

**PART II        RULES FOR THE CONSTRUCTION  
AND CLASSIFICATION OF SHIPS  
IDENTIFIED BY THEIR MISSION**

**TITLE 11    VESSELS IN GENERAL**

**SECTION 3 HULL EQUIPMENT**

**CHAPTERS**

- A        APPROACH**
- B        DOCUMENTS,        REGULATIONS        AND  
STANDARDS**
- C        MATERIALS AND MANLABOUR**
- D        SPECIFIC SYSTEM REQUIREMENTS**
- E        FIRE        DETECTION,        PROTECTION,  
PREVENTION        AND        FIGHTINGVESSELS  
HAVING GT ≥ 500**
- F        FIRE        DETECTION,        PROTECTION,  
PREVENTION        AND        FIGHTINGVESSELS  
HAVING GT < 500**
- G        SHIP MANEUVERING: RUDDERS, SOLE  
PIECES AND RUDDER HORNS**
- H        EVALUATION OF SCANTLING OF THE  
HATCH COVERS AND HATCH COAMINGS  
IN THE CLOSING ARRANGEMENT OF  
CARGO HOLDS OF SHIPS**
- T        TESTS AND INSPECTIONS**



## CONTENTS

|   |           |
|---|-----------|
| <b>CHAPTER A</b> .....  | <b>7</b>  |
| <b>APPROACH</b> .....   | <b>7</b>  |
| <b>A1. APPLICATION</b> .....  | <b>7</b>  |
| 100. Nature of the systems .....  | 7         |
| <b>CHAPTER B</b> .....  | <b>7</b>  |
| <b>DOCUMENTS, REGULATIONS AND STANDARDS</b> ...   | <b>7</b>  |
| <b>B1. DOCUMENTS TO BE SUBMITTED TORBNA</b> 7   |           |
| 100. Lifting appliances .....   | 7         |
| 200. Anchoring mooring and towing systems .....   | 7         |
| 300. Steering system .....  | 7         |
| 400. Life saving appliances (LSA) .....   | 7         |
| 500. Fire prevention, detection and fighting.....   | 7         |
| 600. Hull openigns –means of protection and closure .....                                       | 8         |
| 700. Hull accessories .....   | 8         |
| <b>B2. REGULATIONS AND STANDARDS</b> .....  | <b>8</b>  |
| 100. Application.....   | 8         |
| <b>B3. STANDARDS</b> .....  | <b>9</b>  |
| 100. National and International Standards .....   | 9         |
| <b>CHAPTER C</b> .....  | <b>9</b>  |
| <b>MATERIALS AND MANLABOUR</b> .....  | <b>9</b>  |
| <b>C1. MATERIALS FOR HULL EQUIPMENT</b> .....   | <b>9</b>  |
| 100. Application.....   | 9         |
| <b>C2. MANLABOUR</b> .....  | <b>9</b>  |
| 100. Application.....   | 9         |
| <b>CHAPTER D</b> .....  | <b>10</b> |
| <b>SPECIFIC SYSTEM REQUIREMENTS</b> .....   | <b>10</b> |
| <b>D1. LIFTING APPLIANCES</b> .....   | <b>10</b> |
| <b>D2. ANCHORING, MOORING AND TOWING</b> ....   | <b>10</b> |
| 100. Application and design .....   | 10        |
| 200. Arrangement .....  | 10        |
| 300. Equipment number and anchoring equipment table (for vessels of unrestricted service) ..... | 11        |
| 400. Ancoring equipment for ships having NE below 205 to 50 .....                               | 15        |
| 500. Chain cables for bower anchors .....   | 17        |
| 600. Windlass design and testing.....   | 18        |
| 700. Mooring and towing ropes.....  | 19        |
| 800. Spare parts.....   | 21        |
| 900. Mooring winches.....   | 24        |
| <b>D3. MANOEUVERING SYSTEM</b> .....  | <b>24</b> |
| <b>D4. LIFE SAVING APPLIANCES (LSA)</b> .....   | <b>24</b> |
| 100. Aplicação .....  | 24        |
| <b>D5. FIRE FIGHTING EQUIPMENT</b> .....  | <b>24</b> |
| 100. Aplicação .....  | 24        |
| 200. Portable extinguishers for vessels with GT < 500 .....                                     | 24        |
| 300. Fire extinguishers for vessels having Gross Tonnage GT ≥ 500.....                          | 28        |
| 400. Emergency Equipment Breathing Device – EEBD for vessels with GT ≥ 500 .....                | 28        |
| <b>D6. HULL OPENINGS: MEANS OF PROTECTION AND</b> .....   | <b>28</b> |
| 100. Definitions.....   | 28        |
| 200. Access scuttles .....  | 29        |

