FTP3 Fire Door

(Dec 2004) (Rev.1 July 2006) (Rev.2 July 2010)

(FTP Code sub-section 5.3 and Annex 1, Part 3 – Test for "A", "B", and "F" class divisions)
~~**Paragraph 2.1, paragraphs 2.3.1 and 2.6.1 of resolution A.754(18)**~~

Regulation

FTP Code sub-section 5.3 reads:

"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."

FTP Code Annex 1 FIRE TEST PROCEDURES PART 3 - TEST FOR "A", "B" AND "F" CLASS DIVISIONS reads:

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.**

**Products tested for use in buildings have similar classification markings. However, they do not correspond to the classes in marine use.*

2 Fire test procedure

2.1 The products shall be tested and evaluated in accordance with the fire test procedure specified in resolution A.754(18). This contains test procedures also for windows, fire dampers and pipe and duct penetrations in its appendices.

2.2 Specimen sizes

2.2.1 For the purpose of this Code, the first sentence of paragraphs 2.1.1, 2.4.1 and 2.7.1 of the Annex to resolution A.754(18) is replaced by the following:

> *"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, except that the minimum overall dimensions of 2,440 mm in height and 4.65 m² in the exposed surface of the test specimen may be used in testing up to 31 December 1998. The approval expiry date is 31 December 2003 for approvals based on tests with such smaller test specimen."*

Note:

1. This UI is to be uniformly implemented by IACS Members and Associates to ships keel laid from 1 July 2005.
2. Rev.1 of this UI is to be uniformly implemented by IACS Members and Associates from 1 January 2007.
3. Rev.2 of this UI is to be uniformly implemented by IACS Societies from 1 January 2011.

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2.2.2 For the purpose of this Code, the first sentence of paragraphs 2.2.1, 2.5.1 and 2.8.1 of the Annex to resolution A.754(18) is replaced by the following:

"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, except that the minimum overall dimensions of 2,440 mm in length and 4.65 m² in the exposed surface of the test specimen may be used in testing up to 31 December 1998. The approval expiry date is 31 December 2003 for approvals based on tests with such smaller test specimen."

2.2.3 The specimen sizes shall be given in the test reports.

2.3 Where thermal radiation through windows is required to be limited, the window assembly may be tested and evaluated in accordance with appendix 1 of this part.

2.4 Where ceilings or linings are required to be continuous "B" class ceilings or linings they may be tested and evaluated in accordance with appendix 2 of this part.

3 Additional requirements

3.1 The integrity of class "B" constructions shall be achieved with non-combustible materials. Adhesives used in the construction of the specimen are not required to be non-combustible; however, for the purpose of this Code, they shall have low flame-spread characteristics.

3.2 Materials placed at "B" class panel joints for avoiding vibration or noise transmission shall be of low flame spread characteristics and fire tested with "B" class divisions along which they are used. However, such materials shall be non-combustible if they are necessary to support the non-combustible "B" class structure or to achieve the required integrity.

3.3 Doors and shutters, which are fitted above the bulkhead deck and which are required to meet both fire protection and watertight requirements, shall comply with the fire protection requirements as required in the Convention, for the divisions where they are installed. The watertight doors fitted below the bulkhead deck are not required to be insulated.

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.

Interpretation

1 Methods of evaluation and testing

For sliding and hinged fire doors (in the following called “fire doors”) larger than those which can be accommodated in the standard specimen size (2,440 mm wide and 2,500 mm high), as specified in part 3 of the FTP Code,

1. if such doors can be accommodated into a larger test furnace, it is recommended to conduct a test with the full size specimen of the door; or

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2. it is recommended to use the following method for evaluation of the fire performance of the door and approval of the door may be used.

2 Fire doors of marginally larger dimensions

~~**Interpretation**~~

2.1 A fire door of marginally larger dimensions than a ~~fire tested~~ fire door tested in accordance with the FTP Code may be individually assessed and accepted for a specific project with the same classification, provided all of the following are met:

- ~~Dimensions (width, height) are not more than 15% above those of the tested door.~~
- ~~The surface area of the door is not more than 10% above that of the tested door.~~
- ~~The door design does not deviate in any other aspect from the one tested.~~
- ~~The results of the original fire test give comfortable margins.~~

1. dimensions (width, height) are not more than 15% above those of the fire door tested in accordance with the FTP Code;
2. the surface area of the door is not more than 10% above that of the fire door tested in accordance with the FTP Code;
3. the door design does not deviate in any other aspect from the fire door tested in accordance with the FTP Code; and
4. the tested door has successfully satisfied both insulation and integrity criteria for the following times, as appropriate:

"B-0"	0 min insulation	36 min integrity
"B-15"	18 min insulation	36 min integrity
"A-0"	0 min insulation	68 min integrity
"A-15"	18 min insulation	68 min integrity
"A-30"	36 min insulation	68 min integrity
"A-60"	68 min insulation	68 min integrity.

~~Doors having dimensions larger than that indicated above and larger than the standard test furnace as per resolution A.754(18) may be accepted provided that:~~

- ~~the door's design corresponds to an approved one except for the altered size and, if necessary in order to satisfy integrity requirements, the number of anchorage points such as hinges and latches; and~~
- ~~mechanical and stress calculations are carried out to justify the larger door size and its securing arrangement based on the results of the fire test of the specimen which complies with the dimensions of the standard test furnace as per resolution A.754(18).~~

3 Fire doors larger than those in section 2 above, but not exceeding 50% in surface area of a fire door tested in accordance with the FTP Code

3.1 An engineering assessment can be used to extrapolate the fire test results of a fire door tested in accordance with the FTP Code to apply to a door larger than those in section 2

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above, but not exceeding 50% in surface area of a fire door tested in accordance with the FTP Code.

