COMPREHENSIVE REVIEW OF THE FIRE TEST PROCEDURES CODE

Report of the working group at FP 52 (part 2)
Draft revised text of the FTP Code

Submitted by the Chairman of the working group

SUMMARY

Executive summary: This document provides the draft revised text of the International Code for Application of Fire Test Procedures (FTP Code), developed at FP 52, for consideration of the Sub-Committee at this session.

Strategic direction: 2

High-level action: 2.1.1

Planned output: 2.1.1.1

Action to be taken: Paragraph 2


Draft revised FTP Code

1 Further revised version of the draft FTP Code, which has incorporated discussion results at FP 52 (FP 52/WP.1, paragraphs 7, 8, 9 and 27 and annex 3; and FP 53/4 (Report of the working group at FP 52 (part 2)) and further investigation, is set out at the annex to this document.

Editorial harmonization

2 The following editorial harmonization has been done throughout the draft revised text of the FTP Code, contained in the annex to this document:

.1 “paragraph” is used for referencing a particular paragraph, i.e. “paragraph 2.5”;

.2 “standard ISO …” is used for referencing ISO standard; and

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allowance of values is given in a way of “X + Y mm” or “X ±Y mm” case by case according to the allowance given.

Action requested of the Sub-Committee

3.3 The Sub-Committee is invited to use this document in its consideration on the agenda item 4 (Comprehensive review of the fire test procedures code) and take action as appropriate.
ANNEX

DRAFT
INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES
(200X FTP CODE)

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DRAFT
INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES
(200X 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 1974 SOLAS Convention, as amended.

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

2 APPLICATION

2.1 This Code is applicable for the 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 only made to a product’s fire performance 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 1974 SOLAS Convention, 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.


3.8 *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 (minutes).

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;

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

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

4.2.3 The testing laboratory shall use a quality control system audited by the competent authority based on standard ISO 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 test procedures 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 4.3.2).

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

5.2 Type approval

5.2.1 The type approval certificates shall be issued and renewed on basis of the test reports of the applicable fire tests (see paragraph 4).

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 no more than five 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 test method(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 .11 to .14 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 of 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 to 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 OTHER TEST PROCEDURES

8.1 The newest test procedures adopted by the Organization are considered 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 approvals of products tested in accordance with the previous version of this Code provided the tests were conducted no later than 6 months [1 year] after entry into force of the revised Code. The purpose is to allow test laboratories a practical period of grace to obtain test equipment necessary to comply with the revised Code. Tests conducted later than 6 months [1 year] after entry into force of the revised Code shall be conducted in accordance with the present version. Noting paragraph 8.1, the Administration may renew type approvals of products tested in accordance with this version or previous version of this Code provided the test reports are not more [15] years old.

9 LIST OF REFERENCES

The following ISO standards are referred to in parts 1 to 11 of annex 1 to the Code:


.2 ISO 1182: 2002 [200x], Reaction to fire tests for building and transport products – Non-combustibility test;

.3 ISO 1716: 2002 [200x], Reaction to fire tests for building products – Determination of the heat of combustion;


.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;

* 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).
.9 ISO 13943: [2009], Fire safety – Vocabulary;


.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; and

.13 ISO/DIS 21489, Fire tests – Method of measurement of gases using Fourier transform infrared spectroscopy (FTIR) in cumulative smoke test.
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 provisions in paragraph 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 FTPC 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, annex 2 to the Code is referred.
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 of this part (ISO 1182). However, the test exposure need not exceed a 30 min duration.

3 FIRE TEST PROCEDURES AND 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 subsections 8.3 and 8.4 of the appendix does not exceed 30°C;

.2 the average surface thermocouple temperature rise as calculated in subsections 8.3 and 8.4 of the appendix does not exceed 30°C;

.3 the average duration of sustained flaming as calculated in subsection 8.2 of the appendix does not exceed 10 s; and

.4 the average mass loss as calculated in subsection 8.1 of the appendix does not exceed 50%.

4 TEST REPORT

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

5 REFERENCE DOCUMENT

Appendix

Test procedure 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

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


2 NORMATIVE REFERENCES

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

.1 ISO 1182: 200x, Reaction to fire tests for building and transport products – Non-combustibility test; and


3 TERMS AND DEFINITIONS

For the purpose of this appendix, the terms and definitions given in Fire safety – Vocabulary (ISO/IEC 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.

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: 200x). 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 volume of $76 \pm 8 \text{ cm}^3$, a diameter of $45 \pm 2 \text{ mm}$ and a height of $50 \pm 3 \text{ mm}$.

5.2 **Preparation**

5.2.1 If the thickness of the material is different from $50 \pm 3 \text{ mm}$, specimens of the height of $50 \pm 3 \text{ mm}$ 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 $50 \pm 3 \text{ mm}$ shall be constructed such that the all layers are represented in the sample in proportion to their presence, by volume, in the original sample.

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, ten specimens shall be made.

6  **CONDITIONING**

The test specimens shall be dried in a ventilated oven maintained at $60 \pm 5^\circ \text{C}$, 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 be not 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 8.2.4 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 section 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, 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 given 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 given 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 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 value 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

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

For non-homogeneous products, calculate the averages for subsections 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 2 of part 1.

8.2 Mass loss

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.

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

8.3 Flaming

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.

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 \( T_{\text{ave}}(\text{furnace}) \) and the average specimen surface temperature rise \( T_{\text{ave}}(\text{surface}) \) from the value obtained by subsection 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 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 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 section 8;

.15 observations made during the test;

.16 classification of the material

.17 a statement that the test has been conducted in accordance with the requirements of part 1 of the FTP Code and if any deviations have been made to the prescribed procedures (including any special requirements of the Administration), a clear statement of the deviations; 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 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 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 to 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 the 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 of specific optical density of smoke ($D_{s \text{ max}}$) shall be obtained for each test in accordance with section 9 of appendix 1 to this part 2.

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 within 3 min of the time when the maximum specific optical density of smoke is reached. The concentration of each toxic gas shall be determined as ppm (part per million) in the chamber volume.

2.4 Classification criteria

2.4.1 Smoke

An average ($D_m$) of the maximum of specific optical density of smoke ($D_{s \text{ max}}$) of three tests at each test condition in subsection 2.3 shall be calculated:

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

2. for materials used as primary deck covering, the $D_m$ shall not exceed 400 in any test condition;
for materials used as floor covering, the $Dm$ shall not exceed 500 in any test condition; and

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 shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Gas</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>1450 ppm</td>
</tr>
<tr>
<td>HBr</td>
<td>600 ppm</td>
</tr>
<tr>
<td>HCl</td>
<td>600 ppm</td>
</tr>
<tr>
<td>HCN</td>
<td>140 ppm</td>
</tr>
<tr>
<td>HF</td>
<td>600 ppm</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>120 ppm (200 ppm for floor coverings)</td>
</tr>
<tr>
<td>NO$_x$</td>
<td>350 ppm</td>
</tr>
</tbody>
</table>

[Alternative proposal is contained in document FP 52/4/1, annex, appendix 2.]