|  |           |
|--|-----------|
| 300. Manholes.....   | 29        |
| 400. Openings in the side shell .....  | 29        |
| 500. Drain plugs and bottom plugs.....   | 29        |
| 600. Closure of Chain Lockers.....   | 29        |
| 700. Other protections. ....   | 30        |
| <b>D7. HULL EQUIPMENT: ACCESSORIES AND FITTINGS</b> .....  | <b>30</b> |
| 100. Ladders in tanks or access ladders .....  | 30        |
| 200. Davits .....  | 30        |
| 300. Handrails .....   | 30        |
| <b>D8. SINGLE POINT MOORING</b> .....  | <b>30</b> |
| 100. Equipment standards for single point mooring.....   | 30        |
| <b>D9. FREEING PORTS</b> .....   | <b>31</b> |
| 100. Vessels with GT < 500 .....   | 31        |
| 200. Vessels with GT ≥ 500.....  | 31        |
| <b>D10. SHIPBOARD FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING ON CONVENTIONAL VESSELS</b> ..... | <b>33</b> |
| 100. Application and Definitions .....   | 33        |
| 200. Towing.....   | 34        |
| 300. Mooring.....  | 35        |
| 400. Towing and mooring arrangements plan .....  | 36        |
| 500. Corrosion Addition .....  | 37        |
| 600. Survey After Construction .....   | 37        |
| <b>D11. SIDE SCUTTLES AND WINDOWS</b> .....  | <b>37</b> |
| 100. Side scuttles and windows .....   | 37        |
| <b>CHAPTER E</b> .....   | <b>37</b> |
| <b>FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION FOR SHIPS HAVING GROSS TONNAGE GT ≥ 500</b> .....                       | <b>37</b> |
| <b>E1. GENERAL</b> .....   | <b>37</b> |
| 100. Application.....  | 37        |
| 200. Applicable requirements depending on ship type38  |           |
| <b>E2. FIRE SAFETY OBJECTIVES AND FUNCTIONAL REQUIREMENTS</b> .....  | <b>38</b> |
| 100. Fire safety objectives .....  | 38        |
| 200. Functional requirements .....   | 38        |
| 300. Achievement of the fire safety objectives.....  | 39        |
| <b>E3. DEFINITIONS</b> .....   | <b>39</b> |
| 100. Definitions.....  | 39        |
| <b>E4. PROBABILITY OF IGNITION</b> .....   | <b>43</b> |
| 100. Purpose .....   | 43        |
| 200. Arrangements for fuel oil, lubrication oil and other flammable oils .....   | 44        |
| 300. Arrangements for gaseours fuel for domestic purposes .....  | 44        |
| 400. Miscellaneous items of ignition sources and ignitability.....   | 44        |
| <b>E5. FIRE GROWTH POTENTIAL</b> .....   | <b>45</b> |
| 100. Purpose .....   | 45        |
| 200. Control of air supply and flammable liquid to the space .....   | 45        |
| 300. Means of control in machinery spaces.....   | 46        |
| 400. Additional requirements for means of control in periodically unattended machinery spaces .....                            | 46        |
| 500. Fire protection materials:use of non-combustible materials .....  | 47        |
| 600. Fire protection materials: Use of combustible materials .....   | 47        |
| <b>E6. SMOKEGENERATION POTENTIAL AND TOXICITY</b> .....  | <b>49</b> |

