp and weft directions fail to meet one or more of the criteria specified in subparagraphs .1 to .3 and .5 above because of poor performance of only one of the five specimens tested, one complete retest of a similar batch is permitted. Failure of the second batch to meet any of the criteria shall provide the basis for rejection of the fabric for use.

4 ADDITIONAL REQUIREMENTS

The tests shall be made by using specimens of the final product (e.g., with colour treatment). In cases where only the colours change, a new test is not necessary. However, in cases where the basis product or the treatment procedure change, a new test is required.

5 TEST REPORT

The test report shall include the information contained in paragraph 7 of appendix 1 to this part.

APPENDIX 1

FIRE TEST PROCEDURES FOR DETERMINING THE RESISTANCE TO FLAME OF VERTICALLY SUPPORTED TEXTILES AND FILMS

WARNING – HEALTH AND SAFETY OF TEST OPERATORS

Burning of textiles may produce smoke and toxic gases which can affect the health of operators. The testing area shall be cleared of smoke and fumes by suitable means of forced ventilation after each test, then restored to the required testing conditions.

1 SCOPE

This appendix specifies a fire test procedure for qualifying textiles and films used primarily as vertically hanging curtains and draperies, as meeting the requirements for the resistance to propagation of flame specified in the relevant regulations of chapter II-2 of the Convention. Fabrics, which are not inherently flame resistant, shall be exposed to cleaning or exposure procedures and tested both before and after such treatment.

2 DEFINITIONS

2.1 *After-flame time* is the time during which the material continues to flame after the ignition source has been removed or extinguished.

2.2 *Sustained ignition* means the case where after-flame time is 5 s or more.

2.3 *Afterglow* means persistence of glowing of a material after cessation of flaming or after the ignition source has been removed.

2.4 *Surface flash* means a rapid flash of a flame across the surface of the fabric primarily involving the surface pile finish and often leaving the base fabric in an essentially undamaged condition.

3 PURPOSE

The test method provides information on the ability of a fabric to resist sustained ignition and flame propagation when exposed to a small igniting flame. The performance of a fabric in this test does not necessarily indicate its resistance to flame propagation when exposed to conditions substantially different from those used in the test.

4 TEST APPARATUS

4.1 Gas burner

A gas burner shall be provided as illustrated in figure 1. This shall be so mounted that the axis of the burner barrel is capable of adjustment to each of three fixed positions, *viz*., vertically upwards, horizontal or at an angle of 60° to the horizontal. The positions assumed by the burner with respect to the fabric are illustrated in figure 2. Figures 3 and 4 show the burner supporting plate which keeps the burner in such positions.

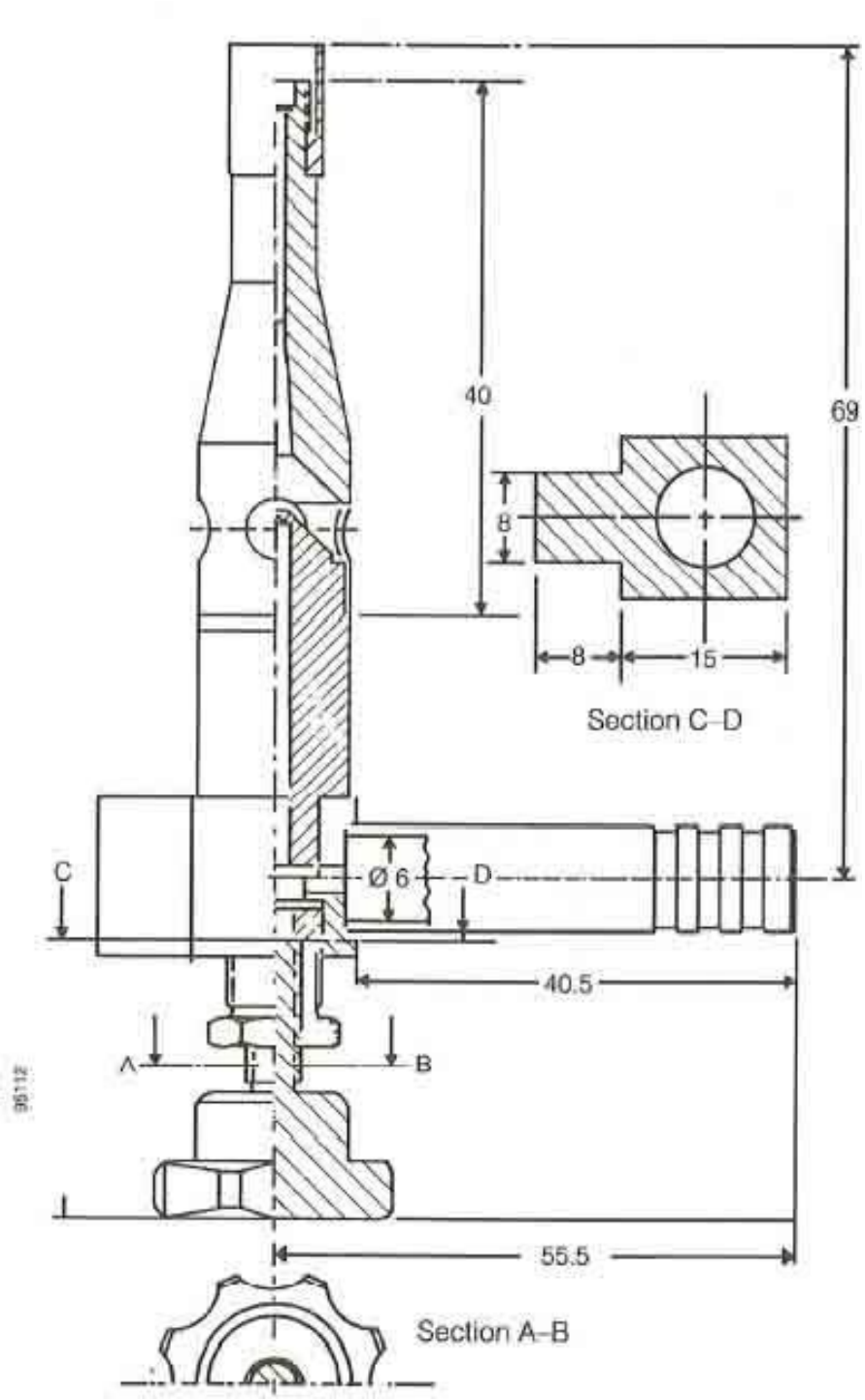


Figure 1 – **Ignition burner**
(according to Deutsche Industrie – Norm (DIN)50 051 type KBN)

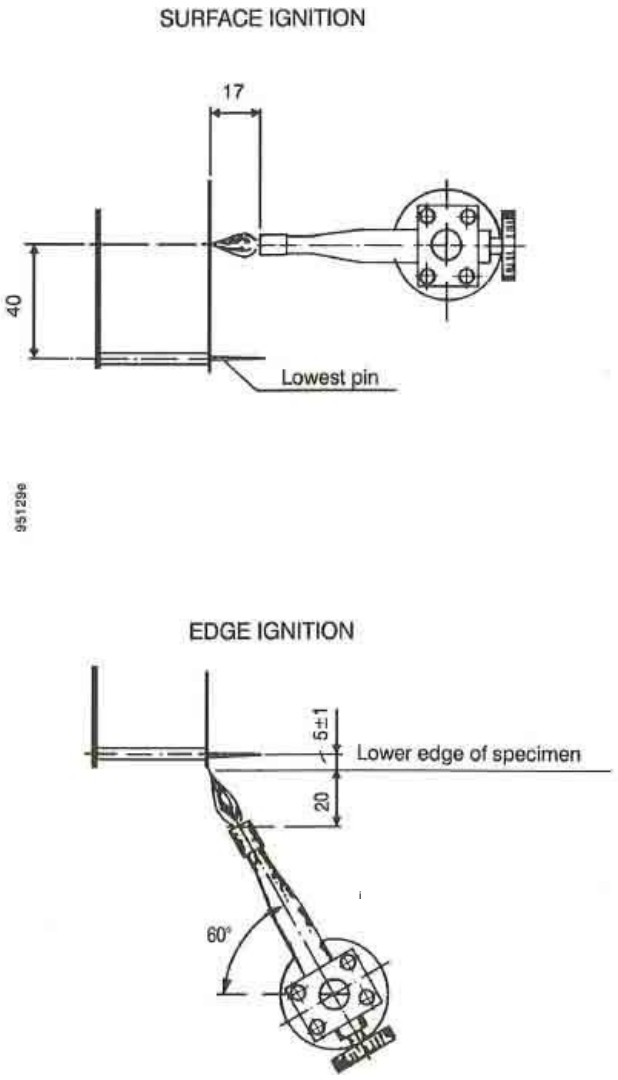


Figure 2 – Ignition burner: fabric positions

4.2 Fuel gas

Commercial grade propane of at least 95% purity shall be used.

4.3 Specimen holder

A rectangular test frame, 200 ± 1 mm long x 150 ± 1 mm wide shall be provided, constructed of stainless steel, 10 mm wide by 2 mm thick. Mounting pins incorporating distance stubs constructed of stainless steel 2 ± 1 mm diameter shall be fixed at each corner of the test frame and at the centre of both long members. Figures 3 and 4 illustrate the specimen holder.

4.4 Base support

The specimen holder shall be supported over a rigid metal base by means of two vertical uprights to which the specimen holder is attached. The metal base also provides a support for pivoting the burner pedestal to move the burner flame into contact with or away from the specimen. Figures 3 and 4 illustrate the base support and the pedestal.

