Part C - Suppression of Fire

Regulation 11 - Structural Integrity

1. Purpose

The purpose of this regulation is to maintain structural integrity of the ship, preventing partial or whole collapse of the ship structures due to strength deterioration by heat. For this purpose, materials used in the ships' structure shall ensure that the structural integrity is not degraded due to fire.

2. Material of hull, superstructures, structural bulkheads, decks and deckhouses

The hull, superstructures, structural bulkheads, decks and deckhouses shall be constructed of steel or other equivalent material. For the purpose of applying the definition of steel or other equivalent material as given in regulation 3.43, the "applicable fire exposure" shall be according to the integrity and insulation standards given in tables 9.1 to 9.4. For example, where divisions such as decks or sides and ends of deckhouses are permitted to have "B-0" fire integrity, the "applicable fire exposure" shall be half an hour.

3. Structure of aluminium alloy

Unless otherwise specified in paragraph 2, in cases where any part of the structure is of aluminium alloy, the following shall apply:

3.1 the insulation of aluminium alloy components of "A" or "B" class divisions, except structure which, in the opinion of the Administration, is non load-bearing, shall be such that the temperature of the structural core does not rise more than 200°C above the ambient temperature at any time during the applicable fire exposure to the standard fire test; and

3.2 special attention shall be given to the insulation of aluminium alloy components of columns, stanchions and other structural members required to support lifeboat and liferaft stowage, launching and embarkation areas, and "A" and "B" class divisions to ensure:

3.2.1 that for such members supporting lifeboat and liferaft areas and "A" class divisions, the temperature rise limitation specified in paragraph 3.1 shall apply at the end of one hour; and

3.2.2 that for such members required to support "B" class divisions, the temperature rise limitation specified in paragraph 3.1 shall apply at the end of half an hour.

4. Machinery spaces of category A

4.1 Crowns and casings

Crowns and casings of machinery spaces of category A shall be of steel construction and shall be insulated as required by tables 9.5 and 9.7, as appropriate.

4.2 Floor plating

The floor plating of normal passageways in machinery spaces of category A shall be made of steel.

5. Materials of overboard fittings

Materials readily rendered ineffective by heat shall not be used for overboard scuppers, sanitary discharges, and other outlets which are close to the waterline and where the failure of the material in the event of fire would give rise to danger of flooding.

6. Protection of cargo tank structure against pressure or vacuum in tankers

6.1 General

The venting arrangements shall be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks shall exceed design parameters and be such as to provide for:

6.1.1 the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank in all cases through pressure/vacuum valves; and

6.1.2 the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging.

6.2 Openings for small flow by thermal variations

Openings for pressure release required by paragraph 6.1.1 shall:

6.2.1 have as great a height as is practicable above the cargo tank deck to obtain maximum dispersal of flammable vapours, but in no case less than 2 m above the cargo tank deck; and

6.2.2 be arranged at the furthest distance practicable, but not less than 5 m, from the nearest air intakes and openings to enclosed spaces containing a source of ignition and from deck machinery and equipment which may constitute an ignition hazard. Anchor windlass and chain locker openings constitute an ignition hazard.

6.3 Safety measures in cargo tanks

6.3.1 Preventive measures against liquid rising in the venting system

Provisions shall be made to guard against liquid rising in the venting system to a height which would exceed the design head of cargo tanks. This shall be accomplished by high level alarms or overflow control systems or other equivalent means, together with independent gauging devices and cargo tank filling procedures. For the purposes of this regulation, spill valves are not considered equivalent to an overflow system.

6.3.2 Secondary means for pressure/vacuum relief

A secondary means of allowing full flow relief of vapour, air or inert gas mixtures to prevent over pressure or under pressure in the event of failure of the arrangements in paragraph 6.1.2. Alternatively, pressure sensors may be fitted in each tank protected by the arrangement required in paragraph 6.1.2, with a monitoring system in the ship's cargo control room or the position from which cargo operations are normally carried out. Such monitoring equipment shall also provide an alarm facility which is activated by detection of over pressure or under pressure conditions within a tank.