|   |           |  |            |
|---|-----------|--|------------|
| 100. Purpose .....  | 49        | 500. Means of escape on passenger ships from special category and open ro-ro spaces to which any passengers carried can have access..... | 104        |
| 200. Paints, varnishes and other finishes.....  | 49        | 600. Means of escape from ro-ro spaces.....  | 104        |
| 300. Primary deck coverings.....  | 49        | 700. Additional requirements for ro-ro passenger ships   | 105        |
| <b>E7. DETECTION AND ALARM .....</b>  | <b>53</b> | 800. Doors in watertight bulkheads of cargo ships and passenger ships .....  | 105        |
| 100. Purpose .....  | 53        | <b>E13. ALTERNATIVE DESIGN AND ARRANGEMENTS.....</b>   | <b>110</b> |
| 200. General requirements .....   | 53        | 100. 1 Purpose .....   | 110        |
| 300. Initial and periodical test.....   | 53        | 200. General.....  | 110        |
| 400. Protection of machinery spaces .....   | 54        | 300. Engineering analysis .....  | 110        |
| 500. Protection of accommodation and service spaces and control stations.....   | 54        | 400. Evaluation of the alternative design and arrangements.....  | 110        |
| 600. Protection of cargo spaces in passenger ships  | 55        | 500. Exchange of information .....   | 110        |
| 700. Manually operated call points .....  | 55        | 600. Re-evaluation due to change of conditions.....  | 110        |
| 800. Fire alarm signalling systems in passenger ships   | 56        | <b>E14. PROTECTION OF VEHICLE, SPECIAL CATEGORY AND RO-RO SPACES .....</b>   | <b>110</b> |
| <b>E8. CONTROL OF SMOKE SPREAD .....</b>  | <b>56</b> | <b>E15. CASUALTY THRESHOLD, SAFE RETURN TO PORT AND SAFE AREAS .....</b>   | <b>114</b> |
| 100. Purpose .....  | 56        | 100. Application .....   | 114        |
| 200. Protection of control stations outside machinery spaces  | 56        | 200. Purpose .....   | 114        |
| 300. Release of smoke from machinery spaces .....   | 57        | 300. Casualty threshold.....   | 114        |
| 400. Draught stops.....   | 57        | 400. Safe return to port for passenger vessels.....  | 114        |
| <b>E9. CONTAINMENT OF FIRE .....</b>  | <b>58</b> | 500. Safe area(s) .....  | 115        |
| 100. Purpose .....  | 58        | 600. Alternate space for medical care.....   | 115        |
| 200. Thermal and structural boundaries.....   | 58        | <b>E16. DESIGN CRITERIA FOR SYSTEMS TO REMAIN OPERATIONAL AFTER A FIRE CASUALTY .....</b>  | <b>115</b> |
| 300. Passenger ships.....   | 58        | 100. Application .....   | 115        |
| 400. Cargo ships except tankers: methods of.....  | 67        | 200. Purpose .....   | 115        |
| 500. Tankers.....   | 72        | 300. Systems*.....   | 115        |
| 600. Penetrations in fire-resisting divisions and prevention of heat transmission .....   | 72        | <b>E17. SAFETY CENTER ON PASSENGER SHIPS</b>   | <b>116</b> |
| 700. Protection of openings in fire-resisting divisions   | 73        | 100. Application .....   | 116        |
| 800. Protection of openings in machinery spaces boundaries and cargo space boundaries .....   | 76        | 200. Purpose .....   | 116        |
| 900. Ventilation systems.....   | 77        | 300. Location and arrangement .....  | 116        |
| <b>E10. FIRE FIGHTING.....</b>  | <b>81</b> | 400. Layout and ergonomic design .....   | 116        |
| 100. Purpose .....  | 81        | 500. Communications.....   | 116        |
| 200. Water supply systems .....   | 81        | <b>E18. HELICOPTER FACILITIES .....</b>  | <b>116</b> |
| 300. Portable fire extinguishers.....   | 86        | 100. Purpose .....   | 116        |
| 400. Fixed fire-extinguishing systems .....   | 86        | 200. Application .....   | 116        |
| 500. Fire-extinguishing arrangements in machinery spaces  | 87        | 300. Structure.....  | 117        |
| 600. Fire-extinguishing arrangements in control stations, accommodation and service spaces .....  | 89        | 400. Means of escape .....   | 117        |
| 700. Fire-extinguishing arrangements in cargo spaces  | 90        | 500. Fire fighting appliances .....  | 117        |
| 800. Cargo tank protection and Protection of cargo pump-rooms in tankers.....   | 96        | 600. Drainage facilities.....  | 118        |
| 900. Fire-fighter's outfits .....   | 96        | 700. Helicopter refuelling and hangar facilities ....  | 118        |
| <b>E11. STRUCTURAL INTEGRITY.....</b>   | <b>97</b> | 800. Operations manual and fire-fighting service..   | 118        |
| 100. Purpose:.....  | 97        | <b>CHAPTER F .....</b>   | <b>119</b> |
| 200. Material of hull, superstructures, structural bulkheads, decks and deckhouses .....  | 97        | <b>FIRE FIGHTING FOR VESSELS WITH AB &lt; 500 ....</b>   | <b>119</b> |
| 300. 3 Structure of aluminium alloy.....  | 97        | <b>F1. APPLICATION .....</b>   | <b>119</b> |
| 400. Machinery spaces of category A .....   | 97        | 100. Application .....   | 119        |
| 500. Materials of overboard fittings .....  | 97        | 200. Fire safety objectives.....   | 119        |
| 600. Protection of cargo tank structure against pressure or vacuum in tankers.....  | 97        | 300. Achievement of the fire safety objectives.....  | 119        |
| <b>E12. MEANS OF ESCAPE .....</b>   | <b>99</b> | <b>F3. FIRE SAFETY MEASURES.....</b>   | <b>120</b> |
| 100. Purpose: swiftly escape to the lifeboat and liferaft embarkation deck. For this purpose, the following functional requirements shall be met: ..... | 99        | 100. Purpose .....   | 120        |
| 200. General requirements .....   | 100       | 200. Structural fire protection.....   | 120        |
| 300. Means of escape from control stations, accommodation spaces and service spaces.....  | 100       | 300. Materials .....   | 121        |
| 400. Means of escape from machinery spaces .....  | 103       | 400. Surface of insulation.....  | 121        |
|   |           | 500. Ventilation systems .....   | 121        |
|   |           | 600. Oil fuel arrangements.....  | 122        |
|   |           | 700. Special arrangements in Category 'A'  |            |