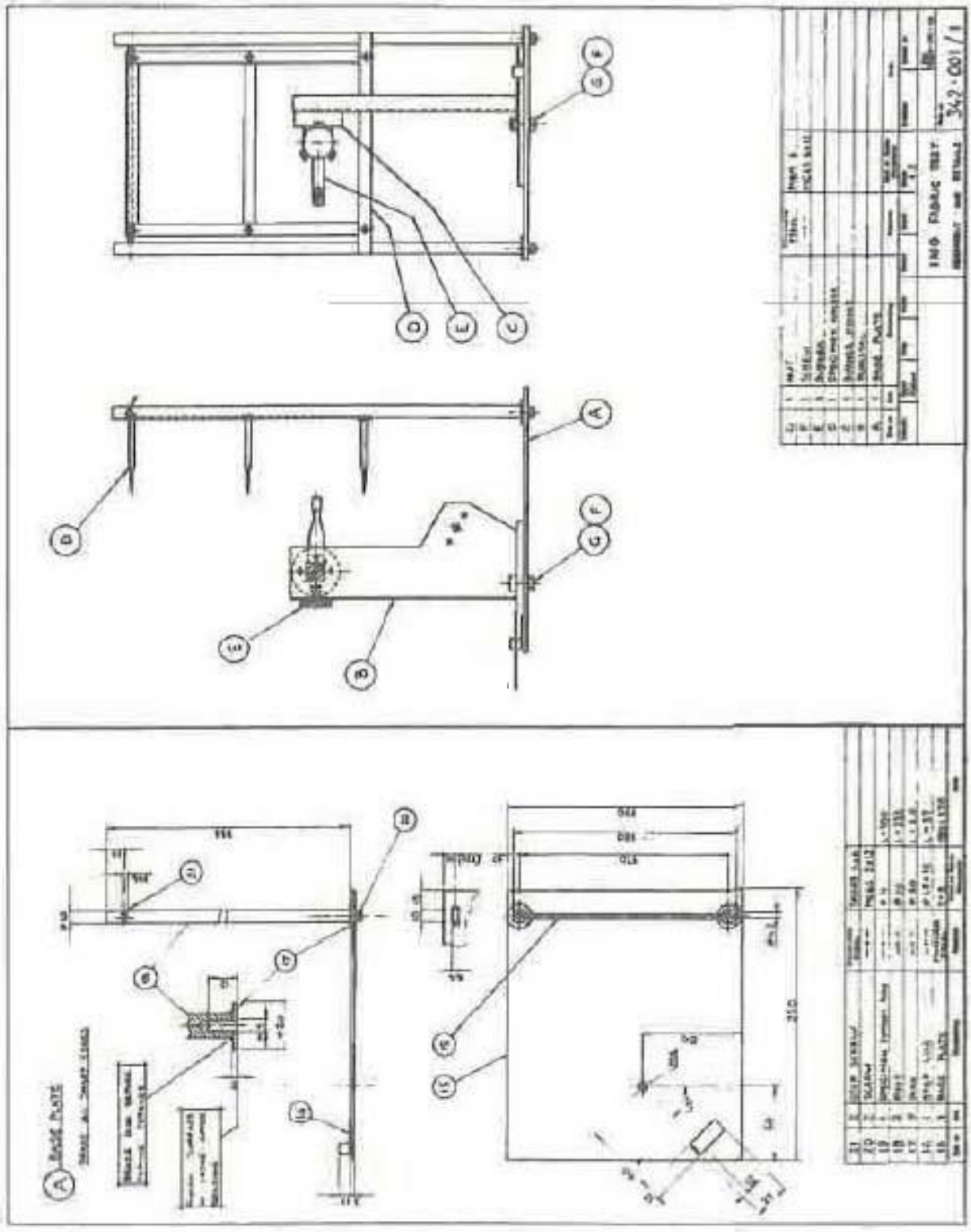


Figure 3 – Fabric test: assembly and details

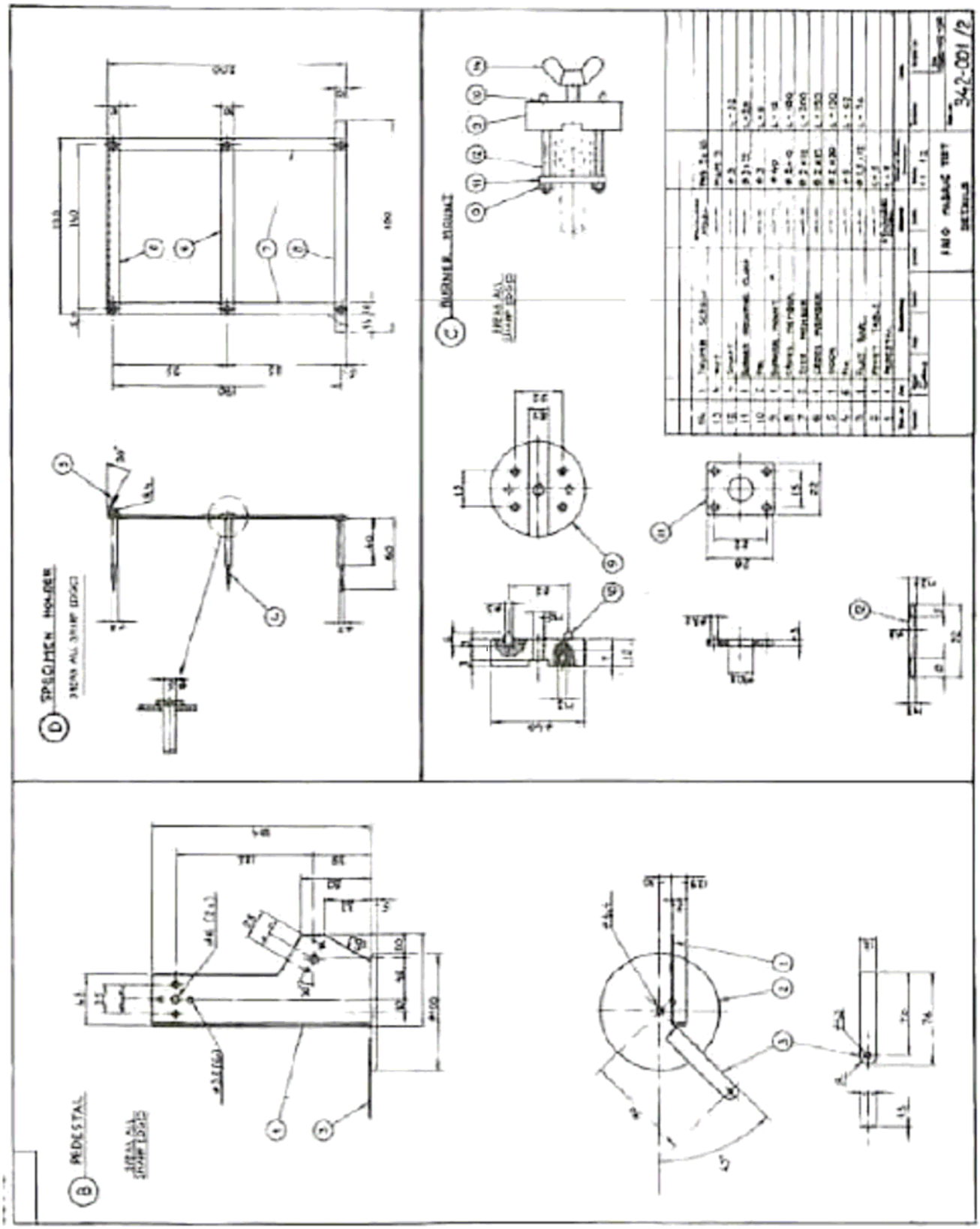


Figure 4 – Fabric test: details

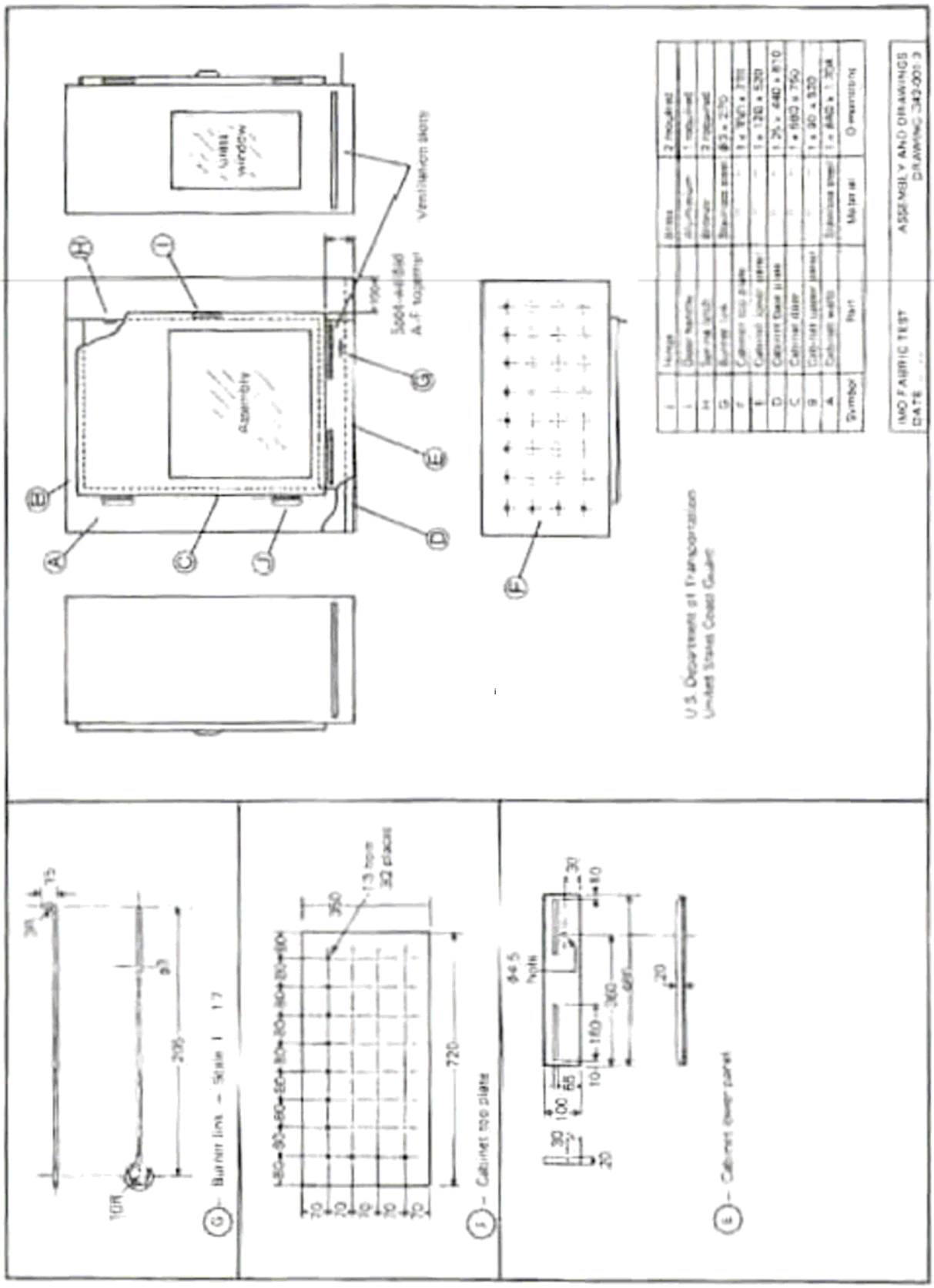


Figure 5 – Fabric test: test enclosure

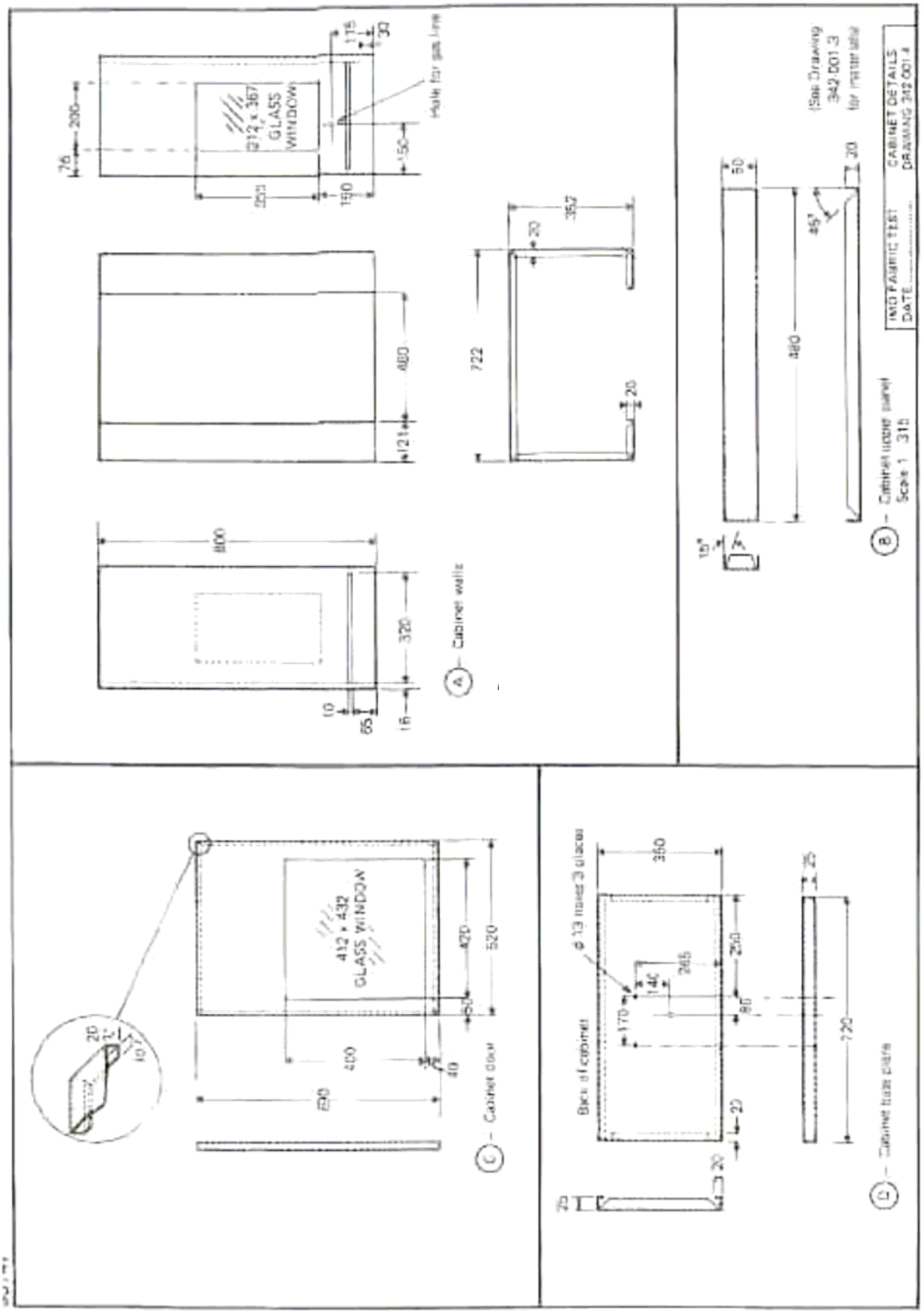


Figure 6 – Fabric test: test enclosure

4.5 Test enclosure

A 0.5 mm to 1 mm thick sheet metal draught-shielding enclosure shall be provided, measuring roughly 700 ± 25 mm wide x 325 ± 25 mm deep x 750 ± 25 mm high. The roof shall be provided with 32 circular holes, each 13 ± 1 mm in diameter, symmetrically drilled, and baffled vent openings shall be provided at the base of each side giving at least 32 cm^2 of free vent area, symmetrically distributed. One 700 mm x 325 mm face shall be constructed to accommodate a closure door mainly of glass, and one smaller side shall also be constructed as a vision panel. A hole shall also be provided for the gas feed tube and remotely-controlled burner positioning rod. The floor of the enclosure shall be covered with a non-combustible insulating material. The interior shall be painted black. Figures 5 and 6 illustrate the test enclosure.

5 TEST SPECIMENS

5.1 Preparation

The specimens shall be as representative as possible of the material provided and shall exclude selvages. At least 10 specimens shall be cut, each measuring 220 mm x 170 mm, five in the direction of the warp, five in the direction of the weft. Where the fabric has differing surfaces on the two sides enough samples shall be cut for both surfaces to be tested. Using a template 220 mm x 170 mm, with holes approximately of 5 mm diameter located on the template at the position of the pins on the frame, each specimen shall be laid flat on a bench and premarked/punctured, to ensure a repeatable and reproducible tension of the specimen, after mounting on the frame.

5.2 Conditioning and exposure procedures

The specimens shall be conditioned at 20 ± 5°C and 65 ± 5% relative humidity for not less than 24 h before test. If the material is not inherently flameproof, one of the exposure procedures detailed in appendix 3 may, at the discretion of the approving authority, be applied to at least 10 further specimens.

5.3 Mounting

Each specimen shall be removed from the conditioning atmosphere and either tested within 3 min or placed in a sealed container until required. The fabric shall be mounted on the pins of the test frame in the locations previously marked on each fabric (see paragraph 5.1). The location of the fabric on the pins shall be such that it is roughly centred in the width direction and the lower edge of the fabric extends 5 ± 1 mm below the lower pin.

6 TEST PROCEDURE

6.1 Presetting of the igniting flame

The gas burner shall be ignited and preheated for at least 2 min. The fuel supply shall then be adjusted so that, when the burner is in the vertical position, the distance between the tip of the burner tube and the visible tip of the flame is 40 ± 2 mm. If desired a gas flow meter may be used as a means of achieving reproducibility in adjusting the burner flame length.

6.2 Determining the mode of flame application for a given fabric

6.2.1 The angle of the burner shall be adjusted to the horizontal position and the height fixed so that the flame, when the burner is in position, will impinge on the fabric at a central

point, 40 mm above the level of the first row of pins. The door to the enclosure shall then be closed and the burner moved into a position such that the burner tip is 17 mm from the face of the specimen.

6.2.2 The flame shall be applied for 5 s and then removed. If no sustained ignition occurs a new specimen shall be fixed to the holder and the flame applied as before but in this case for 15 s. Failure to achieve sustained ignition at the longer duration requires the position of the burner to be adjusted to a position such that the tip of the burner lies 20 mm below the bottom edge of the fabric, the flame impinging on it.

6.2.3 The flame shall be applied in this position to a new specimen for 5 s and if no sustained ignition occurs another specimen shall be inserted and the time of flame application shall be extended to l5 s.

6.2.4 The ignition condition to be used for testing the specimens shall be that at which sustained ignition is first achieved when the order of tests listed above is followed. In the absence of sustained ignition the specimens shall be tested under conditions showing the greatest char length. The method of flame application for warp and weft specimens shall be determined using the ignition sequence given above.

6.3 Flame test

Using the burner position and flame application time found to be appropriate for the specimens under test, a further five specimens cut in both warp and weft directions shall be tested as described in paragraph 6.2 and the after-flame times noted. Any evidence of surface flash shall be noted. If afterglow is observed to occur during a test, the specimen shall be allowed to remain in place until all glowing has ceased. The extent of char is also measured. Where doubt exists as to the precise limit of damaged fabric, the procedure detailed in appendix 2 shall be followed.

6.4 Flaming drops

To investigate if burning drops of thermoplastic materials are capable of igniting combustible materials on the base of the apparatus, cotton wool as specified in part 3, appendix 1, paragraph 7.9, shall be laid to a depth of 10 mm over the base plate, immediately below the specimen holder. Note shall be made of any ignition or glowing of the cotton wool.

7 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with part 7 of the 2010 FTP Code (see subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the material, i.e. curtain, drape, etc.;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including, as applicable:

.1 mass per unit area;

.2 thickness;

.3 colour and tone: if the product has a pattern, the representative colour shall be described;

.4 quantity and number of any coating;

.5 method and quantity of fire retardant treatment;

.6 materials of the product such as wool, nylon, polyester, etc., and its composite ratio;

.7 composition of weave: such as plain, weave, twilled;

.8 density (number/inch): the number of threads per inch in both warp and weft; and

.9 yarn number count;

.11 description of the specimen including mass per unit area, thickness and dimensions, colour, orientations tested and face subject to the test;

.12 date of sample arrival;

.13 details of specimen conditioning including type of cleaning and weathering procedures used and information of the detergent used;

.14 date of test;

.15 test results:

.1 mode of flame application used;

.2 duration of flame application;

.3 after-flame time;

.4 length of char;

.5 ignition of cotton wool from drops; and

.6 occurrence of surface flash and its propagation length;

.16 observations made during the test;

.17 determination whether the tested material meets the performance criteria in paragraph 3 of this part; and

.18 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

APPENDIX 2

MEASUREMENT OF LENGTH OF CHAR OR MATERIAL DESTRUCTION

1 APPARATUS

A hook and weight assembly shall be used to determine the length of char or destruction of the specimen. The combined mass of the assembly shall be as indicated in table 1.

Table 1 – Mass to tear charred fabric

Mass of fabric being tested (g/m^2)	Total mass used to tear fabric (g)
smaller than 200	100
200 – 600	200
greater than 600	400

2 METHOD

After all flaming and afterglow on the specimen have ceased, the length of char or material destruction shall be determined immediately. The length of char in this test is defined as the distance from the end of the specimen which was exposed to the flame to the end of a tear made lengthwise in the specimen through the centre of the charred area in the following manner:

.1 the edge of the highest or greatest char penetration of the sample shall be inspected to determine if as a result of thermoplastic behaviour a thickening of the edge has developed as a result of the test. If this has occurred a cut shall be made, after cooling, only sufficiently deep to cut through the highest portion of this thickened edge of the charred specimen;

.2 the specimen shall be folded parallel to its length and lightly creased through the maximum visible portion of the charred length;

.3 the hook shall be inserted in the specimen, on one side of the charred area, 8 mm in from the adjacent outside edge and 8 mm up from the bottom; and

.4 the specimen shall then be grasped with the fingers on the opposite side of the charred area, and raised gently until it supports the weight. The specimen will tear through the charred area until fabric strong enough to carry the load is reached.

APPENDIX 3

CLEANING AND WEATHERING PROCEDURES

1 GENERAL CONSIDERATIONS

It is assumed that any fabric intended for marine use will either have been subjected to a permanent fire-retardant treatment or have been made from inherently flame-resistant materials. This appendix describes procedures intended to permit verification of this assumption.

2 APPLICATION

2.1 These procedures should be applied to fabrics.

2.2 Each fabric should be subjected to only those exposure procedures which are applicable to its intended use. It should meet the flame-resistance requirements of paragraph 5 after passing through the appropriate exposure cycles.

2.3 Accelerated exposure tests described in this appendix should provide sufficient testing to permit a reasonable appraisal of the durability of the treatment (under the conditions for which it was designed) for the useful life of the fabric.

3 ACCELERATED DRY-CLEANING

3.1 The treated fabric should be dry-cleaned in a coin-operated dry-cleaning apparatus as part of a load made up with dummy pieces of dry-cleanable fabrics. The effective liquor ratio should be 1:10 or 10 kg of liquid per kilogram of fabric.

3.2 The coin-operated apparatus with perchloroethylene solvent (about 1% charge system involving an emulsifying agent and water) should run for the full 10- to 15-minute cycle which includes tumble-drying. At the end of each dry-cleaning cycle, remove the load from the unit and separate the pieces.

3.3 The above dry-cleaning should be repeated until 10 full cycles of cleaning and drying have been completed.

3.4 Test specimens should then be cut from the dry-cleaned fabric for testing.

4 ACCELERATED LAUNDERING

4.1 A specimen of the treated fabric should be washed in an automatic commercial washing machine using the commercial detergent, or the preparation of the test specimen should be carried out according with the instructions/recommended method given by the manufacturer.

4.2 The operating cycle outlined in table 1 should be followed.

4.3 The specimen should then be dried in a tumble dryer at a temperature of 80°C.

4.4 The above procedure should be repeated until 10 full cycles of washing and drying have been completed. If the material is to be subjected to a special use, more laundering may be required.

4.5 Where instructions for laundering a fabric are supplied by the manufacturer or finisher, those instructions should be followed in preference to the above procedure which simulates a typical commercial laundering practice.

Table 1 – Operating cycle for accelerated laundering (1)

Operation	Time (min)	Temperature (°C)
1 Sudsing	6	55
2 Sudsing	6	70
3 Sudsing	6	70
4 Bleaching	8	70
5 Rinsing	2	70
6 Rinsing	2	70
7 Rinsing	2	70
8 Rinsing	2	55
9 Blueing	3	40
10 Hydroextraction	3	40

(1) This cycle is intended for white fabrics. For coloured fabrics, the bleaching and blueing operations are omitted and the temperature of the "sudsing" and "rinsing" operations is reduced by 17°C.

5 ACCELERATED WATER LEACHING

5.1 A sample of the treated fabric should be totally submerged in a vessel containing tap water at room temperature for a period of 72 h. The vessel should be capable of use with a liquor ratio of 1:20.

5.2 The water should be drained from the tank and replenished at 24-hour intervals during the immersion period.

5.3 At the conclusion of the immersion period, the sample should be removed from the test vessel and dried in a tumble dryer or oven at a temperature of about 70°C.

6 ACCELERATED WEATHERING

Either a suitable accelerated weathering procedure using a xenon lamp or one of the following described procedures may be called for by the responsible Administration.

6.2 Alternative procedure No.1

6.2.1 Apparatus:

.1 the apparatus should consist of a vertical metal cylinder fitted with a vertical carbon arc at its centre and having a specimen holder mounted within;

.2 the diameter of the cylinder should be such that the distance to the face of the specimen holder from the centre of the carbon arc is 375 mm;

.3 the cylinder should be arranged to rotate about the arc at a rate of approximately one revolution per minute;

.4 a water spray should be provided within the cylinder and fitted with means to regulate the amount of water discharged;

.5 the vertical carbon arc should be either 13 mm diameter solid electrode type, if operating on direct current, or a single-cored electrode, if operating on alternating current. The electrodes should be of uniform composition; and

.6 the arc should be surrounded by a clear globe of quartz glass, 1.6 mm thick, or other enclosure having equivalent absorbing and transmitting properties.

6.2.2 Operation of the test equipment:

.1 the specimens for test should be mounted on the inside of the cylinder facing the arc;

.2 the cylinder should rotate at approximately one revolution per minute for the duration of the test;

.3 the water spray should discharge about 0.0026 m^3/min on to the specimens for about 18 min during each 120-minute period;

.4 the arc should operate on 13 A direct current or 17 A, 60 Hz alternating current, with voltage at the arc of 140 V;

.5 the electrodes should be renewed at intervals sufficiently frequent to ensure full operative conditions of the lamp; and

.6 the globe should be cleaned when the electrodes are removed or at least once in each 36 h of operation.