6.3.3 Bypasses in vent mains

Pressure/vacuum valves required by paragraph 6.1.1 may be provided with a bypass arrangement when they are located in a vent main or masthead riser. Where such an arrangement is provided there shall be suitable indicators to show whether the bypass is open or closed.

6.3.4 Pressure/vacuum-breaking devices

One or more pressure/vacuum-breaking devices shall be provided to prevent the cargo tanks from being subject to:

6.3.4.1 a positive pressure, in excess of the test pressure of the cargo tank, if the cargo were to be loaded at the maximum rated capacity and all other outlets are left shut; and

6.3.4.2 a negative pressure in excess of 700 mm water gauge if the cargo were to be discharged at the maximum rated capacity of the cargo pumps and the inert gas blowers were to fail.

Such devices shall be installed on the inert gas main unless they are installed in the venting system required by regulation 4.5.3.1 or on individual cargo tanks. The location and design of the devices shall be in accordance with regulation 4.5.3 and paragraph 6.

6.4 Size of vent outlets

Vent outlets for cargo loading, discharging and ballasting required by paragraph 6.1.2 shall be designed on the basis of the maximum designed loading rate multiplied by a factor of at least 1.25 to take account of gas evolution, in order to prevent the pressure in any cargo tank from exceeding the design pressure. The master shall be provided with information regarding the maximum permissible loading rate for each cargo tank and, in the case of combined venting systems, for each group of cargo tanks.

MCA Guidance

G1 Hinged or portable decks

G1.1 Moveable decks with their connecting ramps should be constructed of steel or equivalent material. Proposals to construct such decks with aluminium should be referred initially to MCA Headquarters.

G2 False decks

G2.1 False decks should be constructed of steel or equivalent material except that small areas used for dancing in dining rooms may be constructed of wood which should be included in the total volume of combustibles referred to in regulation 5.3.2.3. A false deck is any deck which is fitted above the level of a structural deck for any purpose and is sometimes referred to as a false or raised floor.

G3 'A' Class division

G3.1 Subject to any additional requirements for watertight or load-bearing structure, the minimum scantlings required for steel and aluminium alloy 'A' Class divisions should be derived from the following tables and should be insulated as indicated in the guidance G11.8.2 to paragraph 3.

G4 Scantlings of steel 'A' Class divisions

G4.1 Where swedges are used to stiffen 'A' Class bulkheads the spacing should not exceed 760mm.

Table showing the geometrical properties required when using steel stiffeners or beams spaced 760mm apart and without end connections.

Span of Stiffener or Beam	Plating Thickness	Geometrical Properties in conjunction with plating 610mm x thickness	
Metres	mm	Moment of Inertia (I)	Section Modulus (I/Y)
		cm^4	cm^3
2.4	4.0	87.5	12.0
2.7	4.5	130.0	17.0
3.0	5.0	175.0	22.0
3.3	5.5	237.5	27.0
3.6	6.0	305.0	32.0

(Note: The spacing of stiffeners or beams should not normally exceed 760mm. However, where stiffeners or beams are spaced other than 760mm apart their moment of inertia and section modulus should be increased or decreased in direct proportion to the distance apart.)

G5 Scantlings of aluminium alloy 'A' Class divisions

G5.1 Where 'A' Class divisions are constructed of aluminium alloy the aluminium structure should have the equivalent strength and stiffness to that of steel having the same length of unsupported span - see table.

Table giving the ratios to be used to obtain equivalent strength values when using aluminium alloys.

Required Plating thickness of aluminium alloy	=	1.4 x thickness of steel plating
Required Inertia (I) of aluminium alloy stiffeners or beams	=	2.8 x inertia (I) of steel stiffeners or beams
Required Modulus (I/Y) of aluminium alloy	=	2.35 x Modulus (I/Y) of steel stiffeners or beams

stiffeners or beams		

G6 Scantlings of steel or aluminium alloy 'B' Class divisions

G6.1 Subject to any additional requirements for load-bearing structure, the minimum scantlings required for steel or aluminium alloy 'B' Class divisions should be the same as those for steel and aluminium alloy 'A' Class divisions as derived from the preceding tables.