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 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 \(Ds_{\text{max}}\) for each test (section 8 of the appendix 1); and

.2 \(D_m\) for each test conditions (paragraph 2.4.1 above); and

.2 for the toxicity tests, the values listed in section 9 of appendix 2;

.16 observations made during the test;

.17 classification of the material;

.18 a statement that the test has been conducted in accordance with the requirements of part 2 of the FTP Code and if any deviations have been made to the prescribed procedures (including any special requirements of the Administration), a clear statement of the deviations; 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”.

5 Reference documents


ISO 13943: [2009], Fire safety − Vocabulary.


Appendix 1

Test procedure for Smoke generation


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 1 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/m² and 50 kW/m².

2 Normative references

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

.1 ISO 291:1977, Plastics - Standard atmospheres for conditioning and testing;
.2 ISO 5659-2:2006, Plastics – Smoke generation, Part 2: Determination of optical density by a single chamber test; and

.3 ISO 13943: [2009], Fire safety – Vocabulary.

3 TERMS AND DEFINITIONS

For the purposes of this appendix 1, 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 11.1.1).

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/m² (three specimens with a pilot flame and three specimens without a pilot flame) and three specimens shall be tested at 50 kW/m² 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 10.8.2.

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 ± 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 of 25 ± 1 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 paints 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 850 ± 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 specimen 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 specimen of thickness of 25 mm shall be tested without any backing board nor 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 or three cuts (20 to 40 mm long) 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 (see standard ISO 291).

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 subsection 4.5 are followed carefully.
5  APPARATUS AND ANCILLARY EQUIPMENT


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


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/m² or 50 kW/m². For intumescent materials the distance between 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/m² or within the range 55 ± 5°C for tests with the radiator cone at 50 kW/m². Close the inlet valve.

For intumescent materials testing, the chamber wall temperature is within 50 ± 10°C for tests with the radiator cone at 25 kW/m² or within 60 ± 10°C for tests with the radiator cone at 50 kW/m².

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

Place a wrapped specimen, prepared in accordance with subsections 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 by the time immediate after the start of the test.

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

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.

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

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.

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).

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 subsection 10.8 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/m² in the presence of pilot flame;
- .2 irradiance of 25 kW/m² in the absence of pilot flame; and
- .3 irradiance of 50 kW/m² 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 subsection 9.1. If the value of $D_{s\text{ max}}$ 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 $D_s$

9.1.1 For each specimen, produce a graph of light transmission against time and determine the minimum transmission $T_{min}$. Convert $T_{min}$ to the maximum specific optical density $D_{s\text{ max}}$ by calculation to two significant figures using the following equation:
\[ Ds_{\text{max}} = 132 \log_{10} \left( \frac{100}{T_{\text{min}}} \right) \]

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 \( Ds_{\text{max}} \) determined in paragraph 9.1.1, the correction factor \( C_{\text{f}} \), which depends upon the use of the range-extension filter. The value of \( C_{\text{f}} \) 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 \( T_c \) (see paragraph 8.7.4) to determine the correction factor \( Dc \). Calculate \( Dc \) as for \( Ds_{\text{max}} \) in paragraph 9.1.1. Do not record the correction factor \( Dc \) if it is less than 5% of \( Ds_{\text{max}} \).

10 Other reference

Appendix 2

Test procedure for Gas measuring method

**Reference document:** ISO/DIS 21489: Fire tests – Method of measurement of gases using Fourier transform infrared spectroscopy (FTIR) in cumulative smoke test at the preliminary identified maximum smoke density point.

1. ** scope**

This International Standard 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.

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.

Gas measurements by FTIR shall be carried out when the maximum smoke density is obtained. That time is determined by a smoke density measurement test carried out in accordance with standard ISO 5659-2.

2. **Normative references**

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


ISO 13943: [2009], Fire safety – Vocabulary.

ISO 19702: 2006, Toxicity testing of fire effluents – Analysis of gases and vapours in fire effluents using FTIR technology.

ISO/DIS 21489: Fire tests – Method of measurement of gases using Fourier transform infrared spectroscopy (FTIR) in cumulative smoke test.

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 test correspondent to the time to reach the maximum specific optical density 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 preliminary smoke density tests in appendix 1 and standard ISO 5659-2:2006. 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 including probe, gas sampling line, filter and pump shall be in accordance with standard ISO/DIS 21489: Fire tests – Method of measurement of gases using Fourier transform infrared spectroscopy (FTIR) in cumulative smoke test.

6 GAS ANALYSIS TECHNIQUE

An FTIR system as described in standard ISO 19702 shall be used. Gas analysis during a cumulative smoke test shall be done at a single defined time point specified in paragraph 2.4.2 of part 2.

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 gas sampling line in temperature of 170 ± 10°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 50 to 4500 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 minute 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 any smoke test is started in a day, to carry out a dummy gas measurement where the ambient air in smoke chamber is sampled and analysed by the normal test procedure, and 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 $D_{mST} - (SRP \times 0.5)$ (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 20 min period has elapsed to verify and 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 the 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 valve of the chamber will automatically open according to standard ISO 5659-2. If this happens, this shall be reported.

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 in accordance with annex A of standard ISO/DIS 21489, and total acid gases trapped by the filtering materials ($Q_a$ (g)) shall be obtained.

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

$$V_s = S_{fl} \times St$$

Where

$S_{fl}$ is the gas sampling flow rate (l/s),

$St$ is the gas sampling time (s).
9.2.3 Relative volume of the gas \((V_a (l))\) shall be calculated by:

\[
V_a = \left( \frac{Q_a}{P_{Ma}} \right) \times V_m
\]

Where

- \(V_m\) is the molar volume at standard conditions,
- \(P_{Ma}\) is the molar mass of the gas.

9.2.4 The concentration correction \((Cca \text{ (ppm)})\) for a acid gas shall be obtained by:

\[
Cca = \frac{V_a}{V_s} \times 10^6
\]

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 2.6.1 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 subsection 2.3 of this part), 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 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 procedure specified in appendix 1 to this part. This contains test procedures also 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 140°C, and the temperature rise recorded by any of the individual unexposed-face thermocouples shall not be more than 180°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

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 subsection 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 fire 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 subsection 7.6 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 subsection 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 of this part.