|   |            |
|---|------------|
| <i>machinery spaces and where necessary other machinery spaces</i>                                  | 122        |
| 800. Arrangements for gaseous fuel for domestic purposes and oil heating.....                       | 122        |
| 900. Means of escape.....   | 122        |
| <b>F4. RECOMENDATORY FIXED FIRE FIGHTING SYSTEMS .....</b>  | <b>123</b> |
| 100. Purpose.....   | 123        |
| 200. Recommendation for fixed fire-extinguishing arrangements in Category 'A' machinery spaces..... | 123        |
| 300. Protection of paint lockers and flammable liquid lockers .....                                 | 123        |
| 400. Portable Fire-extinguishers.....   | 123        |
| <b>F5. FIRE FIGHTING EQUIPMENT .....</b>  | <b>123</b> |
| 100. General.....   | 123        |
| 200. Fire blanket.....  | 123        |
| 300. Fire-fighter's outfit (which includes an axe) ..   | 123        |
| 400. Safety Plan and Fire Fighting Plan.....  | 123        |
| <b>F6. ALTERNATIVE DESIGN AND ARRANGEMENTS.....</b>   | <b>124</b> |
| 100. General.....   | 124        |
| 200. Engineering analysis.....  | 124        |
| <b>F7. REQUIREMENTS FOR NON-PROPELLED VESSELS.....</b>  | <b>124</b> |
| 100. Basic Recommendations .....  | 124        |
| <b>CHAPTER G.....</b>   | <b>125</b> |
| <b>SHIP MANEUVERING: RUDDERS, SOLE PIECES AND RUDDER HORNS .....</b>                                | <b>125</b> |
| <b>G1. APPLICATION, DEFINITION, MATERIALS.....</b>  | <b>125</b> |
| 100. General.....   | 125        |
| 200. Definitions.....   | 125        |
| 300. Basic assumptions.....   | 125        |
| 400. Design considerations.....   | 125        |
| 500. Materials.....   | 126        |
| <b>G2. RUDDER FORCE AND RUDDER TORQUE .....</b>   | <b>126</b> |
| 100. Rudder blades without cut-outs. See Fig. F.G2.100.1.....                                       | 126        |
| 200. Rudder blades with cut-outs (semi-spade rudders) .....   | 128        |
| <b>G3. RUDDER STOCK.....</b>  | <b>128</b> |
| 100. Rudder stock scantlings in way of the tiller. ...  | 128        |
| 200. Rudder strength calculation.....   | 129        |
| 300. Rudder stock scantlings due to combined loads.....   | 129        |
| <b>G4. RUDDER BLADE SCANTLINGS .....</b>  | <b>129</b> |
| 100. Permissible stresses. ....   | 129        |
| 200. Rudder blade scantlings.....   | 129        |
| 300. Single plate rudders.....  | 129        |
| <b>G5. RUDDER STOCK COUPLINGS AND PINTLES .....</b>   | <b>130</b> |
| 100. Horizontal flange couplings.....   | 130        |
| 200. Cone couplings .....   | 130        |
| 300. Vertical flange couplings.....   | 130        |
| 400. Pintles .....  | 131        |
| <b>G6. RUDDER STOCK-, RUDDER SHAFT- AND PINTLE BEARINGS.....</b>                                    | <b>131</b> |
| 100. Minimum bearing surface.....   | 131        |
| 200. Length of bearings. ....   | 131        |
| 300. Bearing clearances .....   | 131        |
| <b>G7. STRENGTH OF SOLE PIECES AND OF RUDDER HORNS .....</b>  | <b>132</b> |
| 100. Sole piece.....  | 132        |
| 200. Rudder horn.....   | 132        |