3.2 Such an assessment can be accepted for verification, only if the dimensions of the door in question are greater than the maximum permitted by the IMO furnace and the results from tested door have been found satisfactory in accordance with section 1 above.

3.3 The methodology used to extrapolate the fire tests results shall include the following three steps:

1. standard fire test of the "specimen" to obtain reference temperature and structural displacements. Such a "specimen" may be either:

    1.1 a door already certified through the fire test which is identical in design to the door to be analysed (fire test to include additional instrumentation as per paragraph 3.4.2; or

    1.2 a specially-built specimen where the finite element method is to be performed to extrapolate the results of a specimen for a door having a size exceeding the maximum size allowed by the furnace of the testing laboratory; the specimen should be a mock-up of the door in question, but having a size that fits in the furnace;

2. finite element analysis in paragraph 3.6, of the "specimen" to calibrate the thermal and mechanical boundary conditions of the FEM model, which are adjusted until the numerical and experimental temperature and displacement distribution compare satisfactorily; and

3. finite element analysis in paragraph 3.5, of the door in question carried out using the model calibrated as per paragraph 3.7, assuming that the differences in the geometry and dimensions between the actual door and the specimen door do not significantly influence the results.

3.4 Data to be submitted

3.4.1 In order for the analysis to be carried out, the following information should be submitted:

1. detailed drawings of the door, the door frame and the closure and locking devices including clearances and interferences;

2. test report of the prototype used to extrapolate the results.

In this respect, additional instrumentation should consist of two sets of three 1.6 mm diameter thermocouples fitted through the thickness of the leaf, at depths of 1/3t, 1/2t, 2/3t. Such sets should be fitted, on the upper part of the door, within a circle of 100 mm in diameter whose centre is 150 mm aside of the surface thermocouples fitted in the centre of the top quarters;

3. mechanical characteristics of all materials used for the construction of the door and its insulation:

    3.1 young's module;
    3.2 yield strength; and
    3.3 density; and

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4. thermal properties:

4.1 thermal expansion coefficient;
4.2 thermal conductivity; and
4.3 specific heat.

3.4.2 Since the properties in sections 3.4.1.3 and 3.4.1.4 are temperature dependent, it is necessary that the required data be given as a function of the temperature range foreseen for the fire tests. Where it is not possible to obtain experimental data, an engineering evaluation shall be submitted with the supporting documentation for the proposed curves of variation of mechanical and thermal characteristics as a function of the temperature in the considered range.

3.5 Method of analysis

The comparison of the fire resistance of doors having larger geometry shall be carried out in two steps:

1. evaluation of the heat transmission through the specimen thickness and of the temperature on the unexposed specimen surface; and

2. evaluation of the strength characteristics and of the displacements of the structural members of the specimen.

3.6 Heat transmission analysis

3.6.1 By carrying out finite element calculations, the histories over time of the heat transmission within the structural assembly are computed and the temperature is compared with the temperature experienced by the assembly represented in the standard fire test.

3.6.2 Based on suitable data for the temperature-dependent variables, an iterative procedure is used for the evaluation of thermal-mechanic properties.

3.6.3 The thermal boundary conditions of convecting and radiative type are:

$q_c = h_c (T_s – T_\infty)$

and

$q_r = \sigma\varepsilon(T_s^4 – T_\infty^4)$

where:

q_c and q_r: Convective and radiative heat flux, respectively
h_c: Convective heat transfer coefficient
σ: Stefan-Boltzmann constant
ε: Emissivity coefficient
T_s: Surface temperature
T_∞: Furnace or ambient temperature.

3.6.4 The two equations can be included in an equivalent boundary condition:

$q = H_{eq} (\sigma, \varepsilon, T_s, T_\infty) (T_s – T_\infty)$

where:

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the equivalent coefficient H_{eq} depends on the unknown surface temperature. However, it can be calculated as part of the finite element analysis using an emissivity coefficient appropriately calibrated with the fire test results.

3.6.5 The equivalent heat transfer coefficient can be assumed to be constant on the single exposed surface, as the furnace assembly built in accordance with the FTP Code gives uniformity of the temperature and heat flux within the furnace.

3.6.6 Alternatively, the temperature distribution measured on the specimen of the standard fire test can be directly applied on the finite element structural model taking into account the same time histories.

3.7 Structural analysis

3.7.1 Using the results of the heat transmission analysis and information on temperature-dependent material properties, the thermal stresses and deformations on the geometry are evaluated. When modelling the structural assembly, attention should be paid to using a sufficient number of elements to account for the non-uniform temperature distribution within the member and to catch the non-linear temperature-dependent behaviour.

3.7.2 Once the model is prepared, the analysis is to be carried out stepwise. For each element, the incremental strain or deformation caused by a temperature increase is calculated and a new stress level is obtained based on the stress-strain relationship applicable for that particular temperature increase.

3.7.3 The mechanical boundary conditions are to be congruent in order to represent the real interaction of the door with the external frame for the overall length of the test.

4 Larger fire doors exceeding 50% in surface area of a fire door tested in accordance with the FTP Code

4.1 For larger doors exceeding 50% in surface area of a fire door tested in accordance with the FTP Code, a full analysis is to be performed as per SOLAS regulation II-2/17.

4.2 The approach shall be based on the results of the fire test of the door having the maximum dimensions permitted by the IMO furnace according to the procedure described under section 3.

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