3.5 Additional requirements

3.5.1 “A” and “B” class constructions shall be constructed from non-combustible materials. The following exceptions are permissible:

.1 adhesives 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.
**Note:** The calcium silicate board described as a dummy specimen specified in subsection 3.5 of appendix 1 of part 5 should be used as a standard substrate for adhesives.

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 of this part.

3.5.2.2 The cotton pad shall not be used when the temperature on the unexposed surface, in the vicinity of the opening, has exceeded 300°C.

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.

5 **TEST REPORT**

The test report shall include the information in 9 of Appendix 1.

6 **REFERENCE DOCUMENT**

Appendix 1

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

1.10 “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 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 given above, then the test specimen shall be of the maximum height to be used in practice. (The latter part of the first section is not necessary today and future, therefore to be deleted.)

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
- thickness of plating 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 full 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) may 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 (deck).
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 paragraph 2.8.3 (ceilings). The distance between the steel bulkhead/deck and the insulating membrane shall be stated.

2.1.4  Light weight constructions

The test specimen shall have dimensions, design and description as described in paragraphs 2.4.1, 2.4.2 and 2.4.3.

2.2  “A” class decks

2.2.1  Dimensions

2.2.1.1 The minimum overall dimensions of 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 ± 0.5 mm
- thickness of plating 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.

2.2.3  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  
[This figure is the same as the figure 2 of resolution A.754(18).]

**Figure 3** – Connection between restraint frame and structural steel core  
[This figure is the same as the figure 3 of resolution A.754(18).]
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 2.3.2.2).

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

2.3.2.12 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.

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

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

[2.3.2.15 Large size door (case-by-case approval), larger than those which can be accommodated in the standard specimen size (e.g., 2,440 mm wide and 2,500 mm high) can be tested in larger bulkheads of similar design or specimens of the door can be prepared and can be tested in following manner:

.1 actual dimensions in the direction and components in the thickness direction of the door shall be incorporated into the specimen;

.2 the weak points such as hinges and joints shall be incorporated into the specimen;

.3 the specimen shall contain the top edge of the door leaf and the related door frame part; and

.4 the specimen shall contain the bottom edge of the door leaf and the related door frame part.

The arrangement of the specimens in relation to the actual large size door shall be documented and shall be to the satisfaction of the Administration.]

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;
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

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 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 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 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 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 confirm agreement between the actual specimen and the drawings and the laboratory is able to 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 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 2.6.2.3).

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 subsection 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 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 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 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 subsection 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.

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) may 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 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 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 subsection 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.
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) may 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 details of the components used for this purpose, details of joints, connections, air gaps and all other details.

3 MATERIALS FOR TEST SPECIMENS

3.1 Specifications

Prior to the test, the following information 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 flexible 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 binder 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 section 4.

3.2.1.4 For the determination of the thickness, the density and the moisture and/or binder 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 characteristics

3.2.3.1 If necessary (see subsection 3.1), non-combustibility tests in accordance with part 1 of this annex shall be conducted.
3.2.3.2 Where materials used in the construction of the specimen are required to be non-combustible, i.e. for "A" class and "B" class, evidence in the form of test reports in accordance with the test method in part 1 issued by a testing laboratory recognized by the Administration shall be provided. These test reports shall not be more than [24] months old at the date of the performance of the fire resistance test. If such reports cannot be provided, then tests as prescribed in pat 1 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 issued by a testing laboratory recognized by the Administration shall be provided. These test reports shall not be more than [24] months old at the date of the performance of the fire resistance test. If such reports cannot be provided then tests as prescribed in part 5 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 referred to in paragraphs 7.5.1.1 and 7.5.1.2.

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 Specimens of each material, measuring minimum 60 mm x 60 mm x thickness of the material, shall be weighed (initial weight W₁) and then heated in a ventilated oven at a temperature of 105 ± 2°C for 24 h and reweighed when cooled (W₂). However, gypsum-based, cementation and similar materials shall be dried at a temperature of 55 ± 5°C to constant weight (W₂).

3.2.7.2 The moisture content (W₁-W₂) of each specimen shall be calculated as a percentage of the dry weight (W₂).
3.2.8 Organic content

After the percentage moisture contents have been calculated as specified above, the specimens shall be further heated in an oven at a temperature of 550 ± 20°C for 24 h and again weighed \( W_3 \). The binder content \( W_2 - W_3 \) shall be calculated as a percentage of the dry weight \( W_2 \).

[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 shall not be tested until it has reached an air-dry condition. This condition is defined as an equilibrium (constant weight) with an ambient atmosphere of 50 ± 5% relative humidity at 23 ± 2°C.

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 subsection 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/m³ and 2,400 kg/m³. 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, 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.

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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 section 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

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: 1999 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: 1999[, except that the diameter of the thermocouple shall be 3 ± 0.2 mm].

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 aluminum (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 1 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 screw 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/m³.

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 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 section 2. For specimens larger than specified in section 2, additional thermocouples shall be provided in the proportion one per 1.5 m² of the specimen area. In case of a door assembly, specimen area refers to the entire bulkhead construction with the door fitted.

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.

![Furnace thermocouple assembly](image)

**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.

![Pressure-sensing heads](image)

**Figure 5 – Pressure-sensing heads**

[This figure is not different from figure 5 of resolution A.754(18).]
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/m³.

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 mm², 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 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](image-url) – Unexposed-surface thermocouple junction and insulating pad

[This figure is not different from the figure 6 of resolution A.754(18).]

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 binding 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 overlayed 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 paced 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;
when a construction has two differently orientated joint details, for example normal to each other, then two thermocouples additional to those already described in 7.5.1.3 above shall be used, one on each of two intersections;

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

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

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:

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;

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

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:

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;

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

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;
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;

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

two thermocouples on the top panel, and two thermocouples on the joint between the top panel and the adjacent bulkhead panels. All thermocouples located 125 mm above the top of the door leaf;

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;

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); and

the door constructions, which incorporate a top panel, shall always be tested with thermocouples on the unexposed face of the top panel and of the joining profiles at a level 125 mm above the top of the door leaf.

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

[This figure is the same as figure 7 of resolution A.754(18).]

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

[This figure is the same as figure 8 of resolution A.754(18).]

**Figure 9** – Position of unexposed-face thermocouples for “B” and “F” class division

[This figure is the same as figure 9 of resolution A.754(18).]

### 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 834-1:1999.

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 pad holder](image)

[This figure is the same as figure 10 of resolution A.754(18).]

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.

![Figure 11 – Gap gauges](image)

(A gap gauge of 12 mm diameter is to be added.)