6.2.3 Test cycle:

.1 specimens should be subjected to this exposure for 360 h;

.2 specimens should then be allowed to dry thoroughly at a temperature of between 20°C and 40°C; and

.3 after drying, the specimens should proceed through the flame test.

6.3 Alternative procedure No.2

6.3.1 Apparatus:

.1 the apparatus should consist of a vertical carbon arc mounted at the centre of a vertical cylinder;

.2 a rotating rack should be mounted on the inside of the cylinder such that the distance from the face of the specimen to the centre of the arc is 475 mm;

.3 the arc should be designed to accommodate two pairs of carbon electrodes No.22 upper electrodes and No.13 lower electrodes. However, the arc should burn between only one pair of electrodes at a time;

.4 no filters or enclosures should be used between the arcs and the specimens; and

.5 spray nozzles should be mounted in the cylinder so that the specimens should be exposed to wetting for about 18 min during each 120-minute period.

6.3.2 Operation of test equipment:

.1 the specimens for test should be mounted on the rotating rack, facing the arc;

.2 the rack should rotate about the arc at a uniform speed of about one revolution per minute;

.3 the arc should operate on 60 A and 50 V across the arc for alternating current or 50 A and 60 V across the arc for direct current; and

.4 water-spray nozzles should discharge about 0.0026 m^3/min on to the specimens for about 18 min during each 120-minute period.

6.3.3 Test cycle:

.1 specimens should be subjected to this exposure for 100 h;

.2 they should then be allowed to dry thoroughly at a temperature of between 20°C and 40°C; and

.3 after drying, the specimens should proceed through the flame test.

PART 8 – TEST FOR UPHOLSTERED FURNITURE

1 APPLICATION

Where upholstered furniture is required to have qualities of resistance to the ignition and propagation of flame, the upholstered furniture shall comply with this part.

2 FIRE TEST PROCEDURES

The upholstered furniture shall be tested and evaluated in accordance with the fire test procedure specified in appendix 1 to this part.

3 PERFORMANCE CRITERIA

3.1 Smouldering cigarette test

3.1.1 Two smouldering cigarette tests are required, as specified in paragraph 7.2 of appendix 1.

3.1.2 If progressive smouldering or flaming is not observed within a one-hour period, or if the cigarette fails to smoulder its complete length, record a pass result for the smouldering cigarette test unless the test piece fails the final examination, as specified in paragraph 7.4 of appendix 1.

3.2 Flame ignition source test

3.2.1 Two propane flame ignition tests are required, as specified in paragraph 7.3 of appendix 1.

3.2.2 If flaming or progressive smouldering is not observed in this test, record a pass result for the propane flame ignition source test unless the test piece fails the final examination, as specified in paragraph 7.4 of appendix 1.

4 ADDITIONAL REQUIREMENTS

The tests shall be made by using specimens of the final product (e.g., with colour treatment). In cases where only the colours change, a new test is not necessary, however, in cases where the basis product or the treatment procedure changes, a new test is required.

5 TEST REPORT

The test report shall include the information contained in paragraph 8 of appendix 1.

APPENDIX 1

FIRE TEST PROCEDURES FOR THE IGNITABILITY BY SMOKERS' MATERIALS OF UPHOLSTERED COMPOSITES FOR SEATING

WARNING – HEALTH AND SAFETY OF OPERATORS

General

There is a considerable risk with these tests and precautions must be taken.

Enclosure

For safety, the tests shall be conducted in a suitable fume cupboard. If such a cupboard is not available, an enclosure shall be constructed so that the tester is not exposed to the fumes (see paragraph 7.1.1).

Extinguishers

Accessible means of extinguishing the samples shall be provided, for example a bucket of water, a fire blanket, or fire extinguisher.

1 SCOPE

This test procedure prescribes methods for assessing the ignitability of material combinations, e.g., covers and filling used in upholstered seating when subjected to either a smouldering cigarette or a lighted match as might be applied accidentally in the use of upholstered seats. It does not cover ignition caused by deliberate acts of vandalism.

2 DEFINITION

For the purposes of this test procedure, the following definition applies.

Progressive smouldering means an exothermic oxidation not accompanied by flaming which is self-propagating, i.e. independent of the ignition source. It may or may not be accompanied by incandescence.

Note: In practice it has been found that there is usually a clear distinction between materials which may char under the influence of the ignition source but which do not propagate further (non-progressive) and those where smouldering develops in extent and spreads (progressive).

3 PRINCIPLE

The principle is to subject an assembly of upholstery materials arranged to represent, in stylized form, the joint between the seat and back (or seat and arm) surfaces of a chair to two sources of ignition, one being a smouldering cigarette, and the other a flaming source approximating to the calorific output of a burning match.

4 APPARATUS

4.1 Test rig

4.1.1 A suitable test rig is illustrated in figures 1 and 2. It shall consist of two rectangular frames hinged together and capable of being locked at right angles to each other.

The frames shall be made from nominal 25 mm x 3 mm steel flat bar and shall securely hold expanded steel platforms set 6 ± 1 mm below the top edge of the frames.

Note: The size of the mesh of the expanded steel is not critical, but a mesh size across the diagonals of approximately 28 mm x 6 mm has been found to be suitable.

4.1.2 The internal width and height of the back frame shall be 450 ± 2 mm x 300 ± 2 mm and the width and depth of the base frame 450 ± 2 mm x 150 ± 2 mm. A standard edging section may be used around the expanded steel to give protection and greater rigidity.

4.1.3 The sides of the frame shall extend beyond the back of each frame to provide for the hinge holes and to form the back legs. The hinge rod shall be of nominal 10 mm diameter steel, continuous across the back of the rig, and its axis 22.5 ± 0.5 mm beyond the back member of each frame.

4.1.4 The frames shall be lockable at right angles by a bolt or pin through each of the pairs of members forming the back legs. The front legs may be welded across the front corners of the base frame. The height of the legs shall be such as to leave a gap not less than 50 mm high between the base frame and the supporting surface.

4.1.5 For the tests, the rig shall be sited within the enclosure (see paragraph 7.1.1) and the testing shall be performed in a substantially draught-free environment permitting an adequate supply of air.

4.2 Smouldering cigarette source

4.2.1 An untipped cigarette, complying with the following requirements, is needed:

length	70 ± 4 mm
diameter	8 ± 0.5 mm
mass	0.95 ± 0.15 g
smouldering rate	11 ± 4.0 min/50 mm

4.2.2 The smouldering rate shall be verified, as follows, on one sample from each batch of 10 cigarettes used. Mark the cigarette, conditioned as described in paragraph 5.1, at 5 mm and 55 mm from the end to be lit. Light it as described in paragraph 7.2.1 and impale it horizontally in draught-free air on a horizontal wire spike inserted not more than 13 mm into the unlit end. Record the time taken to smoulder from the 5 mm mark to the 55 mm mark.

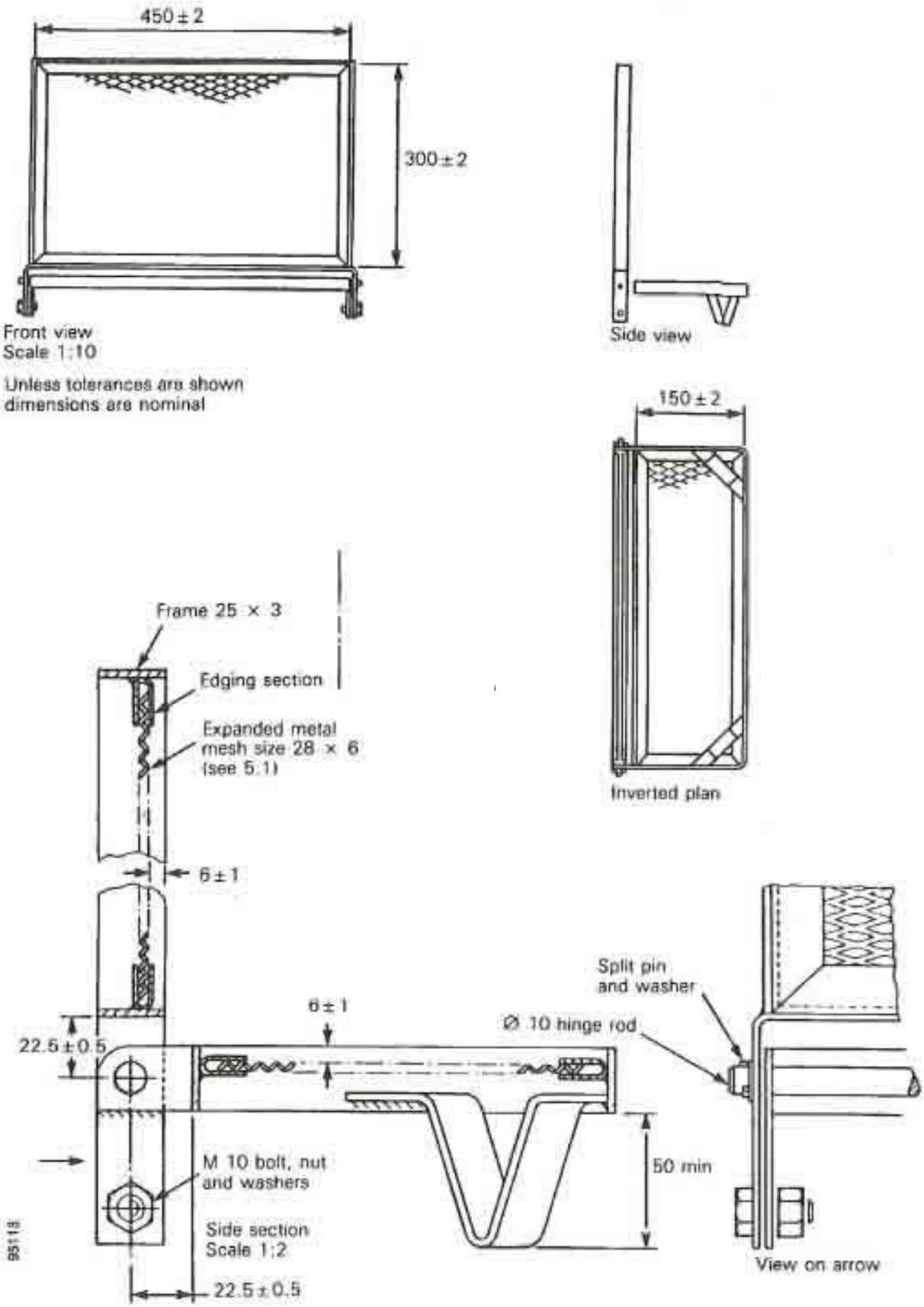


Figure 1 – **Test rig**
(All dimensions are in millimetres. All parts are of steel.)

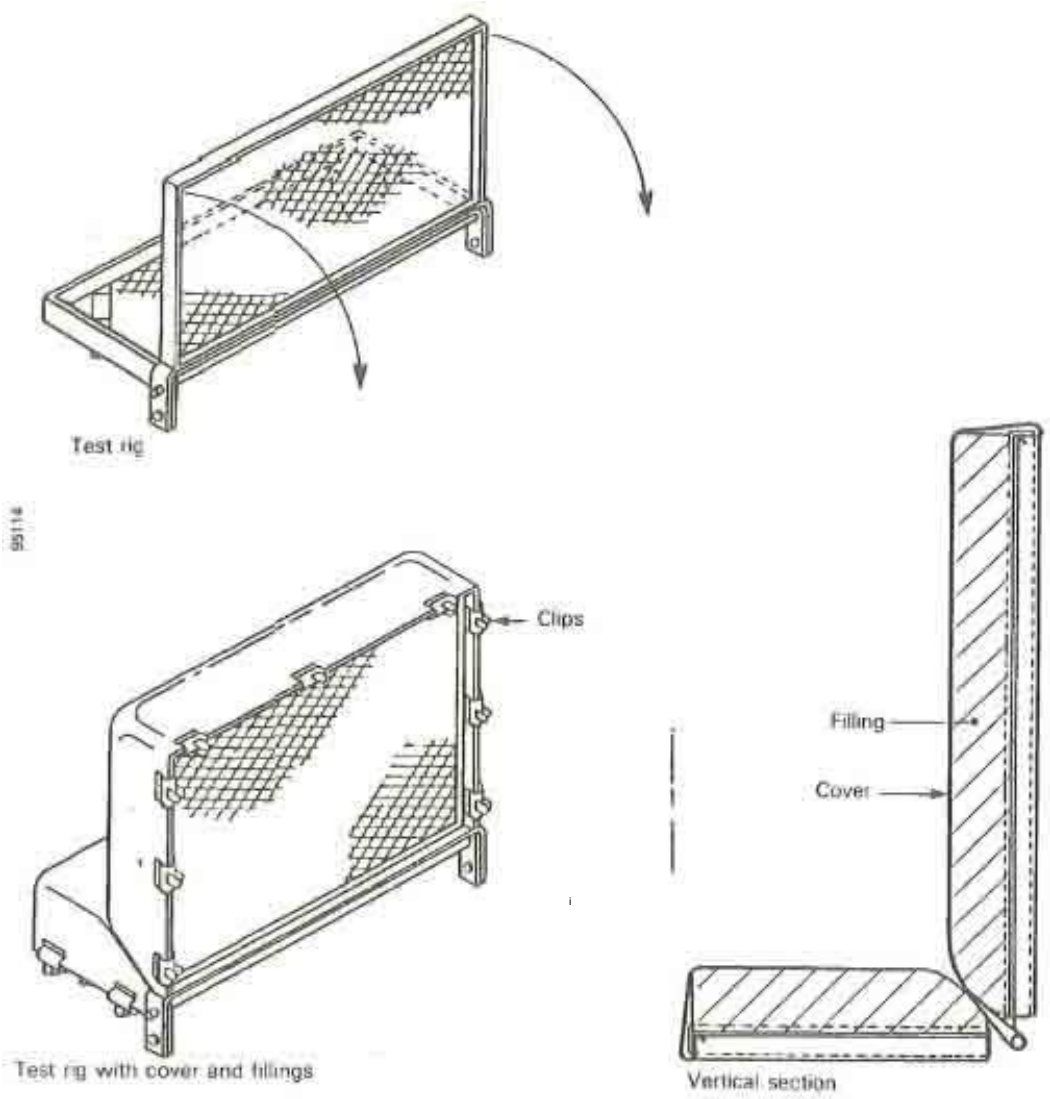


Figure 2 – Test rig assembly

4.3 Propane flame ignition source

Note: This source has been designed to give a calorific output approximating to that of a burning match.

The burner is a tube of stainless steel with internal diameter 6.5 ± 0.1 mm, outside diameter 8 ± 0.1 mm and length 200 ± 5 mm. The fuel shall be propane gas of 95% purity. Fuel supply rate: 6.38 ± 0.25 g/hour at 20°C.

5 ATMOSPHERE FOR CONDITIONING AND TESTING

5.1 Conditioning

The materials to be tested and the cigarettes shall be conditioned immediately before the test for 72 h in indoor ambient conditions and then for at least 16 h in an atmosphere having a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%.

5.2 Testing

For testing, a substantially draught-free environment, having a temperature of 20 ± 5°C and a relative humidity of 20% to 70%, shall be used.

6 TEST PIECES

6.1 General

The test piece materials shall be representative of the cover, filling and any other components to be used in the final assembly.

6.2 Cover material and fabric interliner

6.2.1 The cover size needed for each test is 800 ± 10 mm x 650 ± 10 mm. The long dimension shall be cut parallel to the selvage. The cover may be constructed from smaller pieces of material provided that the resulting seams are not located within 100 mm of the area likely to be affected by the test.

6.2.2 The cover shall have triangular cut-outs of 325 mm from one end on both sides. The cut-outs shall be so positioned that when assembled on the test rig the lie of any pile is down the back assembly and from the hinge to the front of the base frame. The size of these cut-outs shall be approximately 50 mm base and 110 mm high.

6.2.3 Where a fabric interliner is used, it shall be cut to the same dimensions and in the same orientation as the cover for fitting to the test rig under the cover.

6.3 Upholstery filling

6.3.1 Two pieces, one 450 ± 5 mm x 300 ± 5 mm x 75 ± 2 mm thick, and the other 450 ± 5 mm x 150 ± 5 mm x 75 ± 2 mm thick are required for each test.

6.3.2 Some cushioning assemblies may consist of several layers that may be typically felt, wadding or different foams. In these cases the test pieces shall reproduce the upper 75 mm of the cushioning assembly.

6.3.3 Where the filling is less than 75 mm thick, the test piece shall be built up to the required thickness by adding to the underside a further layer of the bottom material.

7 TEST PROCEDURE

7.1 Preparation

7.1.1 All tests shall be carried out in a suitably-constructed fume enclosure, and ensure that the means of extinguishment are close at hand (see Warning section).

7.1.2 Open out the test rig and thread the covering fabric and, if any, the fabric interliner behind the hinge bar.

7.1.3 Place the filling pieces under the covering fabric and, if any, the fabric interliner locating the filling pieces in the frame recesses, and allowing approximately 20 mm of fabric to wrap round the inside of the frames.

7.1.4 Lock the frames at right angles using the bolts or pins ensuring that the filling components are not displaced.

7.1.5 Fasten the fabric over the top, bottom and sides of the frame using clips and ensure that the fabric or fabrics are secured and under even tension.

7.2 Smouldering cigarette test

7.2.1 Light a cigarette (see paragraph 4.2) and draw air through it until the tip glows brightly. Not more than 8 mm of the cigarette shall be consumed in this operation.

7.2.2 Place the smouldering cigarette in position along the junction between the vertical and horizontal test pieces, allowing at least 50 mm from the nearest side edge, or from any marks left by any previous test to the cigarette, and simultaneously start the clock.

7.2.3 Observe the progress of combustion, and record any evidence of progressive smouldering (see paragraph 2) or flaming in the interior and/or cover.

