Rules for the Certification and Acceptance on Board of Class A and B Fire Doors

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1 PREMISE

The Rules for the Classification of Ships (Pt C, Ch 4, Sec 1) require that the doors installed on A and B class divisions be type approved.
These Rules describe the procedures for the certification and acceptance on board of fire doors.

2 FIELD OF APPLICATION

These Rules apply to class A and B fire doors.

3 DEFINITIONS AND ABBREVIATIONS

3.1 MED Directive

European Community Directive 96/98/EC and subsequent amendments.

3.2 FTP Code

International Code for Application of Fire Test Procedure of the International Maritime Organization (IMO).

4 FIRE DOORS INSTALLED ON RINA CLASSED SHIPS

Class A and B fire doors intended to be installed on RINA classed ships are to be type approved by RINA and tested at the Manufacturer's facility.
Fire doors intended to be installed on ships flying a flag of one of the countries of the European Community are to be certified in accordance with the requirements of the MED Directive, under the conditions specified in item [8].
As far as classification is concerned, the certification of doors by RINA in accordance with the MED Directive is considered equivalent to RINA type approval.

5 TESTING AND CERTIFICATION OF FIRE DOORS

5.1 General

The procedures for issuance of RINA type approval certificate and those for issuance of type approval in accordance with the MED Directive (Module B) make reference to the same International Standards (FTP Code) and only differ in relation to the type of certificate issued.
The testing procedures are quite similar also when the Manufacturer applies for production certification in accordance with Module F of the MED Directive. Also in this case the main difference consists in the type of the certificate.

5.2 Type approval certification

5.2.1 Documents to be submitted

Detailed drawings of the door for the certification is requested are to be submitted for review to RINA Head Office. The drawings are to indicate all the information necessary to build the door and are to include the material characteristics.

5.2.2 Sampling

A sample built in accordance with the applicable requirements of the FTP Code is to be sent to the RINA testing laboratory or to another recognised laboratory.

5.2.3 Type test

The sample is to be subjected to the standard fire test in accordance with the requirements of the FTP Code. If the fire test is not carried out by the RINA testing laboratory, the tests are to be attended by a RINA Surveyor.

5.2.4 Issue of the certificate

Upon the satisfactory completion of the type test, a RINA Type Approval Certificate and/or a MED Directive Module B Certificate are/is issued. The certificate has a validity of five years; at the end of the validity period the repetition of the type test may be required at RINA's discretion.

5.3 Production control

5.3.1 Individual testing

All doors produced on the basis of a RINA Type Approval Certificate are to be individually tested at the Manufacturer's facility in the presence of a RINA Surveyor, in accordance with the RINA "Rules for the testing and certification of materials and marine products".
These tests are intended to verify the conformity of the door with the prototype that has been subjected to the fire test.
The doors produced by the Manufacturer are to be identical to the one subjected to the type test; no modification is acceptable unless it has been approved by RINA Head Office in accordance with the procedure indicated in [6].

5.3.2 Testing of doors certified in accordance with the MED Directive

Doors which are produced in conformity to the MED Directive Module B certificate issued by RINA are to be tested at the Manufacturer's facility in accordance with one of the following procedures:

- As indicated in item [5.3.1], if the Manufacturer has applied for the certification of the production as per the MED Directive Module F.
- As indicated in the RINA "Rules for the Certification of Marine Equipment in accordance with European Directive 96/98/CE and subsequent amendments", if the Manufacturer has applied for the certification of the production as per the MED Directive Module D or E. Also in this case no modification of the fire tested prototype is acceptable unless it has been agreed to by RINA Head Office in accordance with the provisions of [6].

6 DOORS HAVING DETAILS DIFFERENT FROM THE CERTIFIED PROTOTYPE

6.1 General

Any alterations to a door tested for the issuance of the type approval certificate are to be submitted to RINA Head Office. The Head Office will decide at its discretion whether the alterations are such as to require a repetition of the type tests or whether an extension of the approval issued for the prototype may be granted.

6.2 Evaluation of alterations

6.2.1 Doors with alterations such as not to require the repetition of the type test

Minor alterations regarding the fire resistance of the door may be accepted by RINA Head Office, based on its experience and on the documentation submitted by the Manufacturer, provided that the alterations are not such as to affect the results obtained during the prototype fire test. In such cases, RINA Head Office issues an extension of the approval with a description of the details of the prototype that have been altered.
Examples of alterations that might be considered acceptable without repetition of the fire test are the following:

a) doors of dimensions smaller than the certified prototype,
b) sliding doors with fewer leaves than the certified door, provided no leaf exceeds the dimensions of the largest leaf of the certified door,
c) hinged doors opening in a direction opposite to the certified door,
d) doors having one linear dimension (height or width) exceeding the corresponding dimension of the certified door by not more than 10%.