G6.2 Aluminium alloy 'B' Class divisions of B-15 and B-0 should be insulated respectively to the same standards as aluminium alloy 'A' Class divisions of A-15 and A-0 standards unless an approval certificate has been issued for the appropriate 'B' Class standard.

G7 Structure supporting lifeboats and liferafts

G7.1 Notwithstanding preceding paragraphs and guidance G9.20, on separation of machinery spaces from other spaces, any aluminium alloy structure which supports the lifeboat, liferaft and marine escape system embarkation, stowage, handling and lowering positions is required to be insulated such that the temperature rise limitation of the structural core shall apply for 60 minutes duration. Such structure should be insulated in the same manner as an aluminium alloy 'A' Class division of A-0 standard.

G8 Aluminium structure for passenger ships

G8.1 Insulating the structure

G8.1.1 Tables 9.1, 9.2, 9.3 and 9.4 of regulation 9 require all bulkheads and decks to be 'A' Class or 'B' Class divisions except for those decks referred to in guidance G9.27 and a limited number of bulkheads in the tables which are permitted to be 'C' Class divisions. Consequently all aluminium alloy bulkheads and decks including the ships side and boundaries of superstructures and deckhouses, except for the decks referred to above and 'C' Class bulkheads, are required by paragraph 3 to be insulated such that the temperature of their structural core does not rise more than 200°C above the ambient temperature when subjected to a standard fire test of 60 and 30 minutes duration in the case of 'A' Class and 'B' Class divisions respectively.

G8.2 Insulating aluminium alloy 'A' Class divisions

G8.2.1 Aluminium alloy has a low melting point and its strength properties are severely diminished at elevated temperatures. 'A' Class divisions constructed of alloy have therefore to be protected against the effect of heat by the fitting of approved fire insulation to all surfaces which may be exposed to a fire. Paragraph 3.1 requires that the insulation of 'A' Class divisions shall be such that the temperature of the aluminium alloy core does not rise more than 200°C above ambient temperature at any time during the standard fire test of 60 minutes duration. This requirement applies to aluminium alloy 'A' Class divisions A-60, A-30, A-15 or A-0 standard. Such divisions should be insulated on both sides, except for decks which should be insulated at least on their underside. Where such divisions form the outer boundaries of the ship's hull, superstructures or deckhouses, only their inside surfaces need to be insulated. Flanges and webs of deep girders should be insulated as part of the structural core, even when they exceed the dimensions of the stiffeners included in the standard structural core of IMO Resolution A 754(18) on which the insulation was tested.

G8.3 Steel or aluminium alloy 'B' Class divisions

G8.3.1 Paragraph 3 requires that the insulation of aluminium alloy 'B' Class divisions shall be such that the temperature of the aluminium alloy core does not rise more than 200°C above the ambient temperature at any time during a standard fire test of 30 minutes duration. This requirement applies to 'B' Class divisions of any standard i.e. B-15 or B-0.

G8.3.2 Steel 'B' Class divisions of B-15 standard should be insulated to the same standard as steel 'A' Class divisions of A-15 standards and aluminium alloy 'B' Class divisions of B-15 and B-0 should be insulated respectively to the same standards as aluminium alloy 'A' Class divisions of A-15 and A-0 unless an approval certificate has been issued for the appropriate 'B' Class standard.

G8.4 Approved insulations

G8.4.1 Approved materials should be used to insulate the aluminium alloy 'A' Class and 'B' Class divisions in accordance with the conditions indicated in the appropriate approval certificates. In the absence of any approvals covering the use of materials as the insulating media for aluminium alloy 'A' Class or 'B' Class divisions of a particular standard then a material which has been approved for a higher standard for aluminium alloy 'A' Class or 'B' Class divisions should be used.