Note: The detection of smouldering may be difficult and is made easier if a watch is kept for smoke emerging at points at a distance from the cigarette. Smoke is most easily viewed by looking down a rising column by means of a mirror.

7.2.4 If progressive smouldering or flaming of the upholstery components is observed at any time within 1 h of the placement of the cigarette, extinguish the test piece and record a fail result for the smouldering cigarette test.

7.2.5 If progressive smouldering or flaming is not observed within the one-hour period, or if the cigarette fails to smoulder its complete length, repeat the test with a new cigarette placed in a fresh position not less than 50 mm from any previous test damage. If progressive smouldering or flaming is not observed in this retest, or if the cigarette fails to smoulder its complete length, record a pass result for the smouldering cigarette test unless the test piece fails the final examination specified in paragraph 7.4. Otherwise, extinguish the test piece and record a fail result.

Note: This repeat test may run concurrently with the first test.

7.3 Propane flame test

7.3.1 Light the propane emerging from the burner tube, adjust the gas flow to the appropriate rate (see paragraph 4.3) and allow the flame to stabilize for at least 2 min.

7.3.2 Position the burner tube axially along the junction between the seat and back so that the flame is not less than 50 mm from the nearest side edge, or from any marks left by any previous test, and simultaneously start the clock.

7.3.3 Allow the gas to burn for a period of 20 ± 1 s, and then terminate by carefully removing the burner tube from the test pieces.

7.3.4 Observe for flaming or progressive smouldering (see paragraph 2) in the interior and/or cover. Disregard flames, afterglow, smoking or smouldering that cease within 120 s of the removal of the burner tube.

7.3.5 If flaming or progressive smouldering of the upholstery components is observed, extinguish the test piece. Record a fail result for the propane flame ignition source test.

7.3.6 If flaming or progressive smouldering is not observed, repeat the test at a fresh position, as described in paragraph 7.3.2. If flaming or progressive smouldering is not observed in this retest, record a pass result for the propane flame ignition source test unless the test piece fails the final examination specified in paragraph 7.4. Otherwise extinguish the test piece and record a fail result.

7.4 Final examination

Cases of progressive smouldering undetected from the outside have been reported. Immediately after completion of the test programme on the assembly, dismantle and examine it internally for progressive smouldering. If this is present, extinguish the test piece and record a fail result for the relevant test source. For safety reasons, ensure that all smouldering has ceased before the rig is left unattended.

8 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with part 8 of the 2010 FTP Code (see also subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the furniture, e.g., seat, sofa, office chair, etc;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including, as applicable:

.1 fabric:

.1 material: materials such as wool, nylon, polyester, etc., and its composite ratio;

.2 composition of weave: such as plain, weave, twilled;

.3 density (number/inch): the number of threads per inch in both warp and weft;

.4 yarn number count;

.5 thickness of the fabric in mm;

.6 mass: weigh per unit area (g/mm^2);

.7 colour and tone: if the product has a pattern, the representative colour shall be described; and

.8 fire retardant treatment;

.2 fillings:

.1 material (name of the manufacturer, type designation);

.2 density: weight per unit volume (kg/m^3) and for products where thickness is difficult to measure exactly square density (g/m^2); and

.3 fire retardant treatment, if any;

.11 description of the specimen including dimensions and mass of the fabric and the fillings, colour, orientation of the fabric;

.12 date of sample arrival;

.13 details of specimen conditioning including type of cleaning and weathering procedures used and information of the detergent used, if applicable;

.14 date of test;

.15 test results including:

.1 dimensions and mass of cigarette used;

.2 smouldering rate of the cigarette used;

.3 extent of damage (burning and/or char) of specimen measured from the ignition source; and

.4 occurrence of progressive smouldering;

.16 observations made during the test;

.17 determination whether the tested material meets the performance criteria in paragraph 3 of this part; and

.18 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

APPENDIX 2

GUIDANCE NOTES

1 This test procedure prescribes methods for examining the ignitability, in defined circumstances, of an assembly of upholstery materials. These materials are combined together in a way intended to be generally representative of their end use in upholstered seating, and the ignition sources are a smouldering cigarette and a flame representing a burning match.

1.1 Thus, the potential ignitability of a particular cover, filling and interliner in combination can be assessed and this will allow the development of specifications concerned with ignition by smokers' materials. However, there are two important limitations, as follows:

.1 the tests are concerned only with ignitability, and any controls of fire hazard have to consider, in addition, other aspects of fire performance such as rate of fire development, heat output, rate and quantity of smoke production and toxic gas evolution. Ideally, any attempts to reduce ignitability ought not to affect these other properties adversely; and

.2 the tests only measure the ignitability of a combination of materials used in upholstered seating and not of a particular finished item of furniture incorporating these materials. They give an indication of, but cannot guarantee, the ignition behaviour of the finished item of furniture. This limitation occurs because design features of the furniture can greatly affect its fire properties; any ignitability tests of a piece of furniture would therefore need to be carried out on the actual item and not on component materials or mock-ups. However, limited information on ignitability more specifically related to an intended design may be obtained, as indicated in paragraphs 2 and 3.

2 This test procedure prescribes laboratory tests for an assembly of materials which will give general guidance on the ignitability of finished furniture. Where more specific information is required, or in critical areas of end use, the principles may be applied to complete items or components of furniture or to suitably modified test assemblies, some examples of which are given below. In such cases the sources of ignition described in paragraphs 4.2 and 4.3 of appendix 1 may be applied at positions which, as a general rule, correspond to those where the hazard of ignition occurs in use.

Example 1: If a chair were to have a gap between the seat and back cushions, the placement of ignition sources in the angle of the test apparatus would be inappropriate. Instead, face ignition, where the sources are placed at the centre of the horizontal and vertical surfaces, would be more meaningful.

Example 2: The test apparatus may be used to model the junction of any vertical and horizontal surfaces so that both arm and back constructions, if different, may be tested separately in conjunction with the seat.

Example 3: The use of different materials in a back and seat of a chair may be reproduced in the test, two different cover fabrics being joined by sewing or staples behind the hinge bar.

Example 4: If, in the final design, a loose cushion is to be placed on an upholstered seat platform, additional cigarette traps are produced between the loose cushion and the surrounding upholstery. This may be examined by constructing a loose cushion of the appropriate materials measuring 500 ± 5 mm x 75 ± 2 mm to be placed on top of the horizontal surface of the normally assembled test arrangement.

3 Another way in which this test principle might be used is to give information about individual materials to be used in a combination. For example, the ability of a cover material to provide protection against ignition can be indicated by testing it in combination with a substrate of known flammability; standard non-flame-retardant flexible polyether foam with a density of about 22 kg/m^3 has been found to be suitable. Such information about the individual materials does not eliminate the need to test the actual combination, but it can help in the short-listing of material combinations and so reduce the overall amount of testing required.

APPENDIX 3

GUIDE FOR INDEPENDENT TEST FOR COVER AND FILLING MATERIALS

SEPARATE OPTIONAL TESTS FOR EACH MATERIAL (COVER MATERIAL AND FILLING MATERIAL)

1 Independent test for cover material (check the ability of the cover material)

1.1 The cover material should be tested on non-flame-retardant filling material. If tested on other flame-retardant filling materials, the cover will be approved for use on that specific filling material only.

1.2 Before carrying out the independent test for cover material, the filling material used for this test should be checked and confirmed whether it would be non-flame-retardant material, which would not satisfy the criteria of this standard. This would be confirmed by the independent test for the filling material described in paragraph 2 below.

2 Independent test for the filling material (check the ability of the filling material)

The test for the filling material should be done without the cover material. If the material satisfies the criteria of this standard, it would be considered that such material would have sufficient performance as a filling material for "upholstered furniture", and it would also be considered that such material is not suitable as a standard non-flame-retardant filling material for a stand-alone test for cover material, described above.

3 Type approval for "upholstered furniture"

3.1 Type approval for "upholstered furniture" might be applied by the combination of the covering and filling. But if both materials, cover and filling material, could pass the criteria of this standard and have sufficient test reports for each individual material as evidence of the independent test, an additional test for the actual combination would not be required.

3.2 The Administration may specify that they will only recognize one of the options for their approval.

PART 9 – TEST FOR BEDDING COMPONENTS

1 APPLICATION

Where bedding components are required to have qualities of resistance to the ignition and propagation of flame, the bedding components shall comply with this part.

2 FIRE TEST PROCEDURES

The bedding components shall be tested and evaluated in accordance with the fire test procedure specified in the appendix to this part.

3 PERFORMANCE CRITERIA

The bedding component is classified as not readily ignitable if it shows no progressive smouldering ignition as specified in paragraph 10.1 of the appendix or flaming ignition as specified in paragraph 10.2 of the appendix.

4 ADDITIONAL REQUIREMENTS

The tests shall be made by using specimens of the final product (e.g., with colour treatment). In cases where only the colours change, a new test is not necessary. However, in cases where the basic product or the treatment procedure changes, a new test is required.

5 TEST REPORT

The test report shall include the information described in paragraph 11 of the appendix.

APPENDIX

FIRE TEST PROCEDURES FOR IGNITABILITY OF BEDDING COMPONENTS

INTRODUCTION

The test specified in this method deals with a simple presentation of a particular aspect of the potential fire situation typified by smouldering cigarettes and a match equivalent flame exposure to the product. The test alone cannot provide any direct guidance on behaviour or safety in other types of accidents, like exposure to larger sources of flames. A test of this type may, however, be used to make comparisons or to ensure the existence of a certain characteristic considered to have a bearing on fire performance in general. No other significance shall be attached to performance in this test.

SAFETY WARNING

The attention of all users of the test is drawn to the following warning:

> In order that suitable precautions may be taken to safeguard health, the attention of all engaged with fire testing is drawn to the fact that toxic or harmful gases may be released during combustion of test specimens.

1 SCOPE

The method specifies a procedure to determine the ignitability of bedding components with small smouldering and flaming sources of ignition.

2 FIELD OF APPLICATION

2.1 The method is intended for testing bedding components such as blankets, quilts, bedspreads, pillows and mattresses, including thin, light mattresses used on top of other mattresses.

2.2 The following items shall be included in bedding components: bed drapes, duvets, comforters.

2.3 The following items shall not be included in bedding components: sheets, pillow cases, box springs, valances (dust ruffles), and bed curtains.

3 DEFINITIONS

3.1 *Mattress* is a product in the form of a resilient material (for instance, polyurethane foam or light fibre fill) or of padding materials in combination with steel springs (spring mattress), enveloped by a cover.

3.2 *Quilt* and *pillow* are products of padding materials (down/feather or textile fibre) enveloped by a textile fabric.

3.3 *Ticking* is a fabric enveloping the resilient material in a mattress.

3.4 *Ignitability* is a measure of the ease with which a material or a product can be ignited so as to flame or progressively smoulder.

3.5 *Ignition source* is a source of energy which is used to ignite combustible materials or products.

3.6 *Flaming* is undergoing combustion in the gaseous phase, usually with emission of light.

3.7 *Smouldering* is an exothermic reaction taking place in a material without flaming, with or without emission of light.

3.8 *Progressive smouldering* is smouldering which continues after the ignition source is extinguished or removed.

4 SAMPLING

The specimens shall be representative of the whole product to be tested. If possible, the specimens shall be taken in such a way that ignition can also be started along seams and their intersections. The top side is exposed. Where there is doubt as to which side is the top side, the test shall be carried out on both sides. Four additional specimens are then needed.

4.1 Mattresses

4.1.1 Sufficient material shall be available for making at least four specimens with dimensions 450 mm x 350 mm in full nominal thickness. The cover shall envelop the mattress completely without wrinkles and shall be secured underneath (for instance, with steel pins).

4.1.2 For testing of mattresses with removable covers, sufficient material shall be available for the making of at least eight specimens, four with and four without the mattress cover, with dimensions 450 mm x 350 mm in full nominal thickness.

4.2 Pillows

Four samples in full size shall be available.

4.3 Other than mattresses and pillows

4.3.1 Four specimens each of size 450 mm x 350 mm shall be cut from each sample.

4.3.2 If the product contains loose filling material, the edges shall be sewn. It is advisable to sew the seams before cutting the specimens in order to avoid loss of filling material.

5 TEST METHOD

5.1 Principle

The test is carried out with the specimen placed in a horizontal position on a test rig. The ignition source is placed on top of the specimen. The determination of the ignitability is carried out using smouldering and flaming ignition sources. A smoulderable insulation of cotton-wool pad on a smouldering cigarette is used as a smouldering ignition source, which is intended to simulate possible smoulderable materials used in bedding. The flaming ignition source is a small propane flame. The ignition of the specimen in progressive smouldering or flaming is observed.

5.2 Apparatus and material

The following equipment and material are necessary for the test:

.1 the test rig for support of the specimen is shown in figure 1. The stand is made of angle iron with nominal dimensions 25 mm x 25 mm x 3 mm. On top of the stand is a platform of wire mesh with openings of nominal dimensions 100 mm x 50 mm;

.2 mineral wool with a nominal density of 60 kg/m^3 and with dimensions 450 mm x 350 mm x 50 mm;

.3 stop clock;

.4 test enclosure, being either a room with a volume greater than 20 m^3 (which contains adequate oxygen for testing), or a smaller enclosure with a through flow of air. Inlet and extraction systems providing air speed of 0.02 m/s to 0.2 m/s in the locality of the rig provide adequate oxygen without disturbing the burning behaviour;

.5 ignition sources: the sequent ignition sources used are a smouldering cigarette covered with a cotton-wool pad and an open flame;

.6 cigarettes: for the tests, cigarettes with the following specifications shall be used:

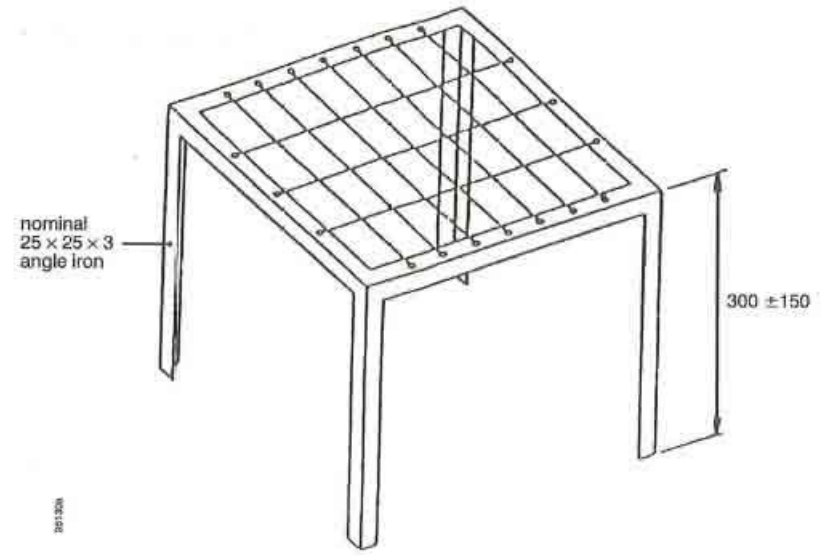
length	70 ± 4 mm
diameter	8 ± 0.5 mm
mass	0.95 ± 0.15 g
smouldering rate	11 ± 4.0 min/50 mm

The smouldering rate shall be verified for every carton of 20 cigarettes as follows:

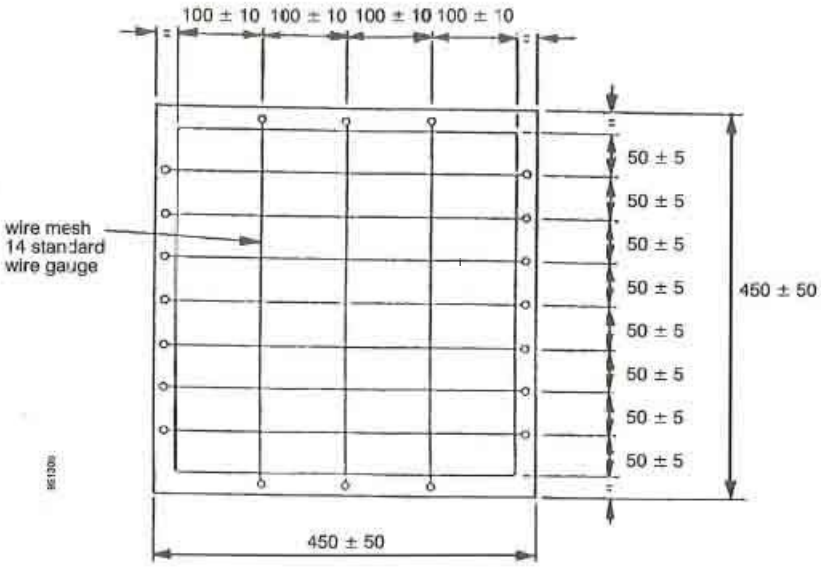
The cigarettes are conditioned as described below under paragraph 7. One cigarette is marked at distances 5 mm and 55 mm from one end. The cigarette is ignited at the end with the 5 mm distance marking, and the air is drawn through the cigarette until a clear glow is observed, but not further than on to the 5 mm marking, thereafter the cigarette is impaled horizontally on a wire spike inserted not more than 13 mm into the unlit end. The time is recorded for the smouldering from the 5 mm to the 55 mm marks;

.7 cotton-wool pad: the cigarette shall be covered with a pad of cotton wool of nominal dimensions 150 mm x 150 mm x 25 mm and of weight 20 ± 6.5 g. The cotton wool shall consist of new, undyed and soft fibres without any admixtures or artificial fibres, and it shall be free from thread, leaf and shell fibre dusts. A suitable material for this purpose is packaged in the form of rolls for surgical use. The piece shall be unwrapped from the roll as a single layer 25 mm to 30 mm thick, cut to plan size, then reduced to the correct mass and thickness by removal of loose fibres from the top; and

.8 flame: the burner is a tube of stainless steel with internal diameter 6.5 ± 0.1 mm, outside diameter 8 ± 0.1 mm and length 200 ± 5 mm. The fuel shall be propane gas of 95% purity. Fuel supply rate: 6.38 ± 0.25 g/hour at 20°C.