8 Method of test

8.1 General

The test shall be carried out generally in accordance with the standard ISO 834: Part 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 20 ± 10°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.

8.2.1 Ambient conditions

The laboratory shall be virtually draught free during the test. The ambient temperature shall be 20 ± 10°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 subsection 7.2 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 per cent 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:

\[
\begin{align*}
\pm 15\% & \quad \text{from } t = 0 \text{ to } 10 \quad \text{(i)} \\
\pm (15-0.5(t-10))\% & \quad \text{from } t = 10 \text{ to } 30 \quad \text{(ii)} \\
\pm (5-0.083(t-30))\% & \quad \text{from } t = 30 \text{ to } 60 \quad \text{(iii)} \\
\pm 2.5\% & \quad \text{from } t = 60 \text{ and over} \quad \text{(iv)}
\end{align*}
\]

where:

\[d = \left(\frac{A - As}{As}\right) \times 100\%\]

\(A\) 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 of 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 naming under examination, for a period of 30 s, or until ignition (defined as glowing or naming) 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. The cotton wool pad shall not be used when the temperature on the unexposed surface, in the vicinity of the opening, has exceeded 300°C. A cotton-wool pad shall be used only once.

8.4.3.3 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.
8.4.3.4 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.

8.4.3.5 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 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. Three 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 12 mm gap gauge can be passed through the specimen such that the gauge projects into the surface; or
3. whether the 25 mm gap gauge can be passed through the specimen such that the gauge projects into the surface.

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, 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. 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 door is mounted with 13 mm gap, the 25 mm gap gauge may be used to determine 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, mating 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 minimum 60 min when the specimen is of an “A” class division, with a structural steel core which is imperforate (e.g., without 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 minimum 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 FTP Code (see also paragraph .2 below);
any deviations from the test method;

name and address of the testing laboratory;

date and identification number of the report;

name and address of the sponsor;

name and/or identification of the product tested;

the name of the manufacturer of the test specimen and of the products and components used in the construction,

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

fire resistant class of the product, i.e. “A-60”, “A-30”, “B-0”, “F-30”, etc.;

the constructional details of the test specimen, including description and drawing and principal details of components. All the details requested in section 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;

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;

date of the test specimen arrival;

details of specimen conditioning;

date of test;

test results:

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;
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 subparagraphs .1 and .3 above) or, if the test is terminated due to the insulation criteria having been exceeded, the times at which limiting temperatures were exceeded; and

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;

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 proviso regarding non-combustibility, under the heading "Classification":

“A deck constructed as described in this report may be regarded as a “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 FTP Code.”

the name of the representative of the Administration present at the test. When a test is not witnessed by a representative of the Administration 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”.

(alternative proposal)
[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.]

a statement that the test has been conducted in accordance with the requirements of this appendix and if any deviations have been made to the prescribed procedures (including any special requirements of the Administration), a clear statement of the deviations; and

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”.

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Appendix 2

Testing of windows, fire dampers, pipe 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 of 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 fun-size dimensioned structural cores as specified in the resolution.

A.I – Windows

1 GENERAL

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.

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 this appendix, 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 of “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. The cotton-wool pad has to be used for windows required to have a classification other than “A-0”.

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 of the thermocouples fixed to the face of the window pane(s) and the window frame 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**

“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 9.2 of appendix 1, 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.

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 subsection 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 constructed in accordance with subsection 2.1.1 of appendix 1 and shall be insulated damper shall be 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 spigots, which shall be welded or bolted into the structural core. The coaming or spigot shall be insulated as shown in figure A1. The coaming or spigot including the damper shall have a length of 900 mm (450 mm on each side of the structural core) and a thickness as follows:

<table>
<thead>
<tr>
<th>Width or diameter of the duct</th>
<th>Minimum thickness of coaming or spigot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 300 mm</td>
<td>3 mm</td>
</tr>
<tr>
<td>760 mm and over</td>
<td>5 mm</td>
</tr>
</tbody>
</table>

2.2.3 The length of the coaming on the exposed side shall be at least 100 mm. The total length including damper shall be increased to comply with this section.

2.2.4 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.

2.2.5 The test specimen shall include the actual dimension and arrangement of the damper and coaming or spigots to be used in actual installation.

* Width means the greater of the two cross-sectional dimensions.
2.2.3 The coamings or spigots (including insulation) shall be positioned only in the top half of a bulkhead but shall be no closer than 200 mm from the edges of a bulkhead or a deck. Where more than one damper is to be tested simultaneously in a division, the separation between adjacent coamings or spigots (including insulation) shall not be less than 200 mm. When more than one damper is included in a bulkhead, the top edges of all dampers shall be, as far as possible, at the same height.

2.2.4 The fire dampers shall be positioned on the exposed face of the bulkhead or deck, at a distance of at least 225 mm from the structural core, with their operative controls also on that side of the division.

2.2.5 The distance between the fire damper and the structural core specified in this subsection means the distance between the fire damper centre and the structural core.

2.2.6 Fire dampers which are operated automatically shall be in the open position at the start of the test.
3 INSTRUMENTATION

3.1 Positioning of thermocouples on the specimen

3.1.1 For each fire damper, two thermocouples 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 division; 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 For fire dampers in bulkheads, for each of the positions indicated above, one of the thermocouples shall be fixed on the top surface of the coaming or spigot and the other thermocouple shall be fixed on the 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.

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 unexposed surface at the spigot or coaming exceeding 180°C above the initial temperature. The average temperature rise is not relevant.

A.III – Pipe and duct penetrations

1 GENERAL

“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.

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.

This section refers from hereon 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 subsection 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 subsection 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.

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

[Testing of “A-0” class pipe penetration in “A-60” bulkhead may be accepted if there is minimum 200 mm uninsulated area around the penetration (the test setup shall be submitted to the Administration for verification before testing).]

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 bulkhead penetration is fitted symmetrically, approval would give approval for general application. For bulkhead penetrations with exposed or unexposed fitted frame, one test for each fitting is required in order for obtaining general application.

When deck penetration is fitted on exposed side, general application will be given. When the deck penetration is fitted symmetrically or on unexposed side, a penetration fitted on exposed side will be required in order to obtain general application.]
[When deck penetration is fitted on exposed side or is fitted symmetrically, general application will be given. When the deck penetration on unexposed side, the approval will limit the penetration to the tested orientation.]

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 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 Penetrations and transits 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 180°C above the initial temperature. The average temperature rise is not relevant.
A.IV – Cable transitis

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 subsection 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 subsection 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.

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

Testing of “A-0” cable transits in “A-60” bulkhead may be accepted if there is minimum 200 mm uninsulated area around the penetration (the test setup shall be submitted to the Administration for verification before testing).]