G8.4.2 Any 'C' Class bulkheads constructed of aluminium alloy which are structural bulkheads supporting 'A' Class or 'B' Class decks are also required by paragraph 3 to be insulated such that the temperature of their structural core does not rise more than 200°C above the ambient temperature when subjected to a standard fire test for the same periods as required for the divisions which they are supporting.

G8.4.3 However where 'C' Class bulkheads constructed of aluminium alloy support a deck, parts of which are 'A' Class and 'B' Class divisions then the bulkheads should be insulated in the same manner as an aluminium alloy 'A' Class bulkhead of A-0 standard.

G8.5 Structure supporting lifeboats and liferafts (paragraph 3.2)

G8.5.1 Paragraph 3.2 should also be applied to structure supporting marine escape system embarkation and stowage areas.

G8.6 Bulkheads and decks not required to be 'A' Class or 'B' Class divisions

G8.6.1 Any ‘C’ class bulkheads or bulkheads and decks to which the asterisk of tables 9.3 or 9.4 apply and are thereby not required to be ‘A’ class standard, which are constructed of aluminium alloy and are structural bulkheads or decks supporting 'A' Class or 'B' Class divisions are required to be insulated such that the temperature of their structural core does not rise more than 200°C above the ambient temperature when subjected to a standard fire test for the same periods of time as required for the divisions which they are supporting.

G8.6.2 Any structural bulkheads and decks referred to in the preceding paragraph, which are constructed aluminium alloy and do not support any 'A' Class or 'B' Class divisions, are still required (9.2.2.4) to be of an 'equivalent material' which, as defined, implies that they should be insulated in order to provide structural and integrity properties equivalent to steel at the end of an appropriate fire test for such bulkheads and decks as they do for 'A' Class and 'B' Class divisions. Nor do the Regulations indicate that the core temperature limitations of 200°C should apply to such bulkheads and decks. Consequently those bulkheads and decks need only be protected respectively by a non-combustible lining or ceiling, or, in the absence of a non-combustible lining or ceiling, by a 25mm thickness of an approved 'A' Class mineral wool insulation.

G9 Aluminium structure for cargo ships and tankers

G9.1 Cargo ships

G9.1.1 Insulating the structure

G9.1.1.1 Tables 9.5 and 9.6 in regulation 9.2.3.3 require all bulkheads and decks to be 'A' Class or 'B' Class divisions except for those bulkheads which are permitted to be 'C' Class divisions and those bulkheads and decks which have an asterisk notation and are consequently permitted to be of aluminium alloy with no 'A' Class standard.

G9.1.1.2 Therefore all aluminium alloy bulkheads and decks except for 'C' Class bulkheads and bulkheads and decks with no 'A' Class standard are to be insulated such that the temperature of their structural core does not rise more than 200°C above the ambient temperature when subjected to a standard fire test of 60 minutes and 30 minutes duration in the case of 'A' Class division and 'B' Class division respectively. See paragraph 3 of this regulation, guidance G11.8.2 to G11.8.6 apply similarly to cargo ships.

G9.2 Tankers

G9.2.1 Insulating the structure

G9.2.1.1 Tables 9.7 and 9.8 in regulation 9.2.4.2 require all bulkheads and decks to be 'A' Class or 'B' Class divisions except for those bulkheads which are permitted to be 'C' Class divisions and those bulkheads and decks which have an asterisk notation and are consequently permitted to be of aluminium alloy with no 'A' Class standard.

G9.2.1.2 Additionally however, all aluminium alloy bulkheads and decks except for 'C' Class bulkheads and bulkheads and decks with no 'A' Class standard are to be insulated such that the temperature of their structural core does not rise more than 200°C above the ambient temperature when subjected to a standard fire test of 60 minutes and 30 minutes duration in the case of 'A' Class divisions and 'B' Class division respectively. See paragraph 3 of this regulation. Guidance G11.8.2 to G11.8.6 apply similarly to tankers.