(a) Platform showing extended legs



(b) Spacing of wire mesh platform

Figure 1 – Test rig

6 PREPARATION OF SPECIMEN

If the blankets, quilts, pillows, thin light mattresses or removable covers are sold as flame retardant, they shall be tested after three cleaning treatments carried out according to one of the following as determined by the Administration:

.1 instructions given by the manufacturer;

.2 a procedure described in standard ISO 6330; or

.3 the commercial detergent.

7 CONDITIONING

The materials to be tested, the cigarettes used as ignition sources and the insulating cotton-wool pads shall be conditioned immediately before testing for 72 h in indoor ambient conditions and then for at least 16 h in an atmosphere having a temperature of 23 ± 2°C and 50 ± 5% relative humidity.

8 TEST PROCEDURES

The test is carried out indoors, in an environment essentially free of air currents. The room temperature shall be 20 ± 5°C and 20 to 70% relative humidity. The mattress specimen is placed directly on the test rig. The blanket, pillow, quilt or thin, light mattress specimen is placed on the mineral wool which is laid on the test rig. The ignition source is placed on top of the specimen. The time is measured from the moment the ignition source is placed on the specimen. The test duration is 1 h from the moment the ignition source is placed on the specimen.

8.1 Testing with smouldering ignition sources

The cigarette is lighted and air is drawn through the cigarette until it glows brightly. Not less than 5 mm and not more than 8 mm of the cigarette shall be consumed in this operation. The cigarette is placed on the specimen at a distance of at least 100 mm from the nearest edge of the specimen or from marks left by any previous test. The cotton-wool pad is placed centrally on the cigarette, and the clock is started. The progress of combustion is observed and any evidence of progressive smouldering ignition (see paragraph 10.1) or of flaming ignition (see paragraph 10.2) of the specimen is recorded. Two separate tests are carried out with the cigarette covered with the cotton-wool pad. On specimens with stitching, one test is carried out with the cigarette placed along a stitching, and one test is carried out with the cigarette placed on a smooth surface if possible.

8.2 Testing with flame as ignition source

The gas is ignited and the gas flow adjusted to the rate indicated in paragraph 5.2.8. The flow is allowed to stabilize for at least 120 s. The burner is placed horizontally on the specimen at a distance of at least 100 mm from any edge of the specimen and not less than 50 mm from any marks left from previous tests. The specimen shall be exposed to the ignition flame for 20 s. The exposure is terminated by carefully removing the burner from the specimen. The progress of combustion is observed and any evidence of progressive smouldering ignition (see paragraph 10.1) or of flaming ignition (see paragraph 10.2) of the specimen is recorded. Two separate tests are carried out. On specimens with stitching, one test is carried out with the burner placed along a stitching, and one test is carried out with the burner placed on a smooth surface if possible.

9 EXPRESSION OF TEST RESULTS

9.1 All time observations are expressed in minutes and seconds elapsed from the start of the test. The test results include:

.1 the behaviour of the specimen during and immediately after the specified test period;

.2 flames or detectable amounts of smoke, heat or glowing during and immediately after the specified test period; and

.3 damages to the specimen after the test is finished, measured in millimetres.

9.2 The results obtained from each individual test shall be reported separately.

10 CRITERIA FOR IGNITABILITY

10.1 Progressive smouldering

For the purpose of this test method, all the types of behaviour described below in subparagraphs .1 to .5 are considered to be progressive smouldering ignition:

.1 any test specimen that produces externally detectable amounts of smoke, heat or glowing after a period of 1 h following the application of the ignition source;

.2 any test specimen that displays escalating combustion behaviour so that it is unsafe to continue the test and requires forcible extinction;

.3 any test specimen that smoulders until it is essentially consumed within the duration of the test;

.4 any test specimen that smoulders to the extremities of the specimen, *viz*. to either side or to the full thickness of the specimen, within the duration of the test. However, all materials having a thickness of 25 mm or less, such as thin, light mattresses, quilts or blankets are allowed to smoulder to the full thickness of the specimen; and

.5 any test specimen that, on final examination, shows evidence of smouldering other than discoloration more than 25 mm in any horizontal direction from the nearest part of the original position of the edge of the cotton-wool pad and open flame ignition source.

10.2 Flaming ignition

10.2.1 ***Mattresses***

For the purpose of this test method, all the types of behaviour described below in subparagraphs .1 to .5 are considered to be flaming ignition:

.1 the occurrence of any flames initiated by a smouldering ignition source;

.2 any test specimen that continues to flame for more than 150 s after removal of the igniting flame;

.3 any test specimen that displays escalating combustion behaviour, so that it is unsafe to continue the test and requires forcible extinction;

.4 any test specimen that burns until more than 66% consumed within 150 s after removal of the igniting flame; and

.5 any test specimen that burns to the extremities of the specimen, *viz.* to either side or to the full thickness of the specimen, within the duration of the test.

10.2.2 ***Blankets, quilts, pillows and thin, light mattresses***

For the purpose of this test method, all the types of behaviour described below in subparagraphs .1 to .5 are considered to be flaming ignition:

.1 the occurrence of any flames initiated by a smouldering ignition source;

.2 any test specimen that continues to flame for more than 150 s after removal of the igniting flame;

.3 any test specimen that displays escalating combustion behaviour, so that it is unsafe to continue the test and requires forcible extinction;

.4 any test specimen that burns until more than 66% consumed within 150 s after removal of the igniting flame; and

.5 any test specimen that burns to either side of the specimen within the duration of the test.

10.3 Classification

The bedding component is classified as not readily ignitable if it shows no progressive smouldering ignition or flaming ignition as specified in paragraphs 10.1 and 10.2.

11 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with part 9 of the 2010 FTP Code (see also subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the material, i.e. mattress, blankets, quilts, pillows, thin, light mattresses or removable covers, etc.;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including, as applicable:

.1 fabric:

.1 material: materials such as wool, nylon, polyester, etc., and its composite ratio;

.2 composition of weave: such as plain, weave, twilled;

.3 density (number/inch): the number of threads per inch in both warp and weft;

.4 yarn number count;

.5 thickness of the fabric in mm;

.6 mass: weight per unit area (g/mm^2);

.7 colour and tone: if the product has a pattern, the representative colour shall be described; and

.8 fire-retardant treatment;

.2 fillings:

.1 material (name of the manufacturer, type designation);

.2 density: weight per unit volume (kg/m^3) and for products where thickness is difficult to measure exactly, square density (g/m^2); and

.3 fire-retardant treatment, if any;

.11 description of the specimen including dimensions and mass of the fabric and the fillings, colour, orientation of the fabric;

.12 date of sample arrival;

.13 details of specimen conditioning including type of cleaning and weathering procedures used and information of the detergent used, if applicable;

.14 date of test;

.15 test results including:

.1 dimensions and mass of cigarette used;

.2 smouldering rate of the cigarette used;

.3 extent of damage (burning and/or char) of specimen measured from the ignition source;

.4 occurrence of progressive smouldering; and

.5 occurrence of flaming ignition;

.16 observations made during the test;

.17 determination whether the tested material meets the performance criteria in paragraph 3 of this part; and

.18 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

PART 10 – TEST FOR FIRE-RESTRICTING MATERIALS FOR HIGH-SPEED CRAFT

1 APPLICATION

Where materials used in high-speed craft are required to be fire-restricting, they shall comply with this part.

2 FIRE TEST PROCEDURE AND CRITERIA FOR FIRE-RESTRICTING MATERIALS

2.1 General

Surface materials on bulkheads, wall and ceiling linings including their supporting structure, furniture, and other structural or interior components required to be fire-restricting materials by the provisions of the 1994 HSC Code or 2000 HSC Code shall be tested and evaluated in accordance with the fire test procedures specified in appendix 1 to this part.

2.2 Definition of fire-restricting materials

Fire-restricting materials is as defined in the 2000 HSC Code.

2.3 Surface materials on bulkheads, wall and ceiling linings, including their supporting structure

2.3.1 *Test procedures*

Surface materials on bulkheads, wall and ceiling linings, including their supporting structure shall be tested to standard ISO 9705 as described in appendix 1 to this part. Bulkheads, wall and ceiling linings shall be tested in their end-use configuration, including any surface finish materials.

2.3.2 *Criteria*

Surface materials on bulkheads, wall and ceiling linings including their supporting structure are qualified as "fire-restricting material" if, during the testing time of 20 min according to appendix 1 to this part, the following six criteria are met:

.1 the time average of heat release rate (HRR) excluding the HRR from the ignition source does not exceed 100 kW;

.2 the maximum HRR excluding the HRR from the ignition source does not exceed 500 kW averaged over any 30 s period of time during the test;

.3 the time average of the smoke production rate does not exceed 1.4 m^2/s;

.4 the maximum value of the smoke production rate does not exceed 8.3 m^2/s averaged over any period of 60 s during the test;

.5 flame spread shall not reach any further down the walls of the test room than 0.5 m from the floor excluding the area which is within 1.2 m from the corner where the ignition source is located; and

.6 no flaming drops or debris of the test specimen may reach the floor of the test room outside the area which is within 1.2 m from the corner where the ignition source is located.

2.3.3 ***Other usage of the materials qualified as "fire-restricting materials"***

Materials which are qualified as "fire-restricting materials" by paragraph 2.3.2 using the test method described in paragraph 2.3.1 may be used for furniture or other components if the material closely represents the configuration tested as a room lining in its actual end use (i.e. similar thickness and surface finish).

2.4 Materials used for furniture and other components

2.4.1 ***Test procedures***

Materials used for furniture and other components shall be tested as described in appendix 2 to this part (this does not include vertically supported textiles and films, upholstery, or bedding which shall be tested in accordance with parts 7 to 9, respectively, of this annex).

2.4.2 ***Criteria***

Materials used for furniture and other components are qualified as "fire-restricting material" if the following four criteria are fulfilled:

.1 the time to ignition (TIG) is greater than 20 s;

.2 the maximum 30-second sliding average heat release rate (HRR30,max) does not exceed 60 kW/m^2;

.3 the total heat release (THR) does not exceed 20 MJ/m^2;

.4 the time average smoke production rate (SPRavg) does not exceed 0.005 m^2/s.

3 TEST REPORT

The test report shall include the information in paragraph 9 of appendix 1 or paragraph 12 of appendix 2 and designation of the material according to the test criteria specified in paragraph 2 above.

4 REFERENCE DOCUMENTS

ISO 9705, Fire tests – Full-scale room test for surface products.

ISO 5660-1, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 1: Heat release rate (cone calorimeter method).

ISO 5660-2, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 2: Smoke production rate (dynamic measurement).

ISO 14697, Reaction to fire tests – Guidance on the choice of substrates for building and transport products.

APPENDIX 1

FIRE TEST PROCEDURES – FULL-SCALE ROOM TEST FOR SURFACE MATERIALS ON BULKHEADS, WALL AND CEILING LININGS, INCLUDING THEIR SUPPORTING STRUCTURE, OF HIGH-SPEED CRAFT

Reference document: ISO 9705, Fire tests – Full-scale room test for surface products.

1 SCOPE

1.1 This test procedure specifies a test method that simulates a fire that under well-ventilated conditions starts in a corner of a small room with a single open doorway.

1.2 The method is intended to evaluate the contribution to fire growth provided by a surface product using a specified ignition source.

1.3 The method is especially suitable for products that for some reason cannot be tested in a small laboratory scale, for example thermoplastic materials, the effect of an insulating substrate, joints, surfaces with great irregularity.

1.4 The method is not intended to evaluate the fire resistance of a product.

1.5 A test performed in accordance with the method specified in this appendix provides data for the early stages of a fire from ignition up to flashover.

2 NORMATIVE REFERENCE

The following normative documents contain provisions that when referenced in this text, constitute provisions of this paragraph:

ISO 9705, Fire tests – Full-scale room test for surface products.

ISO 13943, Fire safety – Vocabulary.

3 DEFINITIONS

For the purposes of this appendix, the definitions given in standard IS0 13943 and the following definitions apply.

3.1 *Assembly* is a fabrication of materials and/or composites, for example, sandwich panels.

Note: An assembly may include an air gap.

3.2 *Composite* is a combination of materials which are generally recognized in building construction as discrete entities, for example, coated or laminated materials.

3.3 *Exposed surface* is that surface of the product subjected to the heating conditions of the test.

3.4 *Material* is a single substance or uniformly dispersed mixture, for example, metal, stone, timber, concrete, mineral fibre, polymers.

3.5 *Product* is a material, composite or assembly about which information is required.

3.6 *Specimen* is a representative piece of the product which is to be tested together with any substrate or treatment.

Note: The specimen may include an air gap.

3.7 *Surface product* is any part of a building that constitutes an exposed surface on the interior walls and/or the ceiling such as panels, tiles, boards, wallpapers, sprayed or brushed coatings.

4 PRINCIPLE

4.1 The potential for fire spread to other objects in the room, remote from the ignition source, is evaluated by measurements of the total heat flux incident on a heat flux meter located on the centre of the floor.

4.2 The potential for fire spread to objects outside the room of origin is evaluated by the measurement of the total rate of heat release of the fire.

4.3 An indication of the toxic hazard is provided by the measurement of certain toxic gases.

4.4 The hazard of reduced visibility is estimated by the measurement of production of light-obscuring smoke.

4.5 The fire growth is visually graphic and/or video recording.

Note: If further information is required, measurements of the gas temperature in the room and the mass flow in and out the doorway may be performed.

5 TEST APPARATUS

5.1 General

The test apparatus including test room, ignition source, heat flux instrumentation in the fire room, hood and exhaust duct, instrumentation in the exhaust duct, gas sampling and analysis system, optical smoke measurement system and specimen mounting system and other necessary peripherals shall be in accordance with standard ISO 9705. Calibration of the test apparatus shall be conducted in accordance with standard ISO 9705.

5.2 Ignition source

The standard ignition source is according to annex A of standard ISO 9705, i.e. 100 kW heat output for 10 min and thereafter 300 kW heat output for another 10 min. The total testing time shall be 20 min.

5.3 Specimen mounting

Standard specimen configuration is according to annex G to standard ISO 9705, i.e. the product is mounted both on the walls and ceiling of the test room. The product shall be tested complying to end-use conditions, including any surface finish materials or other surface treatments.

6 PREPARATION OF TEST SPECIMENS

6.1 The product to be tested shall, as far as possible, be mounted in the same way as in practical use.

Note: In the standard specimen configuration, three walls and the ceiling are covered with the product. Alternative specimen configurations are given in annex G to standard ISO 9705.

6.2 In cases where the product to be tested is in board form, the normal width, length and thickness of the boards shall be used as far as possible.

6.3 The product shall be attached either to a substrate or directly to the interior of the fire test room. The mounting technique (for example, nailing, gluing, using a support system) shall, as far as possible, conform to that used for the product. The mounting technique shall be clearly stated in the report, particularly if the mounting technique used improves the physical behaviour of the specimen during the test.

6.4 Thin surface materials, thermoplastic products that melt, paints and varnishes shall, depending on their end use, be applied to one of the following substrates:

.1 non-combustible fibre-reinforced silicate board having a dry density of 680 ± 50 kg/m^3;

.2 non-combustible board having a dry density of 1,650 ± 150 kg/m^3;

.3 chipboard (particle board) having a density of 680 ± 50 kg/m^3 after conditioning in an atmosphere of 50 ± 5% relative humidity at a temperature of 23 ± 2°C;

.4 gypsum board having a density of 725 ± 50 kg/m^3 after conditioning in an atmosphere of 50 ± 5% relative humidity at a temperature of 23 ± 2°C; and

.5 the actual substrate if its thermal properties differ significantly from those of substrates described in subparagraphs .1 to .4, for example, steel, mineral wool.

Note: A suitable thickness for substrates described in subparagraphs .1 to .4 is 9 mm to 13 mm.

6.5 Paints and varnishes shall be applied to one of the substrates listed in paragraph 6.4 at the application rate specified by the client.

6.6 Unless non-hygroscopic, specimens shall be conditioned to equilibrium in an atmosphere of 50 ± 5% relative humidity at a temperature of 23 ± 2°C. Equilibrium shall be deemed to be reached when a representative piece of the specimen has achieved constant mass.

Note 1: For wood-based products and products where vaporization of solvents can occur, a conditioning time of at least four weeks can be required.

Note 2: Constant mass is considered to be reached when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0.1% of the mass of the test piece or 0.1 g, whichever is the greater.

7 TESTING

7.1 Initial conditions

7.1.1 The temperature in the fire test room and the surrounding area from the start of the installation of specimens until the start of the test shall be 20 ± 10°C.

Note: The time between the removal of the specimens from conditioning and the start of the test shall be kept to a minimum.

7.1.2 The horizontal wind speed measured at a horizontal distance of 1 m from the centre of the doorway shall not exceed 0.5 m/s.

7.1.3 The burner shall be in contact with the corner wall. The surface area of the burner opening shall be clean.

Note: Marking the product with a grid of 0.3 m x 0.3 m on those surfaces adjacent to the corner where the burner is located can help in determining the extent of flame spread.

7.1.4 The product shall be photographed or video-filmed before testing.

7.2 Procedure

7.2.1 Start all recording and measuring devices and record data for at least 2 min prior to the burner being ignited.

7.2.2 Adjust the burner to the output level given in annex A of standard ISO 9705, within 10 s of ignition of the burner. Continuously adjust the exhaust capacity so that all of the combustion products are collected.

7.2.3 A photographic and/or video recording of the test shall be made. A clock shall appear in all photographic records, giving time to the nearest 1 s.

7.2.4 During the test, record the following observations, including the time when they occur:

.1 ignition of the ceiling;

.2 flame spread on wall and ceiling surfaces;

.3 change of the heat output from the burner; and

.4 flames emerging through the doorway.

7.2.5 End the test if flashover occurs or after 20 min, whichever occurs first.

Note: Safety considerations can dictate an earlier termination.