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.
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 pipe shall restrain it from movement during the test.

2.2.5 Cable transits shall be welded or bolted into the bulkhead or deck. 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 panels 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.

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 No more than 40% of the inside cross-sectional area of each transit shall be occupied by cables and the distances between adjacent cables and between the cables and the inside of the transit shall be the minimum which is allowable for the actual penetration sealing system.

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

When deck cable transit is fitted on exposed side, general application will be given. When the deck cable transit is fitted symmetrically or on unexposed side, a penetration fitted on exposed side will be required in order to obtain general application.

(Alternative proposal to the second paragraph above.)
[When deck cable transit is fitted on exposed side or is fitted symmetrically, general application will be given. When the deck cable transit on unexposed side, the approval will limit the penetration to the tested orientation.]

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;

.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; and
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.

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

The performance of cable transits may be related to their ability to satisfy both the requirements for insulation and integrity. Penetrations and 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 180°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 tests 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 fluxmeter calibrated with the restricted view to indicate incident heat flux. The fluxmeter shall be water-cooled and capable of measuring heat flux 0 kW/m² to 60 kW/m². The fluxmeter should be calibrated at least once a year against a standard device.

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

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

**Figure**

[This figure is the same as the figure of the existing FTP Code, annex 1, part 3.]

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 the table.

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**

<table>
<thead>
<tr>
<th>Fire resistant division classification</th>
<th>Time period from beginning of test to</th>
<th>Heat flux ( E_c ) (kW/m(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>“A-0”</td>
<td>60 min</td>
<td>56.5</td>
</tr>
<tr>
<td>“A-15”</td>
<td>15 min 60 min</td>
<td>2.34 8.0</td>
</tr>
<tr>
<td>“A-30”</td>
<td>30 min 60 min</td>
<td>2.34 6.4</td>
</tr>
<tr>
<td>“A-60”</td>
<td>60 min</td>
<td>2.34</td>
</tr>
<tr>
<td>“B-0”</td>
<td>30 min</td>
<td>36.9</td>
</tr>
<tr>
<td>“B-15”</td>
<td>15 min 30 min</td>
<td>2.34 4.3</td>
</tr>
</tbody>
</table>
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 forming “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 forming “continuous ‘B’ class construction”.
Part 4 – Test for fire door control systems

As contained in the annex to document FP 52/4/4 with modification described in the annex to document FP 53/4 (Report of the working group at FP 52 (part 2)).
Part 5 – Test for surface flammability

(Test for the 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 for bulkhead or ceiling 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 x the density used during testing) or with a greater thickness if the density is more than 400 kg/m³. 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 x 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 2 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, which average values for all of the surface flammability criteria, as listed in the following table, do not exceed the value listed in the following table, 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, ceiling linings and primary deck covering shall not produce burning droplets during the test. (It shall be considered as a reject material regardless of the surface flammability criteria.) For floor covering, no more than 10 burning drops are acceptable.

<table>
<thead>
<tr>
<th>Table 1 – Surface flammability criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulkhead, wall and ceiling linings</td>
</tr>
<tr>
<td><strong>$CFE$ (kW/m$^2$)</strong></td>
</tr>
<tr>
<td><strong>$Qsb$ (MJ/m$^2$)</strong></td>
</tr>
<tr>
<td><strong>$Qt$ (MJ)</strong></td>
</tr>
<tr>
<td><strong>$Qp$ (kW)</strong></td>
</tr>
<tr>
<td>Burning droplets</td>
</tr>
</tbody>
</table>

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 three values of average heat for sustained burning, as defined in subsection 9.3 of the 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: 2002 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, when no upper layer applied on it, it shall be considered as the “floor covering”, and shall comply with the requirement 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 criteria for linings and ceilings, according to appendix 1 to this part, shall be applied for such exposed surfaces. The calcium silicate board described as a dummy specimen specified in paragraph 3.3 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 in section 10 of appendix 1.

6 Reference documents


ISO 13943: [2009], Fire safety – Vocabulary.

Appendix 1

Fire test procedures for surface flammability of bulkhead, ceiling, deck finish materials and primary deck coverings

WARNING

1 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.

2 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: [2009], Fire safety – Vocabulary; and


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, used in every test to back the specimen.

3.2 Calibration board is a dummy specimen as defined by figure 14, 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 $950 \pm 100 \text{ kg/m}^3$ and shall measure $800 \pm 5 \text{ mm long, 155 } \pm 5 \text{ mm wide and } 25 \pm 2 \text{ mm thick.}$

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 $150 \text{ mm}$ 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. The longest time used in this calculation shall correspond to flame arrival at a station at least $30 \text{ mm}$ prior to the position of furthest flame propagation on 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 $50 \text{ mm}$ 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 $155 \text{ mm x 800 mm}$ 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 5658-2:2006. 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, two parts of pilot burners, 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-fluxmeters, 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 the appendix. 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 paragraph 4.3.1 and subsection 4.6 in 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.

*  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/m².

I:\FP\53\INF-4.doc
6.2.1  *Adjustment of the pilot burner*

6.2.1.1 Adjust the propane gas and air flow rates to about 0.4 \text{l}/\text{min} and 1.0 \text{l}/\text{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 9 of appendix 1). 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 impinge over the top half of the exposed specimen height.

6.2.1.3 The pilot flame shall be checked and, if necessary, adjust in the way stated above every day. The nature of some specimen may make this necessary 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 marine board specimen of about 20 mm thickness (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 panel operating level even when tests are in progress. Both signals shall remain essentially constant for three minutes 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 1 and referred to in the calibration procedure mentioned in subsection 6.1 above.
7 SPECIMENS

7.1 Number required

7.1.1 Specimen required

At least six specimens shall be provided for each different exposed surface.

7.1.2 Required number of the test

Three specimens shall be tested for each different exposed surface of the product evaluated and applied. Condition of retest is described in subsection 8.3.

7.2 Dimensions

7.2.1 The specimens shall be 155 ± 5 mm wide by 800 ± 5 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 to 50 ± 3 mm.

7.3 Substrate

7.3.1 Substrate of surface material and floor coverings

Materials and composites materials shall be tested using their full thickness, attaching to the substrate to which they will be attached in practice when an adhesive if appropriate. The test specimen shall be reflecting actual application on ships.

7.3.2 Substrate of primary deck covering

Specimen shall be applied to a steel plate having the thickness of 3 ± 0.3 mm. The specimens shall have a nominal thickness and the components and construction of the deck covering shall be the same as those used in practice.