However, also for the above listed alterations, the extension of the approval is to be requested from RINA Head Office on a case-by-case basis.

6.2.2 Inspection of doors which require special verification for granting the extension of the approval

RINA reserves the right to grant the extension of approval of a fire door using alternative verification methods, which supply results equivalent to those obtained by the fire test indicated in [5.2.3], for those doors that cannot be considered covered by the prototype type approval certification as indicated in [6.1] and [6.2.1].
For such doors the type test may be replaced by a numeric simulation of the fire test performed through a non-linear finite element analysis, provided that the alterations are limited to variation of details relative to the door and/or door frame construction (for instance the addition or removal of some brackets or chokes) and to the increase of the door linear dimensions (width and/or height).
Such analysis is to be performed in accordance with the requirements indicated in [7] below.
Subject to the satisfactory outcome of the finite element analysis it is possible to issue an approval extension to the modified door.

7 FINITE ELEMENT ANALYSIS FOR THE SIMULATION OF THE FIRE TEST

7.1 General

A finite element analysis can be used solely to extrapolate the fire test results to a door having geometry different from the tested door.
The methodology used to extrapolate the fire tests results is based on the following three steps:

a) standard fire test of the “specimen” to obtain reference temperature and structural displacements. Such “specimen” may be either a door already certified through the fire test which has geometry similar to the door to be analysed, or a specially built specimen where the finite element method is to be performed to extrapolate the results of a specimen to an actual door having a size exceeding the maximum size allowed by the furnace of the testing laboratory;
b) finite element analysis 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;
c) finite element analysis of the actual door carried out using the model calibrated in step b), assuming that the differences in the geometry and dimensions between the actual door and the specimen door do not significantly influence the results.

7.2 Data to be submitted

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

a) detailed drawings of the door, the door frame and the closure and locking devices including the indications of clearances and interferences;
b) test report of the prototype used to extrapolate the results;
c) mechanical characteristics of all materials used for the construction of the door and its insulation;
   - young’s module
   - yield strength
   - density
d) thermal properties:
   - thermal expansion coefficient
   - thermal conductivity
   - specific heat.

Since all these properties are temperature dependent, it is necessary that the required data should 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 is to be submitted with the supporting considerations for the proposed curves of variation of mechanical and thermal characteristics as a function of the temperature in the considered range.

7.3 Method of analysis

7.3.1 General

The comparison of the fire resistance of doors having different geometry may be broken down into two steps:

a) evaluation of the heat transmission through the specimen thickness and of the temperature on the unexposed specimen surface
b) evaluation of the strength characteristics and of the displacements of the structural members of the specimen.

7.3.2 Heat transmission analysis

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.
Based on suitable data for the temperature dependent variables, an iterative procedure is used for the evaluation of thermal-mechanic properties.
The thermal boundary conditions of convecting and radiative type are respectively:

where:

$$q_c = h_c(T_s - T_\infty)$$

and

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

q_c and q_r: Radiate and convective heat flux, respectively
h_c : Convective heat transfer coefficient
σ : Stefan-Boltzmann constant
ε : Emissivity coefficient
T_S : Surface temperature
$T\infty$: Furnace or ambient temperature

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 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.
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 a remarkable uniformity of the temperature and heat flux within the furnace.
In alternative, 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.

7.3.3 Structural analysis

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 is to 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.

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

8 ACCEPTANCE OF DOORS NOT CERTIFIED BY RINA

8.1 Acceptance of doors certified by other Classification Societies or Notified Bodies

The acceptance of doors certified by another Classification Society which is part of IACS (International Association of Classification Societies) and/or by a Notified Body in accordance with the MED Directive will be considered on a case-by-case basis by RINA Head Office.
In any case such doors may be accepted upon satisfactory outcome of the examination of the following documentation:

a) constructional drawings,
b) valid certificates,
c) report on type test carried out in accordance with the requirements of the FTP Code

and of the testing of the doors before or during installation on board in order to ascertain the conformity with the certified prototype.

8.2 Doors certified by administrations of countries that are not part of the European Community

The acceptance of doors certified by or on behalf of an Administration which is not part of the European Community may be considered on a case-by-case basis by RINA Head Office, provided that the class requirements are complied with.