7.2.6 Note the extent of damage of the product after the test.

7.2.7 Record any other unusual behaviour.

8 ANALYSIS AND CALCULATION OF THE TEST RESULTS

Analysis and calculation shall be conducted in accordance with annex F to standard ISO 9705, and the following methods:

.1 the maximum values of smoke production rate at the start and the end of the test shall be calculated as follows: for the first 30 s of testing, use also the values prior to ignition of the ignition source, i.e. zero rate of smoke production, when calculating average. For the last 30 s of testing, use the measured value at 20 min, assign that to another 30 s up to 20 min and 30 s and calculate the average;

.2 the maximum heat release rate (HRR) shall be calculated at the start and the end of the test using the same principles as for averaging the smoke production rate; and

.3 the time averages of smoke production rate and HRR shall be calculated using actual measured values that are not already averaged as described above.

9 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with appendix 1 of part 10 of the 2010 FTP Code (see also subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the material, i.e. surface material on bulkheads, wall or ceiling linings, and description whether and how it includes supporting structure;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, together with details of the construction of the product;

.11 description of the specimen including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, orientations tested and face subject to the test, and construction;

.12 date of specimen arrival;

.13 details of specimen conditioning;

.14 date of test;

.15 test results (see annex F to standard ISO 9705):

.1 time/heat flux incident on the meter at the centre of the floor;

.2 time/volume flow in the exhaust duct;

.3 time/rate of heat release; and if the burner is included, time/heat release from the burner;

.4 time/production of carbon monoxide at reference temperature and pressure;

.5 time/production of carbon dioxide at reference temperature and pressure;

.6 time/production of light-obscuring smoke at actual duct flow temperature;

.7 description of the fire development (photographs); and

.8 calibration results according to paragraph 10.2 of standard ISO 9705;

.16 classification of the material; and

.17 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

10 OTHER REFERENCES

The following parts of standard ISO 9705 shall also be referred to:

.1 annex A – Recommended ignition sources;

.2 annex B – Alternative ignition sources;

.3 annex C – Instrumentation of test room;

.4 annex D – Design of exhaust system;

.5 annex E – Instrumentation in exhaust duct;

.6 annex F – Calculation;

.7 annex G – Specimen configurations; and

.8 annex H – Bibliography.

APPENDIX 2

FIRE TEST PROCEDURES FOR HEAT RELEASE, SMOKE PRODUCTION AND MASS LOSS RATE FOR MATERIALS USED FOR FURNITURE AND OTHER COMPONENTS OF HIGH-SPEED CRAFT

Reference documents: ISO 5660-1, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 1: Heat release rate (cone calorimeter method); and ISO5660-2, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 2: Smoke production rate (dynamic measurement).

1 SCOPE

This paragraph specifies a method for assessing the heat release rate of a specimen exposed in the horizontal orientation to controlled levels of irradiance with an external igniter. The heat release rate is determined by measurement of the oxygen consumption derived from the oxygen concentration and the flow rate in the combustion product stream. The time to ignition (sustained flaming) is also measured in this test.

2 NORMATIVE REFERENCES

The following normative documents contain provisions that, when referenced in this text, constitute provisions of this appendix.

ISO 291, Plastics – Standard atmospheres for conditioning and testing.

ISO 554, Standard atmospheres for conditioning and/or testing – Specifications.

ISO 5660-1, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 1: Heat release rate (cone calorimeter method).

ISO 5660-2, Reaction-to-fire tests – Heat release, smoke production and mass loss rate – Part 2: Smoke production rate (dynamic measurement).

ISO 13943, Fire safety – Vocabulary.

ISO 14697, Reaction to fire tests – Guidance on the choice of substrates for building and transport products.

3 TERMS AND DEFINITIONS

For the purposes of this appendix, the terms and definitions given in standard ISO 13943 and the following apply.

3.1 *Essentially flat surface* is a surface whose irregularity from a plane does not exceed 1 mm.

3.2 *Flashing* is an existence of flame on or over the surface of the specimen for periods of less than 1 s.

3.3 *Ignition* is an onset of sustained flaming as defined in paragraph 3.10.

3.4 *Irradiance* (at a point on a surface) is a quotient of the radiant flux incident on an infinitesimal element of surface containing the point and the area of that element.

Note: Convective heating is negligible in the horizontal specimen orientation. For this reason, the term "irradiance" is used instead of "heat flux" throughout this part of standard ISO 5660 as it best indicates the essentially radiative mode of heat transfer.

3.5 *Material* is a single substance or uniformly dispersed mixture, such as metal, stone, timber, concrete, mineral fibre and polymers.

3.6 *Orientation* is a plane in which the exposed face of the specimen is located during testing, with either the vertical or horizontal face upwards.

3.7 *Oxygen consumption principle* is proportional to the relation between the mass of oxygen consumed during combustion and the heat released.

3.8 *Product* is a material, composite or assembly about which information is required.

3.9 *Specimen* is a representative piece of the product which is to be tested together with any substrate or treatment.

Note: For certain types of product, for example products that contain an air gap or joints, it may not be possible to prepare specimens that are representative of the end-use conditions (see paragraph 7).

3.10 *Sustained flaming* is the existence of flame on or over the surface of the specimen for periods of over 10 s.

3.11 *Transitory flaming* is the existence of flame on or over the surface of the specimen for periods of between 1 s and 10 s.

4 SYMBOL

See table 1 of standard ISO 5660-1.

5 PRINCIPLE

5.1 This test method is based on the observation that, generally, the net heat of combustion is proportional to the amount of oxygen required for combustion. The relation is that approximately 13.1 x 10^3 kJ of heat are released per kilogram of oxygen consumed. Specimens in the test are burned under ambient air conditions, while being subjected to a predetermined external irradiance within the range of 0 to 100 kW/m^2 and measurements are made of oxygen concentrations and exhaust gas flow rates.

5.2 The test method is used to assess the contribution that the product under test can make to the rate of evolution of heat during its involvement in fire. These properties are determined on small representative specimens.

6 APPARATUS

6.1 The test apparatus, including cone-shaped radiant electrical heater, exhaust gas system with flow measuring instrumentation, gas sampling and analysing system, specimen holder and other necessary peripherals, shall be in accordance with standard ISO 5660-1. Calibration of the test apparatus shall be conducted in accordance with standard ISO 5660-1.

6.2 The test apparatus for measuring smoke production rate shall be in accordance with standard ISO 5660-2.

7 SUITABILITY OF A PRODUCT FOR TESTING

7.1 Surface characteristics

7.1.1 A product having one of the following properties is suitable for testing:

.1 an essentially flat exposed surface;

.2 a surface irregularity which is evenly distributed over the exposed surface provided that:

.1 at least 50% of the surface of a representative 100 mm^2 area lies within a depth of 10 mm from a plane taken across the highest points on the exposed surface, or

.2 for surfaces containing cracks, fissures or holes not exceeding in width nor 10 mm in depth, the total area of such cracks, fissures or holes at the surface does not exceed 30% of a representative 100 mm square area of the exposed surface.

7.1.2 When an exposed surface does not meet the requirements of paragraph 7.1.1.1 or 7.1.1.2, the product shall be tested in a modified form complying as nearly as possible with the requirements given in this paragraph. The test report shall state that the product has been tested in a modified form, and clearly describe the modification.

7.2 Asymmetrical products

A product submitted for this test can have faces which differ, or can contain laminations of different materials arranged in a different order in relation to the two faces. If either of the faces can be exposed in use within a room, cavity or void, then both faces shall be tested.

7.3 Materials of short burning time

For specimens of short burning time (3 min or less), the heat release rate measurements shall be taken at not more than 2 s intervals. For longer burning times, 5 s intervals may be used.

7.4 Composite specimens

Composite specimens are suitable for testing, provided that they are prepared as specified in paragraph 8.3 and are exposed in a manner typical of end-use conditions.

7.5 Dimensionally unstable materials

7.5.1 Samples that intumesce or deform so that they contact the spark plug prior to ignition, or the underside of the cone heater after ignition, shall be tested with the separation of 60 mm between the base plate of the cone heater and the upper surface of the specimen. In this case the heater calibration shall be performed with the heat flux meter positioned 60 mm below the cone heater base plate. It must be stressed that the time to ignition measured with this separation is not comparable to that measured with the separation of 25 mm.

7.5.2 Other dimensionally unstable products, for example products that warp or shrink during testing, shall be restrained against excessive movement. This shall be accomplished with four tie wires, as described below. Metal wires of 1 ± 0.1 mm diameter, and at least 350 mm long, shall be used. The specimen shall be prepared in the standard way as described in

paragraph 8. A tie wire is then looped around the specimen holder and retainer frame assembly, so that it is parallel to and approximately 20 mm away from one of the four sides of the assembly. The ends of the wire are twisted together such that the wire is pulled firmly against the retainer frame. Excess wire is trimmed from the twisted section before testing. The three remaining wires shall be fitted around the specimen holder and retainer frame assembly in a similar manner, parallel to the three remaining sides.

8 SPECIMEN CONSTRUCTION AND PREPARATION

8.1 Specimens

8.1.1 The specimen shall be representative of the end-use conditions of the material, including any surface finishes.

8.1.2 In the case of combustible insulation materials that are protected by metallic skins or identifiable as a separate item, the insulation shall be tested without the surface protection.

8.1.3 A sample edge frame shall be used in all tests. The irradiance level shall be set at 50 kW/m^2 for all three tests. The test shall be terminated when 20 min have elapsed since the start of exposure. Data shall be collected for an additional 2 min after the end of a test to ensure that data are available for the entire test duration after time-shifting to account for delay times of part of the instrumentation.

8.1.4 Three specimens shall be tested at 50 kW/m^2 level of irradiance selected and for each different exposed surface.

8.1.5 The specimens shall be representative of the end-use conditions of the material, including any surface finishes and shall be square with sides measuring 100 ± 2 mm.

8.1.6 Products with a normal thickness of 50 mm or less shall be tested using their full thickness.

8.1.7 For products with a normal thickness greater than 50 mm, the requisite specimens shall be obtained by cutting away the unexposed face to reduce the thickness to 50 mm.

8.1.8 When cutting specimens from products with irregular surfaces, the highest point on the surface shall be arranged to occur at the centre of the specimen.

8.1.9 Assemblies shall be tested as specified in paragraph 8.1.3 or 8.1.4, as appropriate. However, where thin materials or composites are used in the fabrication of an assembly, the nature of any underlying construction can significantly affect the ignition and burning characteristics of the exposed surface.

8.1.10 The influence of the underlying layers shall be understood and care taken to ensure that the test result obtained on any assembly is relevant to its use in practice.

8.1.11 When the product is a material or composite which would normally be attached to a well-defined substrate, it shall be tested in conjunction with that substrate using the recommended fixing technique, for example, bonded with the appropriate adhesive or mechanically fixed. In the absence of a unique or well-defined substrate, an appropriate substrate for testing shall be selected in accordance with standard ISO 14697.

8.1.12 Products that are thinner than 6 mm shall be tested with a substrate representative of end-use conditions, such that the total specimen thickness is 6 mm or more.

8.2 Conditioning of specimens

8.2.1 Before the test, specimens shall be conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5% in accordance with standard ISO 554.

8.2.2 Constant mass is considered to be reached when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0.1% of the mass of the test piece or 0.1 g, whichever is the greater.

8.2.3 Materials such as polyamides, which require more than one week in conditioning to reach equilibrium, may be tested after conditioning in accordance with standard ISO 291. This period shall be not less than one week, and shall be described in the test report.

8.3 Preparation

8.3.1 *Specimen wrapping*

8.3.1.1 A conditioned specimen shall be wrapped in a single layer of aluminium foil, of 0.025 mm to 0.04 mm thickness, with the shiny side towards the specimen. The aluminium foil shall be pre-cut to a size to cover the bottom and sides of the specimen and extend 3 mm or more beyond the upper surface of the specimen. The specimen shall be placed in the middle of the foil and the bottom and sides shall be wrapped. The excess foil above the top surface shall be cut if necessary so that it does not extend more than above the top surface of the specimen. The excess foil at the corners shall be folded around the corners to form a seal around the top surface of the specimen. After wrapping, the wrapped specimen shall be placed in the specimen holder and covered by a retainer frame. No aluminium foil shall be visible after the procedure is completed.

8.3.1.2 For soft specimens, a dummy specimen having the same thickness as the specimen to be tested may be used to pre-shape the aluminium foil.

8.3.2 *Specimen preparation*

All specimens shall be tested with the retainer frame. The following steps shall be taken to prepare a specimen for testing:

.1 put the retainer frame on a flat surface facing downwards;

.2 insert the foil-wrapped specimen into the frame with the exposed surface facing downwards;

.3 put layers of refractory fibre blanket (nominal thickness 13 mm, nominal density 65 kg/m^3) on top until at least one full layer, and not more than two layers, extend above the rim of the frame;

.4 fit the specimen holder into the frame on top of the refractory fibre and press down; and

.5 secure the retainer frame to the specimen holder.

9 TEST ENVIRONMENT

The apparatus shall be located in an essentially draught-free environment in an atmosphere of relative humidity of between 20% and 80% and temperature of between 15°C and 30°C.

10 TEST PROCEDURES

10.1 General precautions

Warning: So that suitable precautions are taken to safeguard health, the attention of all concerned in fire tests is drawn to the possibility that toxic or harmful gases can be evolved during exposure of test specimens.

The test procedures involve high temperatures and combustion processes. Therefore, hazards can exist such as burns or the ignition of extraneous objects or clothing. The operator shall use protective gloves for insertion and removal of test specimens. Neither the cone heater nor the associated fixtures shall be touched while hot, except with the use of protective gloves. Care shall be taken never to touch the spark igniter which carries a substantial potential 10 kV. The exhaust system of the apparatus shall be checked for proper operation before testing and shall discharge into a building exhaust system with adequate capacity. The possibility of the violent ejection of molten hot material or sharp fragments from some kinds of specimens when irradiated cannot totally be discounted and it is therefore essential that eye protection be worn.

10.2 Initial preparation

10.2.1 Check the CO_2 trap and the final moisture trap. Replace the sorbent if necessary. Drain any accumulated water in the cold trap separation chamber. The normal operating temperature of the cold trap shall not exceed 4°C.

If any of the traps or filters in the gas sampling system line have been opened during the check, the gas sampling system shall be checked for leaks (with the sample pump on), e.g., by introducing pure nitrogen, at the same flow rate and pressure as for the sample gases, from a nitrogen source connected as close as possible to the ring sampler. The oxygen analyser shall then read zero.

10.2.2 Adjust the distance between the base plate of the cone heater and the upper surface of the specimen.

10.2.3 Turn on power to the cone heater and the exhaust fan. Power to the gas analysers, weighing device and pressure transducer shall not be turned off on a daily basis.

10.2.4 Set an exhaust flow rate of 0.024 ± 0.002 m^3/s.

10.2.5 Perform the required calibration procedures specified in paragraph 10.2 of standard ISO 5660-1. Put a thermal barrier on top of the weighing device (for example, an empty specimen holder with refractory fibre blanket or water-cooled radiation shield). This is to be in place during warm-up and between tests to avoid excessive heat transmission to the weighing device.

10.3 Procedure

10.3.1 ***Start data collection***

Collection of baseline data: the scanning interval shall be 2 s.

10.3.2 Insert the radiation shield in position. Remove the thermal barrier protecting the weighing device. Place the specimen holder and specimen, prepared according to paragraph 8.3, on the weighing device. The radiation shield shall be cooler than 100°C, immediately prior to the insertion.

10.3.3 Insert the spark plug and remove the radiation shield in the correct sequence according to the type of shield that is used, as described below.

For type a) shields (see standard ISO 5660-1), remove the shield and start the test. Within 1 s of removing the shield, insert and power the igniter.

For type b) shields (see standard ISO 5660-1), remove the shield within 10 s after the insertion and start the test. Within 1 s of removing the shield, insert and power the igniter.

10.3.4 Record the times when flashing or transitory flaming occurs. When sustained flaming occurs, record the time, turn off the spark, and remove the spark igniter. If the flame extinguishes after turning off the spark, re-insert the spark igniter and turn on the spark within 5 s, and do not remove the spark until the entire test is completed. Report these events in the test report (paragraph 12).

10.3.5 Collect all data until:

.1 22 min after the time to sustained flaming (the 22 min consist of a 20-min test period and an additional 2-min post-test period to collect data that will be time-shifted);

.2 20 min have elapsed and the specimen has not ignited;

.3 XO_2 returns to the pre-test value within 100 parts per million of oxygen concentration for 10 min; or

.4 the mass of the specimen becomes zero,

whichever occurs first, but in any case, minimum test duration shall be 5 min. Observe and record physical changes to the sample such as melting, swelling and cracking.

10.3.6 Remove specimen and specimen holder. Put a thermal barrier on top of the weighing device.

10.3.7 Three specimens shall be tested and reported as described in paragraph 12. The 180 s mean heat release readings shall be compared for the three specimens. If any of these mean readings differ by more than 10% from the arithmetic mean of the three readings, then a further set of three specimens shall be tested. In such cases, the arithmetic mean of the set of six readings shall be reported.

Note: The test data have limited validity if the specimen melts sufficiently to overflow the specimen holder, if explosive spalling occurs, or if the specimen swells excessively and touches the spark igniter or the heater base plate.

11 CALCULATION

11.1 Time to ignition, heat release rate and total heat release shall be measured and calculated in accordance with standards ISO 5660-1and ISO 5660-2.

11.2 The time averages of smoke production rate (SPR) and heat release rate (HRR) shall be calculated using actual measured values that are not already averaged.

11.3 The 30-second sliding average heat release rate (HRR30) and smoke production rate (SPR30) shall be calculated as the average value during between 15 s before and 15 s after the time. For the first and last 30 s duration, the follows apply:

.1 for the first 30 s of testing, use also the values prior to ignition of the ignition source, i.e. zero rate of smoke production, when calculating average; and

.2 for the last 30 s of testing, use the measured value at 20 min, assign that to another 30 s up to 20 min and 30 s and calculate the average.

11.4 The maximum of 30-second sliding smoke production rate (SPR30max) and the maximum of 30-second sliding average heat release rate (HRR30max) shall be obtained as the maximum of SPR30 and HRR30 respectively.