7.4 Composites materials

7.4.1 Assembly shall be as specified in subsection 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 be reflecting 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 tested face 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 ± 10%. 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, 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 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 subsection 6.3. Start the millivolt recorder recording the output signal of the stack thermocouples, as well as signal from the total radiation pyrometer or heat flux meter positioned, as described in paragraph 6.3.2.

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 10s. 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, which is longer; or
3. flaming reaches the end of the specimen or self-extinguishes and thus ceases progress along the specimen. This criterion shall only be used when heat release measurements are not being made.

8.2.2 Operations in paragraph 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 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;
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 of appendix 1 to this part; or
.3 In case carpets or non-rigid specimens ignites very quickly, this could be caused by pile extension above holder surface, reducing space to pilot flame. In this case, repeat with shims as required by procedure in paragraph 8.1.1.

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 measurements of incident 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 during the conduct of the test. The following data shall be derived from the test results.

9.1 Heat for ignition

As defined in subsection 3.7.

9.2 Heat for sustained burning

A list of the values of this characteristic as defined in subsection 3.9.

9.3 Average heat for sustained burning

9.3.1 An average of the values for the characteristic defined in 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 180 mm position, the heat of sustained burning is not defined. If the heat of sustained burning is not defined for one specimen, \( Q_{sb} \) is calculated using the data from the other two samples. If the heat of sustained burning is not defined for two samples, \( Q_{sb} \) is calculated using the data from the third sample. If the heat of sustained burning is not defined for all three samples, \( Q_{sb} \) is undefined and the criterion of \( Q_{sb} \) 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.

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 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 section 9; and

.3 observations recorded in accordance with subsection 8.4;

.16 classification of the material;

.17 a statement that the test has been conducted in accordance with the requirements of this part and if any deviations have been made to the prescribed procedures (including any special requirements of the Administration), a clear statement of the deviations; 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

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 5658-2:2006.

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 m³/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;

.2 the gas used may be either natural gas or methane. 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/m². 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 m³/h to 3.7 m³/h for natural gas or methane at a pressure to overcome line pressure losses;

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* Flashback limits the maximum operating level with propane.
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

a dummy specimen is a non-combustible board (for example, calcium silicate board) of oven-dry density of $950 \pm 100 \text{ kg/m}^3$ and shall measure $800 \pm 5 \text{ mm long, } 155 \pm 5 \text{ mm wide and } 25 \pm 2 \text{ mm thick and 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 $0 \text{ kW/m}^2$ to $50 \text{ kW/m}^2$ 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: [2006], 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 $\pm 5\%$.

2.2.3 The target sensing of the applied flux should occupy an area not more than $80 \text{ mm}^2$ and be located flush with and at the centre of the water-cooled $25 \text{ 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 \text{ 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 $5 \text{ mm/s}$ 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 of fluxmeter 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 micro V 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 m³ 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 m³/min. The ceiling grill 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 one metre 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 subsection 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 subsection 3.3 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 subsection 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 a special dummy specimen, the flux incident 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 subsection 3.3 (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 one 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 two minutes. 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 subsection 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/m² 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 m³/min to 0.02 m³/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 12. 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 following instructions assume that parts of the flammability test apparatus have been made according to the drawings. 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 or 75 mm. Unless there is a real need for test of thicker specimens, assembly for 50 mm specimens is preferable.

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 larger diameter may correct the problem.

5.5 The four panel support brackets should be fastened to the radiant panel at 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 degree 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 level to ensure that it also lies in a vertical plane.

5.10 The specimen frame with specimen support rails on side and bottom positions and pilot burner holders 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 100 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 degrees 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 degrees 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 6) 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 6) 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 7, is maintained. Another way of adjustment to dimension A is through changes in the number of washers mentioned in subsection 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 flux to the specimen

<table>
<thead>
<tr>
<th>Distance from exposed end of the specimen (mm)</th>
<th>Typical flux levels at the specimen (kW/m²)</th>
<th>Calibration position to be used (kW/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>49.5</td>
<td>50.5</td>
</tr>
<tr>
<td>50</td>
<td>50.5</td>
<td>x</td>
</tr>
<tr>
<td>100</td>
<td>49.5</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>47.1</td>
<td>x</td>
</tr>
<tr>
<td>200</td>
<td>43.1</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>37.8</td>
<td>x</td>
</tr>
<tr>
<td>300</td>
<td>30.9</td>
<td></td>
</tr>
<tr>
<td>350</td>
<td>23.9</td>
<td>23.9</td>
</tr>
<tr>
<td>400</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>450</td>
<td>13.2</td>
<td>x</td>
</tr>
<tr>
<td>500</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>6.2</td>
<td>x</td>
</tr>
<tr>
<td>600</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>3.1</td>
<td>x</td>
</tr>
<tr>
<td>700</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>1.5</td>
<td>x</td>
</tr>
</tbody>
</table>

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 with 5%. Calibration data at other positions should agree with typical values within 10%.

Figure 1 – General view of the apparatus
(This should be replaced by a new photo.)

Figure 2 – View from specimen
(This should be replaced by a new photo.)
Figure 3 – View from radiant panel end
(Existing figure 3 shows out of date configuration and to be deleted.)

Figure 4 — Radiant panel with reverberatory wires viewed through specimen frames
(The reverberatory wires shown in the existing figure 4 is wrong. So, this figure should be deleted.)

Figure 5 – Pilot burner and mount
(Pilot burner configuration has been changed. So, the existing figure 5 should be deleted.)

Figure 3 – Specimen – panel arrangement
Figure 4 – Position of stack and specimen

Figure 5 – Pilot burner details and connections
(Paste here figure 7 of standard ISO 5658-2)

Figure 6 – Position of pilot flame
Figure 7 – Diagrammatic sketch of thermocouple circuit

Two sets of thermocouples 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 term 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 $\Delta U$ to heat release rate of the specimen
(a) millivolt signal change recorded during test
(b) millivolt signal converted to heat release rate curve

Figure 11 – Special calibration dummy specimen for flux gradient calibration
(This figure should be replaced by figure 8 of standard ISO 5658-2.)
**Appendix 3**

**Interpretation of results**

Evaluating unusual test specimen behaviour (see subsection 2.2 of this part)