12 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

.1 reference that the test was carried out in accordance with appendix 2 to part 10 of the 2010 FTP Code (see also subparagraph .2);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and address of the manufacturer/supplier, if known;

.7 type of the material, i.e. furniture component, surface linings or finishes, etc.;

.8 name and/or identification of the product tested;

.9 description of the sampling procedure, where relevant;

.10 description of the product tested including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, together with details of the construction of the product;

.11 description of the specimen including density and/or mass per unit area, thickness and dimensions, colour, quantity and number of any coating, orientations tested and face subject to the test, and construction;

.12 date of sample arrival;

.13 details of specimen conditioning;

.14 date of test;

.15 test conditions:

.1 orifice flow rate calibration constant *C* (see standard ISO 5660-1);

.2 irradiance level (50 kW/m^2), and exhaust system flow rate expressed in m^3/s; and

.3 number of replicate specimens tested under the same conditions (this shall be a minimum of three, except for exploratory testing);

.16 test results:

.1 time to ignition of each specimen, expressed in seconds;

.2 test duration of each specimen, usually 20 min;

.3 for each specimen, 30-second sliding average heat release (HRR30) expressed in kW/m^2 and 30-second sliding average smoke production (SPR30) expressed in m^2/s, represented as a curve, recorded for the entire test of each specimen;

.4 for each specimen, the maximum in 30-second sliding average heat release rate (HRR30max) expressed in kW/m^2 and the maximum in 30-second sliding average smoke production rate (SPR30max) expressed in m^2/s;

.5 the total heat release expressed in kJ/m^2 of each specimen;

.6 additional observations, such as transitory flaming or flashing; and

.7 difficulties encountered in testing, if any;

.17 classification of the material; and

.18 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

13 OTHER REFERENCES

The following parts of standard ISO 5660-1 shall be also referred to for the purpose of this appendix 2:

.1 annex A: Commentary and guidance notes for operators;

.2 annex B: Resolution, precision and bias;

.3 annex C: Mass loss rate and effective heat of combustion;

.4 annex D: Testing in the vertical orientation;

.5 annex E: Calibration of the working heat flux meter;

.6 annex F: Calculation of heat release with additional gas analysis;

.7 annex G: Specimen configurations; and

.8 annex H: Bibliography.

PART 11 – TEST FOR FIRE-RESISTING DIVISIONS OF HIGH-SPEED CRAFT

1 APPLICATION

Where constructions for use in high-speed craft are required to have fire-resisting properties, they shall comply with this part. Such constructions include fire-resisting bulkheads, decks, ceilings, linings and doors.

2 FIRE TEST PROCEDURE

Fire-resisting divisions of high-speed craft shall be tested and evaluated in accordance with the fire test procedures specified in the appendix to this part.

3 ADDITIONAL REQUIREMENTS

3.1 Materials used in fire-resisting divisions shall be non-combustible or fire-restricting as verified in accordance with part 1 or 10 of this annex, respectively.

3.2 Part 3 of this annex is also applicable to certain constructions such as windows, fire dampers, pipe penetrations and cable transits.

3.3 Part 4 of this annex is also applicable where a control system of fire doors is required to be able to operate in case of fire.

3.4 Where combustible veneers are allowed to be provided in fire-resisting divisions in conjunction with non-combustible substrates, the low flame-spread characteristics of such veneers, if required, shall be verified in accordance with part 5 of this annex.

APPENDIX

FIRE TEST PROCEDURES FOR FIRE-RESISTING DIVISIONS OF HIGH-SPEED CRAFT

1 GENERAL

1.1 Under the provisions of the 1994 HSC Code or 2000 HSC Code, constructions for use in high-speed craft shall have fire-resisting properties to the satisfaction of, and be approved by, the Administration. In this context "fire-resisting property" is the ability of the construction to insulate/protect an area from the influence of a fire in an adjoining area by having separating performance during a fire. Such constructions are fire-resisting bulkheads, decks, ceilings, linings and doors.

1.1.1 Fire-resisting divisions for moderate fire hazard are classified as "fire-resisting divisions 30".

1.1.2 Fire-resisting divisions for major fire hazard are classified as "fire-resisting divisions 60".

1.2 The classification shall be expressed in the form of, for example, "Load bearing fire-resisting deck 60" and "Non-load bearing fire-resisting bulkhead 30", i.e. including the qualification on orientation of the division together with a statement if the division in question is evaluated as load bearing or as non-load bearing.

1.3 Testing of fire-resisting divisions and reporting shall generally be in accordance with the requirements given in part 3 of this annex. Where additional interpretation, adoption and/or supplementary requirements may be necessary, these are detailed in this part.

1.4 The test shall continue for a minimum of 30 min for fire-resisting divisions 30, or 60 min for fire-resisting divisions 60, or for an intermediate fire protection time when allowed in accordance with the 2000 HSC Code.

1.5 The following performance criteria for insulation and integrity shall be fulfilled within the classification period (see paragraph 1.4 above):

.1 insulation: the average unexposed face temperature rise shall not be more than 140°C, and the temperature rise recorded by any of the individual unexposed face thermocouple shall not be more than 180°C; and

.2 integrity:

.1 there shall be no flaming on the unexposed face;

.2 there shall be no ignition, i.e. flaming or glowing, of the cotton-wool pad; and

.3 it shall not be possible to enter the gap gauges as described in paragraph 8.4.4 of appendix 1 to part 3 into any opening in the specimen.

1.6 In this appendix, testing of fire-resisting divisions is described in three separate parts, as follows:

.1 non-load bearing fire-resisting divisions;

.2 load bearing fire-resisting divisions having a structural metal core as presupposed in part 3 of this annex for "A" class divisions; and

.3 other load bearing fire-resisting divisions.

2 NON-LOAD BEARING FIRE-RESISTING DIVISIONS

The approach adopted for testing of fire-resisting divisions which are non-load bearing shall follow the requirements for testing "B" class divisions in part 3 of this annex where relevant and appropriate.

3 LOAD BEARING FIRE-RESISTING DIVISIONS HAVING A STRUCTURAL METAL CORE AS PRESUPPOSED IN PART 3 OF THIS ANNEX FOR "A" CLASS DIVISIONS

3.1 The approach adopted for testing of load-bearing fire-resisting divisions having a structural metal core (steel or aluminium) shall follow the requirements for testing "A" class divisions in part 3 of this annex, where relevant and appropriate.

3.2 If the structural core is of aluminium, the average temperature of the structural core shall not rise more than 200°C above its initial temperature at any time within the classification period (see paragraph 1.4 above).

4 LOAD BEARING FIRE-RESISTING DIVISIONS

4.1 The approach adopted for testing of other load bearing fire-resisting divisions shall follow the requirements for testing "B" class divisions in part 3 of this annex where relevant and appropriate.

4.2 In addition, such load bearing divisions shall be tested with the prescribed static load and they shall maintain their load bearing ability within the classification period (see paragraph 1.4 above).

4.3 Nature of test specimen

4.3.1 The construction, erection and stiffening of the test specimen shall be typical of the use in practice.

4.3.2 For vertical divisions (bulkheads), the minimum overall dimensions for the exposed part of the test specimen are 2,440 mm width and 2,500 mm height, or full height if the height is smaller than 2,500 mm.

4.3.3 For horizontal divisions (decks), the minimum overall dimensions for the exposed part of the test specimen are 2,440 mm width and 3,040 mm length (span), or full length if the length is smaller than 3,040 mm.

4.4 Mounting of test specimen

4.4.1 A vertical test specimen shall be simply supported at the top and the bottom and shall not be supported along its vertical edges.

4.4.2 A horizontal test specimen shall be simply supported at the two ends and shall not be supported along its edges parallel to the span.

4.5 Static load

4.5.1 The following levels of loading shall be applied uniformly, as far as practicable, along the top edge of the vertical specimen or surface of the horizontal specimen:

.1 bulkheads: 7.0 kN/m of the width; and

.2 decks: 3.5 kN/m2 of the area.

The load may be applied hydraulically, mechanically or by the use of weights.

4.5.2 The loading equipment shall be able to simulate the conditions of loading, as appropriate, for the test construction. The loading equipment shall also be capable of maintaining the test load at a constant value (to within ± 5% of the required value) without changing its distribution for the duration of the load-bearing capacity period; it shall not significantly influence the heat transfer through the specimen nor impede the use of the thermocouple insulating pads; it shall not interfere with the measurement of surface temperature and/or deformation and shall permit general observation of the unexposed face.

4.5.3 For decks, the total area of the contact points between the loading equipment and the test specimen surface shall not exceed 10% of the total area of the surface of a horizontal test specimen. The equipment shall be capable of following the maximum deformation and the rate of deformation of the test specimen. For bulkheads, the loading equipment has to produce a load uniformly applied to the total width of the bulkhead.

4.5.4 If the tested assembly includes load bearing elements such as beams, they shall be exposed to the furnace on all faces except for the face in contact with the specimen and shall not be placed at less than 200 mm from the furnace walls.

4.5.5 In practice, it may be difficult to produce a uniform load, especially on decks. When determining a load distribution that is representative of the standard conditions described in paragraphs 4.4.2 and 4.5.1, the laboratory shall consider the degrees of freedom, maximum shear force and bending moment.

4.5.6 Mounting methods and loading conditions different to those in paragraphs 4.4.2 and 4.5.1 may be used. In that case, the test conditions and load distribution shall be acceptable to the Administration.

4.5.7 The test report shall include justifications of approximations to uniform load and mounting. The report shall include a description of load repartition in terms of force, surface of contact and position of these contacts.

4.5.8 The test load shall be applied at least 15 min before the commencement of the heating period.

4.6 Deformation

4.6.1 Deformation measurements shall be made using equipment employing mechanical, optical or electrical techniques. Instrumentation for the measurement of deflection of the test specimen shall be located so as to provide data in terms of the amount and rate of deflection during the fire test.

4.6.2 The deformation data shall be recorded to an accuracy of ± 2 mm during the testing period.

4.6.3 For a bulkhead, measurement shall be made of the axial contraction and of the horizontal deflection.

4.6.4 For a deck, measurement shall be made of the vertical deflection.

4.7 Performance criteria for load bearing ability

The test specimen shall be deemed to have failed if it is no longer able to support the test load. Support of the test load is determined by both the amount and the rate of deflection. Since relatively rapid deflections can occur until stable conditions are reached, the rate of deflection criteria of decks is not applied until a deflection of L/30 has been exceeded. For the purposes of this part, the following criteria apply:

.1 bulkheads:

.1 limiting axial contraction of h/100 mm; and

.2 limiting rate of axial contraction of 3 h/1,000 mm/min,

where:

h = the initial height (mm); and

.2 decks:

.1 limiting deflecting of (L)2/400 d mm; and

.2 limiting rate of deflection of (L)2/9,000 d mm/min,

where:

L = the clear span of the specimen (mm); and

d = the distance from the extreme fibre of the design compression zone to the extreme fibre of the design tension zone of the structural section (mm).

5 TEST REPORT

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and the data determined by the test:

.1 reference that the test was carried out in accordance with part 11 of the 2010 FTP Code (see also subparagraph .2 below);

.2 any deviations from the test method;

.3 name and address of the testing laboratory;

.4 date and identification number of the report;

.5 name and address of the sponsor;

.6 name and/or identification of the product tested;

.7 the name of the manufacturer of the test specimen and of the products and components used in the construction;

.8 type of the product, e.g. bulkhead, ceiling, door, window, duct penetration, etc.;

.9 classification of test per paragraph 1.6;

.10 the constructional details of the test specimen, including description and drawing and principal details of components. All the details requested in paragraph 2 shall be given. The description and the drawings which are included in the test report shall, as far as practicable, be based on information derived from a survey of the test specimen. When full and detailed drawings are not included in the report, then the applicant's drawing(s) of the test specimen shall be authenticated by the laboratory and at least one copy of the authenticated drawing(s) shall be retained by the laboratory; in this case reference to the applicant's drawing(s) shall be given in the report together with a statement indicating the method of endorsing the drawings;

.11 all properties of materials used that have a bearing on the fire performance of the test specimen together with measurements of thickness, density and, where applicable, the moisture and/or binder content of the insulation material(s) as determined by the test laboratory;

.12 method of applying load and quantity of the load, if applicable;

.13 date of the test specimen arrival;

.14 details of specimen conditioning;

.15 date of test;

.16 test results:

.1 information concerning the location of all thermocouples fixed to the specimen, together with tabulated data obtained from each thermocouple during the test. Additionally, a graphical depiction of the data obtained may be included. A drawing shall be included which clearly illustrates the positions of the various thermocouples and identifies them relative to the temperature-time data;

.2 the average and the maximum temperature rises and the average core temperature rise, when applicable, recorded at the end of the period of time appropriate to the insulation performance criteria for the relevant classification or, if the test is terminated due to the insulation criteria having been exceeded, the times at which limiting temperatures were exceeded; and

.3 the maximum deflection of the specimen. In case of doors, the maximum deflection at the centre of the door specimen and the maximum displacement of each corner of the door leaf relative to the door frame;

.17 the classification attained by the test specimen shall be expressed in the form of "load-bearing fire-resisting divisions 60 bulkhead", i.e. including the qualification on orientation of the division. The result shall be presented in the test report in the following manner under the heading "Classification": "A bulkhead constructed as described in this report may be regarded as an "load-bearing fire-resisting divisions 60" class bulkhead according to part 11 of annex 1 to the 2010 FTP Code.";

.18 the name of the representative of the Administration present at the test. If the Administration requires prior notification of test and a representative does not witness the test, a note to this effect shall be made in the report in the following form:

"The … (name of the Administration) … was notified of the intention to conduct the test detailed in this report and did not consider it necessary to send a representative to witness it."; and

.19 the statement:

"The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.".

ANNEX 2

PRODUCTS WHICH MAY BE INSTALLED WITHOUT TESTING AND/OR APPROVAL

GENERAL

In general, the products and product groups listed in this annex are considered to have the fire safety characteristics specified below and they may be installed without testing according to and without approval on the basis of the specific fire test procedures in this Code for the specific safety characteristics of the product.

The paragraphs below are numbered with the same part number in which the corresponding testing requirements are specified in annex 1.

1 Non-combustible materials

In general, products made only of glass, concrete, ceramic products, natural stone, masonry units, common metals and metal alloys are considered as being non-combustible and they may be installed without testing and approval.

2 Materials not generating excessive quantities of smoke nor toxic products in fire

2.1 In general, non-combustible materials are considered to comply with the requirements of part 2 of annex 1 without further testing.

2.2 In general, surface materials and primary deck coverings with both the total heat release (Q_t) of not more than 0.2 MJ and the peak heat release rate (Q_p) of not more than 1 kW (both values determined in accordance with part 5 of annex 1) are considered to comply with the requirements of part 2 of annex 1 without further testing.

2.3 Materials meeting the provisions in paragraph 2.2 above are exempted from testing in accordance to standard ISO 1716. They will be expected to satisfy a requirement of maximum gross calorific value (e.g., 45 MJ/m^2) without further testing.

2.4 For high-speed craft, fire-restricting materials are considered to comply with the requirements of part 2 of annex 1 without further testing.

3 "A", "B" and "F" class divisions

3.1 The following products may be installed without testing or approval:

Classification	Product description
Class "A-0" bulkhead	A steel bulkhead with dimensions not less than the minimum dimensions given below: - thickness of plating: 4 mm - stiffeners 60 mm x 60 mm x 5 mm spaced at 600 mm or structural equivalent

Class "A-0" deck	A steel deck with dimensions not less than the minimum dimensions given below: - thickness of plating: 4 mm - stiffeners 95 mm x 65 mm x 7 mm spaced at 600 mm or structural equivalent.

3.2 Notwithstanding the provisions in paragraph 3.1 above, the materials which are used in "A", "B" and "F" class divisions and which are required to have certain other specified characteristics (e.g., non-combustibility, low flame-spread characteristics, etc.) shall comply with the appropriate parts of annex 1 or paragraph 8 and annex 3, of this Code.

4 Fire door control systems

(no entries)

5 Low flame-spread surfaces and primary deck coverings

5.1 Non-combustible materials are considered to comply with the requirements of part 5 of annex 1. However, due consideration shall be given to the method of application and fixing (e.g., glue).

5.2 Primary deck coverings classified as not readily ignitable in accordance with part 5 of annex 1 are considered to comply with the requirements for floor coverings.

5.3 For high-speed craft, surfaces and materials that are qualified as fire-restricting materials are considered to comply with the requirements of part 5 of annex 1 without further testing.

6 Vertically supported textiles and films

(no entries)

7 Upholstered furniture

(no entries)

8 Bedding components

(no entries)

9 Fire-restricting materials for high-speed craft

(no entries)

10 Fire-resisting divisions of high-speed craft

(no entries)

ANNEX 3

FIRE PROTECTION MATERIALS AND REQUIRED APPROVAL TEST METHODS

Table 1 – Fire protection materials and required approval test methods for passenger ships carrying more than 36 passengers and high-speed craft

Test method (FTP Code) / Specimen (Products)	Part 1 Non-combustibility	Part 2 Smoke and toxicity	Part 3 A, B and F class divisions	Part 4 Door systems	Part 5 Surface flammability	Part 7 Curtains or Vertically supported textiles	Part 8 Upholstered furniture	Part 9 Bedding components	Part 10 – ISO 9705 (MSC.40(64) and MSC.90(71)	Part 10 – ISO 5660 (MSC.40(64) and MSC.90(71)	Part 11 – A.754(18) (for 2000 HSC Code)	ISO 1716 Calorific potential	Remarks/ Notes	Applicable regulation SOLAS chapter II-2 and HSC Code
Non-combustibility materials	X													5.3.1.2.1
"A" class bulkhead	X		X											3.2.3, 9.2.2.3
"B" class bulkhead	X		X											3.4.1, 9.2.2.3
"C" class bulkhead	X												1	3.10, 9.2.2.3
"A" class deck	X		X											3.2.3, 9.2.2.3
"B" class deck	X		X											3.4.1, 9.2.2.3
"B" class lining	X		X											3.4.1, 9.2.2.3
"B" class ceilings	X		X											3.4.1, 9.2.2.3
"B" class continuous ceilings	X		X											3.4.1, 9.2.2.3.3
"A" class fire door	X		X											3.2.3, 9.4.1.1.2
"B" class fire door	X		X											3.4.1, 9.4.1.2.1
"A" class windows	X		X											3.2.3, 9.4.1.3.1
"B" class windows	X		X											3.2.3, 9.4.1.3.1
Thermal and acoustic insulation materials	X													5.3.1.1

Test method (FTP Code) / Specimen (Products)	Part 1 Non-combustibility	Part 2 Smoke and toxicity	Part 3 A, B and F class divisions	Part 4 Door systems	Part 5 Surface flammability	Part 7 Curtains or Vertically supported textiles	Part 8 Upholstered furniture	Part 9 Bedding components	Part 10 – ISO 9705 (MSC.40(64) and MSC.90(71)	Part 10 – ISO 5660 (MSC.40(64) and MSC.90(71)	Part 11 – A.754(18) (for 2000 HSC Code)	ISO 1716 Calorific potential	Remarks/ Notes	Applicable regulation SOLAS chapter II-2 and HSC Code
Partial bulkheads	X												2	5.3.1.2.1
Fire damper			X											9.7.1.2.1
Cable transit			X											9.3.1
Pipe penetration			X											9.3.1
Fire Door Control System				X										9.4.1.1.4.15
Ventilation ducts	X													9.7.1.1
Adhesive (bulkhead, deck, door and other division)					X									5.3.1.1
Exposed painted surfaces		X			X								3	5.3.2.4.1.1
Exposed foil, fabric or surface veneers		X			X							X	3	5.3.2.4.1.1
Painted surfaces in concealed spaces					X									5.3.2.4.1.2
Foil, fabric or veneer on surfaces or grounds in concealed spaces					X							X		5.3.2.4.1.2
Ceilings and linings	X												2	5.3.1.2.1
Surfaces of bulkhead and ceiling linings		X			X								4	5.3.2.4.1.1
Grounds	X												2	5.3.1.2.1
Draught stops	X												2	5.3.1.2.1, 8.4
Paints, varnishes and other finishes on exposed interior surfaces		X			X									6.2
Floor coverings		X			X3									5.3.2.4.1

Test method (FTP Code) / Specimen (Products)	Part 1 Non-combustibility	Part 2 Smoke and toxicity	Part 3 A, B and F class divisions	Part 4 Door systems	Part 5 Surface flammability	Part 7 Curtains or Vertically supported textiles	Part 8 Upholstered furniture	Part 9 Bedding components	Part 10 – ISO 9705 (MSC.40(64) and MSC.90(71)	Part 10 – ISO 5660 (MSC.40(64) and MSC.90(71)	Part 11 – A.754(18) (for 2000 HSC Code)	ISO 1716 Calorific potential	Remarks/ Notes	Applicable regulation SOLAS chapter II-2 and HSC Code
Combustible ventilation ducts					X									9.7.1.1.1 Gases are transported by ducts
Insulation materials for cold service systems					X									5.3.1.1 Criteria have to be defined
Vapour barriers					X									5.3.1.1
Primary deck coverings		X			X									4.4.4, 6.3
Curtain – Vertically supported textiles						X								3.40.3, 9.2.2.3.2.2 (6) Toxicity and Opacity can be taken into account in the criteria
Upholstered furniture							X							3.40.6, 5.3.3, 9.2.2.3.2.2 (6)
Bedding components								X						3.40.7, 9.2.2.3.2.2 (6)
Fire restricting divisions									X					HSC 7.4.3.1
Fire restricting ceilings									X					HSC 7.4.3.1
Fire restricting linings									X					HSC 7.4.3.1
Fire restricting case furniture										X				HSC 7.4.3.3.1

Test method (FTP Code) / Specimen (Products)	Part 1 Non-combustibility	Part 2 Smoke and toxicity	Part 3 A, B and F class divisions	Part 4 Door systems	Part 5 Surface flammability	Part 7 Curtains or Vertically supported textiles	Part 8 Upholstered furniture	Part 9 Bedding components	Part 10 – ISO 9705 (MSC.40(64) and MSC.90(71)	Part 10 – ISO 5660 (MSC.40(64) and MSC.90(71)	Part 11 – A.754(18) (for 2000 HSC Code)	ISO 1716 Calorific potential	Remarks/ Notes	Applicable regulation SOLAS chapter II-2 and HSC Code
Fire restricting free-standing furniture										X				HSC 7.4.3.3.1
Fire restricting thermal and acoustic insulation material										X				HSC 7.4.3.3.2
Non-load bearing fire-resisting divisions											X			HSC 7.4.3.3.5
Load bearing fire-resisting divisions, with metal core											X			HSC 7.2.1
Load bearing fire-resistant divisions, without metal core											X			HSC 7.2.1

1 Low flame-spread adhesives may be used.
2 Except in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces.
3 Corridors and stairway enclosures only.
4 In accommodation and service spaces (except saunas) and control stations.
* In case of the maximum gross calorific value less than 45 MJ/m^2 was required.

Table 2 – Fire protection materials and required approval test methods for cargo ships (method IC)

Test method (FTP Code) / Specimen (Products)	Part 1 Non combustibility	Part 2 Smoke and toxicity	Part 3 A, B and F class divisions	Part 4 Door systems	Part 5 Surface flammability	ISO 1716 Calorific potential	Remarks/ Note	Applicable regulation SOLAS chapter II-2 and HSC Code
Non-combustible materials	X							5.3.1.2.2
"A" class bulkheads	X		X					3.2.3, 9.2.3
"B" class bulkheads	X		X					3.4.1, 9.2.3
"C" class bulkheads	X						1	3.10, 9.2.3
"A" class decks	X		X					3.2.3, 9.2.3
"B" class decks	X		X					3.4.1, 9.2.3
"B" class linings	X		X					3.4.1, 9.2.3
"B" class ceilings	X		X					3.4.1, 9.2.3
"B" class continuous ceilings	X		X					3.4.1, 9.2.3.3
"A" class fire doors	X		X					3.2.3, 9.4.2.1
"B" class fire doors	X		X					3.4.1, 9.4.2.1
"A" class windows	X		X					3.2.3, 4.5.2.3
Thermal and acoustic insulation materials	X							5.3.1.1
Fire dampers			X					9.7.1.2.1
Cable transits			X					9.3.1
Pipe penetrations			X					9.3.1
Ventilation ducts	X		~~X~~					9.7.1.1
Adhesives (bulkhead, deck, door and other division)					X			5.3.1.1
Exposed painted surfaces		X			X		3	5.3.2.4.2
Exposed foil, fabric or surface veneers		X			X	X	3	5.3.2.4.2
Painted surfaces in concealed spaces					X			5.3.2.4.2

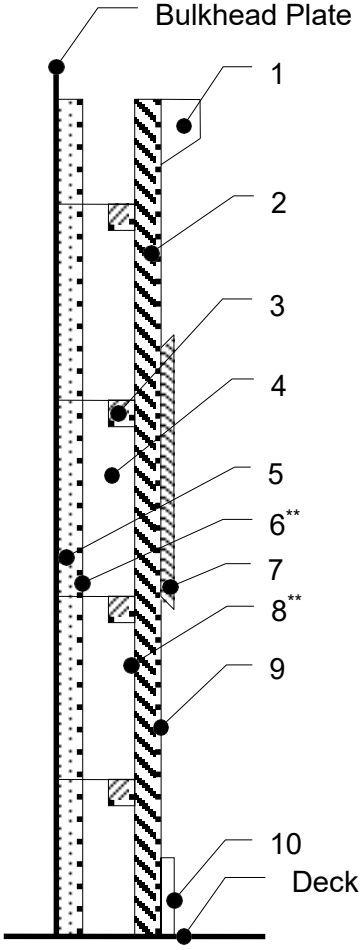
Test method (FTP Code) / Specimen (Products)	Part 1 Non combustibility	Part 2 Smoke and toxicity	Part 3 A, B and F class divisions	Part 4 Door systems	Part 5 Surface flammability	ISO 1716 Calorific potential	Remarks/ Note	Applicable regulation SOLAS chapter II-2 and HSC Code
Foil, fabric or veneer on surfaces or grounds in concealed spaces					X	X		5.3.2.4.2
Ceilings and linings	X						2	5.3.1.2.1
Surfaces of ceiling linings		X			X		4	5.3.2.4.1.1
Grounds	X						2	5.3.1.2.1,
Draught stops	X						2	5.3.1.2.1, 8.4
Paints, varnishes and other finishes on exposed interior surfaces		X						6.2
Floor coverings		X			X		3	5.3.2.4.1
Combustible ventilation ducts					X			9.7.1.1.1
Insulation materials for cold service systems					X			5.3.1.1
Vapour barriers					X			5.3.1.1
Primary deck coverings		X			X			4.4.4, 6.3

1 Low flame-spread adhesives may be used.
2 Except in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces.
3 Corridors and stairway enclosures only.
4 In accommodation and service spaces (except saunas) and control stations.

ANNEX 4

INTERPRETATION OF SOLAS, CHAPTER II-2, REGULATIONS 5.3 AND 6.2 (MSC/Circ.1120)

Table 1 – Materials used on passenger ships for bulkheads of accommodation spaces as defined in regulation II-2/3.1 and its requirements (regulations 5.3 and 6.2)



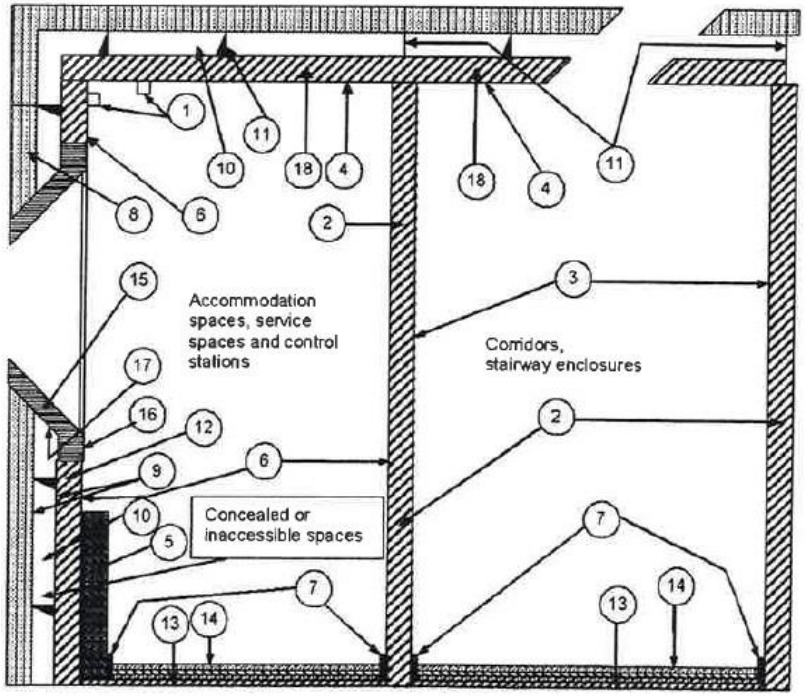
Materials used for bulkheads of accommodation spaces as defined in regulation II-2/3.1					
Bulkhead components	Requirements in SOLAS chapter II-2 for components				
	Non-combustible material (5.3.1.1) (5.3.1.2.1)	Calorific value (5.3.2.2)	Equivalent volume (5.3.2.3)	Low flame-spread (5.3.2.4)*	Smoke production, toxic products (6.2)
	(A)	(B)	(C)	(D)	(E)
1 moulding			X		
2 wall panel (lining)	X				
3 grounds and supports	X				
4 draft stops	X				
5 insulation	X				
6 insulation surface**				X (5.3.2.4.1.2)	
7 decoration			X		
8 painted surface** or fabric or veneer**		– X		X (5.3.2.4.1.2) X (5.3.2.4.1.2)	
9 painted surface or fabric or veneer		– X	X X	X (5.3.2.4.1.1) X (5.3.2.4.1.1)	X X
10 skirting board			X		

Notes:

* Exposed surfaces of corridors and stairway enclosures referred to in regulation II-2/5.3.2.4.1.1 include floor coverings.

** Where the wall panel is an integral part of the fire insulation in accordance with regulation II-2/9.2.2.3.3, these components are to be of non-combustible material.

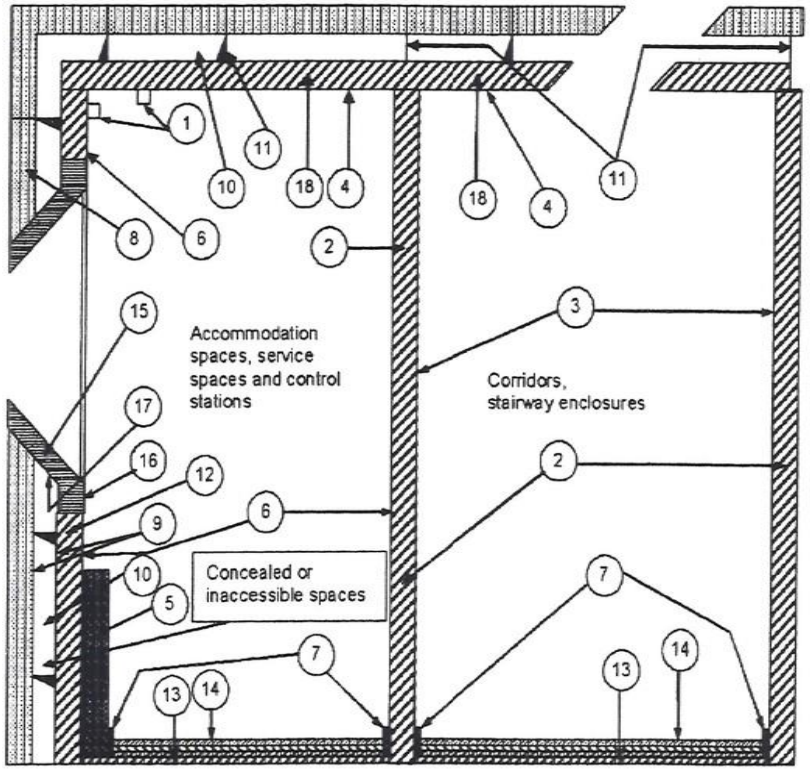
Table 2 – Regulations 5.3 and 6.2 – Materials used in accommodation spaces, as defined in regulation II-2/3.1, of cargo ships (method IC)



		Requirements for components,						
		A Non-combustible material (regulation 5.3.1.2.2)	*B Non-combustible material (regulation 5.3.1.1)*	*C Low flame spread (regulation 5.3.2.4)*	*D Equivalent volume (regulation 5.3.2)*	*E Calorific value (regulation 5.3.2)*	*F Smoke production (regulation 6)*	*G Not readily ignited (regulation 4.4.4 and 6)*
1	Moulding				X			
2	Panel	X						
3	Painted surfaces or Veneer or Fabric or Foils			X	X	X	X[2)]	
4	Painted surfaces or Veneer or Fabric or Foils			X	X	X	X[2)]	
5	Decoration				X			
6	Painted surfaces or Veneer or Fabric or Foils				X	X	X[2)]	
7	Skirting board				X			
8	Insulation		X[1)]					
9	Surfaces and paints in concealed or inaccessible spaces			X				
10	Draught stops	X						
11	Grounds and supports	X		X				
12	Lining	X						
13	Primary deck covering first layer						X	X
14	Floor finishing			X[3)]			X	
15	Window box	X						
16	Window box surface			X	X	X	X	
17	Window box surface in concealed or inaccessible spaces			X				
18	Ceiling panel	X						

1) Vapour barriers used on pipes for cold services (see interpretation to regulation II-2/5.3.1.1 of the Convention) may be of combustible materials providing that their surface has low flame spread characteristics (regulation II-2/5.3.1.1 of the Convention)
2) Applicable to paints, varnishes and other finishes (regulation II-2/6.2 of the Convention)
3) Only in corridors and stairway enclosures

Table 3 – Regulations 5.3 and 6.2 – Materials used in accommodation spaces, as defined in regulation II-2/3.1, of cargo ships (method IIC – IIIC)



		Requirements for components						
		A Non-combustible material (regulation 5.3.1.2.2)	*B Non-combustible material (regulation 5.3.1.1)*	*C Low flame spread (regulation 5.3.2.4)*	*D Equivalent volume (regulation 5.3.2)*	*E Calorific value (regulation 5.3.2)*	*F Smoke production (regulation 6)*	*G Not readily ignited (regulation 4.4.4 and 6)*
1	Moulding				X[3]			
2	Panel	X[4]						
3	Painted surfaces or Veneer or Fabric or Foils			X	X	X	X[5]	
4	Painted surfaces or Veneer or Fabric or Foils			X	X[3]	X[2]	X[5]	
5	Decoration				X[3]		X	
6	Painted surfaces or Veneer or Fabric or Foils				X[3]	X[2]	X[5]	
7	Skirting board				X[3]			
8	Insulation		X[1]					
9	Surfaces and paints in concealed or inaccessible spaces			X				
10	Draught stops	X[4]						
11	Grounds and supports	X[4]		X				
12	Lining	X[4]						
13	Primary deck covering 1st layer						X	X
14	Floor finishing			X[6]			X	
15	Window box	X[4]						
16	Window box surface			X[3]	X[3]	X[2]	X	
17	Window box surface in concealed or inaccessible spaces			X				
18	Ceiling panel	X[4]						

1) Vapour barriers used on pipes for cold services (see interpretation to regulation II-2/5.3.1.1 of the Convention) may be of combustible materials providing that their surface has low flame spread characteristics (regulation II-2/5.3.1.1 of the Convention)
2) Where the material is fitted on non-combustible bulkheads, ceiling and lining in accommodation and service spaces (regulation II-2/5.3.2.2 of the Convention)
3) To be applied to those accommodation and service spaces bounded by non-combustible bulkheads, ceiling and linings (regulation II-2/5.3.2.3.1 of the Convention)
4) Only in corridors and stairway enclosures serving accommodation and service spaces and control stations (regulation II-2/5.3.1.2.2.2 of the Convention)
5) Applicable to paints, varnishes and other finishes (regulation II-2/6.2 of the Convention)
6) Only in corridors and stairway enclosures"

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