<table>
<thead>
<tr>
<th>Unusual behaviour</th>
<th>Guidance on classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Flashing, no steady flame</td>
<td>Report furthest progress of flame and time, and whether or not flash is on centreline. Classify on basis of the data.</td>
</tr>
<tr>
<td>2  Explosive spalling, no flashing or flame</td>
<td>Accept material as passing test.</td>
</tr>
<tr>
<td>3  Rapid flash over surface, later steady flame progress</td>
<td>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.</td>
</tr>
<tr>
<td>4  Specimen or veneer melts and drips off, no flame</td>
<td>Report behaviour and extent of advance on specimen.</td>
</tr>
<tr>
<td>5  Explosive spalling, and flame on exposed part of specimen</td>
<td>Report explosions and classify on basis of flame progress irrespective of whether above or below centerline.</td>
</tr>
<tr>
<td>6  Specimen or veneer melts, burns, and drips off</td>
<td>Reject material regardless of criteria. For floor covering, no more than 10 burning drops are acceptable.</td>
</tr>
<tr>
<td>7  Pilot flame extinguished</td>
<td>Report occurrence, reject data and repeat test.</td>
</tr>
<tr>
<td>8  Heat release signal after test and re-insertion of dummy specimen remains at a higher or lower level than initial stabilizing level.</td>
<td>Reject data and stabilize the equipment, then repeat test.</td>
</tr>
<tr>
<td>9  Very short ignition delay on carpets or non-rigid specimens</td>
<td>Could be caused by pile extension above holder surface, reducing space to pilot flame. Repeat with shims as required by procedure in paragraph 8.1.1 of appendix 1 to this part.</td>
</tr>
<tr>
<td>10 Specimen breaks up, and falls out of holder</td>
<td>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.</td>
</tr>
<tr>
<td>11 Substantial jetting combustible pyrolysis gases from specimen, adhesive or bonding agents</td>
<td>Reject material.</td>
</tr>
<tr>
<td>12 Small flame remaining along the edge of specimen</td>
<td>Report behaviour and terminate the test 3 min after flaming on exposed surface of specimen ceased.</td>
</tr>
</tbody>
</table>
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 document provides recommended guidelines for the selection and preparation of specimen for surface materials for the FTP Code, parts 2 and 5 including selection of substrates or backing materials. This document 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 the representative of the characteristic of the product in actual operating condition in ships. It means that the product, which would be expected to 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 $50 \pm 3$ mm (part 5, appendix 1, paragraph 7.2.1).

2.3 Substrate

Substrate of surface material and floor coverings: Materials and composites materials should be tested using their full thickness, attaching to the substrate to which they will be attached in practice when an adhesive, if appropriate. The test specimen should be reflecting actual application on ships (part 5, appendix 1, paragraph 7.3.1).

2.4 Composites

Assembly should be as specified in subsection 7.2 (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 (part 5, 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 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 (part 5, paragraph 4.2.3).

2.5.2 Therefore, multilayered floor covering, such that each layer complying part5 of “criteria of floor covering”, is accepted, or a test of composite condition may be done. This makes it possible to interchange the layers as long as the each material used is complying with part 5.

2.6 Colour variation and organic contents of the specimen

Usually the influence of colour and organic contents of the specimen give the significant effect to the result of fire test. The organic content of the specimen is a key factor of the combustion characteristic of 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, 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 ($Q_t$) of not more than 0.2 MJ and the peak heat release rate ($Q_p$) 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 subsection 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 section 2, the range of type approval would be considered according to its specimen selection including its substrate or backing material.

3.2 Table-2 shows the relationships of the specimen substrate and the range of type approval of surface materials.
In the following table:

First column: product to be tested.
Second column: substrate.
Third column: range of approval and restriction in use.

<table>
<thead>
<tr>
<th>Products</th>
<th>Test substrate</th>
<th>Limitation of product application for ships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paints and surface veneer</td>
<td>steel (e.g., 1mm)</td>
<td>1 Products can be applied to any metallic base of similar or thicker substrates (metallic bases such as Steel, Stainless steel or Aluminium alloy).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 It is not approved to apply to the non-combustible materials.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Limitation, as appropriate, to ensure that the product is covered by test specimen (such as thickness, adhesive, organic content, density, range of colours).</td>
</tr>
<tr>
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<td>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.</td>
</tr>
<tr>
<td>Standard calcium silicate board, described as a dummy specimen, specified in subsection 3.5 of appendix 1</td>
<td></td>
<td>1 Products can be applied to any non-combustible substrate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 It is not approved to apply to the metallic substrate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Limitation, as appropriate, to ensure that the product is covered by test specimen (such as thickness, adhesive, organic content, density, range of colours).</td>
</tr>
<tr>
<td>Surface veneer</td>
<td>No substrate used at the test (The product has enough thickness for testing without substrate)</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Limitation, as appropriate, to ensure that the product is covered by test specimen (such as thickness, density, material composition, adhesive and application rate, and range of colours).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 When the products to be applied to bulkheads or ceilings by using adhesive, combination test with adhesive should be required.</td>
</tr>
<tr>
<td>Floor covering and primary deck</td>
<td>Thick steel (e.g., 3mm)</td>
<td>1 Limitation by the specimen colour and organic contents that was tested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 May be applied over any low flame-spread floor covering, steel, or non-combustible material.</td>
</tr>
</tbody>
</table>
### Products | Test substrate | Limitation of product application for ships
--- | --- | ---
Coverings | Combination test (combination of layers) | 1. Limitation, as appropriate, to ensure that the product is covered by test specimen (such as thickness, density, material composition, adhesive and application rate, and range of colours).
2. 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 section 3, the choice of specimen including substrate should be considered carefully. This section specifies how to make the test specimen for the FTP Code, parts 2 and 5.

### 4.1 Test specimen

The test specimen shall be selected as the representative of the product. It means that the product, which would be expected to the worst result, should be selected.

### 4.2 Application in ships

[Materials and composites materials should be tested using their full thickness, attaching to the substrate to which they will be attached in practice with an adhesive if appropriate. The test specimen should be reflecting actual application on ships (part 5, appendix 1, paragraph 7.3.1).]

[The specimen should be tested using the thickness specified in subsection 2.2. The substrate should be selected with consideration of the substrates to which they will be attached to 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 Test specimen for part 2

Preparation of test specimen, for smoke and toxicity test, shall be in accordance with the practice outlined in parts 3 and 5 of the Code (refer part 2, subsection 2.2). Therefore, the specimen for the smoke and toxicity test, FTP Code, part 2, should be tested with the same specimen for part 5.

### 4.5 Specimen size

4.5.1 For part 5: width 155 ± 5 mm, length 800 ± 5 mm (part 5, appendix 1, paragraph 7.2.1).

4.5.2 For part 2: width 75 ± 1 mm, length 75 ± 1 mm (part 2, appendix 1, paragraph 6.2.1).
4.6 Specimen thickness

4.6.1 The specimen should be tested using their full thickness (part 5, appendix 1, paragraph 7.2.2).

4.6.2 For part 5: maximum 50 ± 3 mm (part 5, appendix 1, paragraph 7.2.2).

4.6.3 For part 2: maximum 25 ± 1 mm (part 2, appendix 1, paragraph 6.2.3).

4.6.4 If the product thickness is greater than in paragraphs 4.6.2 and 4.6.3 above, the specimens should be obtained by cutting away the unexposed face to reduce to the above maximum thickness.

4.7 Colour variation of the paints or surface materials

If the product has some colour variation, specimen should be carefully selected as the representative of the products, in accordance with the following.

4.7.1 Organic contents

Carefully select the product with maximum organic content when applied by maximum thickness shown in subsection 4.6 above, considering the maximum organic content of the product, when the product would be applied by this maximum thickness.

4.7.2 Colour of the specimen

Black or dark colour should be selected.

4.7.3 Order of priority about specimen colour and organic contents

When the product of darkest colour is different from the product with maximum organic content, the Administration or the testing laboratory may decide the specimen. If the amount of organic contents between black or dark colour specimen and white or bright colour specimen are similar (in difference within 5%), black or dark colour specimen should be chosen. Otherwise, the specimen with the maximum organic content should be selected.

4.7.4 Information of the colour variation and its organic content

Applicants or manufacturers who request the Type approval should submit the information of the colour variation and its organic content to the Administration or testing laboratories. The Administration or testing laboratories may order/advise to the applicant for the selection of the test specimens when necessary.

4.7.5 Attention at the type approval issued

When approving, if the specimen tested can be considered as the representative specimen (i.e. dark 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 similar conditioned product as tested.
4.8 Substrate

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).

4.9 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 similar or higher thickness of the substrate that was tested (part 5, paragraph 1.3 and part 5, appendix 1, paragraph 7.3).

4.10 Substrate of floor coverings

4.10.1 The same as for primary deck coverings, a floor covering should be applied to a steel plate thickness of 3 ± 0.3 mm.

4.10.2 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 (FTP Code, annex 2, paragraph 5.2).

4.11 Composite materials (for bulkhead and ceilings)

4.11.1 Assembly should be as specified in subsection 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.

4.11.2 When the product that has a multilayer construction would be applied to the bulkheads and ceilings, the surface flammability test of combination of each layer should be required to confirm the influence of these underlying constructions (part 5, appendix 1, paragraph 7.4.1).

4.12 Test of adhesives described in the FTP Code, annex 1, part 3

The calcium silicate board described as a dummy specimen, specified in subsection 3.3 of appendix 1 to part 5 should be used as a standard substrate for adhesives.
Part 6 – Test for primary deck coverings

(This part is intentionally left blank.)

Part 7 – Test for vertically supported textile and films

As contained in annex to document FP 52/4/8 with modifications described in the annex to document FP 53/4 (Report of the working group at FP 52 (part 2)).

Part 8 – Test for upholstered furniture

As contained in annex to document FP 52/4/9 with modifications described in the annex to document FP 53/4 (Report of the working group at FP 52 (part 2)).

Part 9 – Test for bedding components

As contained in annex to document FP 52/4/10 with modifications described in the annex to document FP 53/4 (Report of the working group at FP 52 (part 2)).

Part 10 – Test for fire-restricting materials for high-speed craft

As contained in annex to document FP 52/4/11 with modifications described in the annex to document FP 53/4 (Report of the working group at FP 52 (part 2)).

Part 11 – Test for fire-restricting divisions for high-speed craft

As contained in annex to document FP 52/4/12 with modifications described in the annex to document FP 53/4 (Report of the working group at FP 52 (part 2)).
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 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 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 1.0 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. It 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:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Product description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class “A-0” bulkhead</td>
<td>A steel bulkhead with dimensions not less than the minimum dimensions given below:</td>
</tr>
<tr>
<td></td>
<td>- thickness of plating: 4 mm</td>
</tr>
<tr>
<td></td>
<td>- stiffeners 60 x 60 x 5 mm spaced at 600 mm or structural equivalent</td>
</tr>
<tr>
<td>Class “A-0” deck</td>
<td>A steel deck with dimensions not less than the minimum dimensions given below:</td>
</tr>
<tr>
<td></td>
<td>- thickness of plating: 4 mm</td>
</tr>
<tr>
<td></td>
<td>- stiffeners 95 x 65 x 7 mm spaced at 600 mm or structural equivalent.</td>
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</tbody>
</table>

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 section 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)
## Table 1 - Fire protection materials and required approval test methods for passenger ships carrying more than 36 passengers and high speed craft

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<td>“A” class bulkhead</td>
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<td>“B” class bulkhead</td>
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<td>3.4.1, 9.2.2.3</td>
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<td>“C” class bulkhead</td>
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<td>3.2.3, 9.2.2.3</td>
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<td>“B” class deck</td>
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<td>Paints, varnishes and other finishes on exposed interior surfaces</td>
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Remarks/Note: 9.3.1

Applicable regulation: SOLAS chapter II-2 and HSC Code
<table>
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<tr>
<th>Test method (FTP Code)</th>
<th>Specimen (Products)</th>
<th>Applicable regulation</th>
<th>Remarks/Note</th>
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<td>Part 2 Smoke and toxicity</td>
<td>Vapour barriers</td>
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<td>Part 3 A, B and F class division</td>
<td>Primary deck coverings</td>
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<tr>
<td>Part 4 Door systems</td>
<td>Curtain – Vertically supported textiles</td>
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<td>Part 5 Surface flammability</td>
<td>Upholstered furniture</td>
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<td>Part 6 Vertically supported textiles</td>
<td>Bedding components</td>
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<td>Part 7 Fire restricting divisions</td>
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<td>SOLAS chapter II-2 and HSC Code</td>
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<td>Part 8 Fire restricting ceilings</td>
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<td>Part 9 Fire restricting linings</td>
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<td>Load bearing fire-resisting divisions, with metal core</td>
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<tr>
<td>Load bearing fire-resistant divisions, without metal core</td>
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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 then 45 MJ/m² was required.
### Table-2: Fire protection materials and required approval test methods for cargo ships (method IC)

<table>
<thead>
<tr>
<th>Specimen (Products)</th>
<th>Part1 Non combustibility</th>
<th>Part2 Smoke and toxicity</th>
<th>Part3 A, B and F class division</th>
<th>Part4 Door systems</th>
<th>Part5 Surface flammability</th>
<th>ISO 1716 Calorific potential</th>
<th>Remarks/Note</th>
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<td>“B” class bulkheads</td>
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Applicable regulation: SOLAS chapter II-2 and HSC Code
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<td>Exposed foil, fabric or surface veneers</td>
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<td>Foil, fabric or veneer on surfaces or grounds in concealed spaces</td>
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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

ANNEX 4 is as contained in document FP 52/4/2, with the remark that tables 2 and 3 should be redrafted for better readability.