|  |            |
|--|------------|
| 300. Pintle housing .....  | 133        |
| <b>G8. GUIDELINES FOR CALCULATION OF BENDING MOMENT AND SHEAR FORCE DISTRIBUTION.....</b>  | <b>133</b> |
| 100. General .....   | 133        |
| 200. Data for the analysis .....   | 133        |
| 300. Moments and forces to be evaluated .....  | 133        |
| 400. Estimates for spade rudders.....  | 133        |
| <b>G9. PROPELLER NOZZLES.....</b>  | <b>135</b> |
| 100. Application.....  | 135        |
| 200. Design Pressure .....   | 135        |
| 300. Nozzle Cylinder.....  | 135        |
| 400. Internal Diaphragm Thickness.....   | 135        |
| 500. Nozzle Section Modulus .....  | 135        |
| 600. Moving propeller nozzles .....  | 136        |
| <b>CHAPTER H.....</b>  | <b>136</b> |
| <b>EVALUATION OF SCANTLINGS OF HATCH COVERS AND HATCH COAMINGS AND CLOSING ARRANGEMENTS OF CARGO HOLDS OF SHIPS. ....</b>                            | <b>136</b> |
| <b>H1. APPLICATION AND DEFINITIONS .....</b>   | <b>136</b> |
| 100. Application.....  | 136        |
| 200. Definitions.....  | 137        |
| 300. Material.....   | 137        |
| 400. General requirements .....  | 137        |
| 500. Net scantling approach .....  | 137        |
| <b>H2. HATCH COVER AND COAMING LOAD MODEL.....</b>   | <b>138</b> |
| 100. Definitions.....  | 138        |
| 200. Vertical weather design load .....  | 138        |
| 300. Horizontal weather design load .....  | 141        |
| 500. Container loads.....  | 142        |
| 600. Loads due to elastic deformations of the ship's hull .....  | 143        |
| <b>H3. HATCH COVER STRENGTH CRITERIA ..</b>  | <b>143</b> |
| 100. Permissible stresses and deflections .....  | 143        |
| 200. Local net plate thickness:.....   | 143        |
| 300. Net scantling of secondary stiffeners .....   | 144        |
| 400. Net scantling of primary supporting members .....   | 144        |
| 500. Strength calculations.....  | 145        |
| <b>H4. BUCKLING STRENGTH OF HATCH COVER STRUCTURES.....</b>  | <b>146</b> |
| 100. General .....   | 146        |
| <b>H5. DETAIL OF HATCH COVER .....</b>   | <b>154</b> |
| 100. Container foundations on hatch covers .....   | 154        |
| 200. Weather tightness: Further to the following .. requirements IACS Rec. 14 is applicable to hatch covers. ....                                    | 154        |
| <b>H6. HATCH COAMING STRENGTH CRITERIA. ....</b>   | <b>154</b> |
| 100. Local net plate thickness of coamings.....  | 154        |
| 200. Net scantling of secondary stiffeners of coamings.....  | 154        |
| 300. Coamings stays: Coaming stays are to be designed for the loads transmitted through them and permissible stresses according to 3.1.1 H3.101..... | 155        |
| 400. Further requirements for hatch coamings.....  | 155        |
| <b>H7. CLOSING ARRANGEMENTS .....</b>  | <b>156</b> |
| 100. Securing devices.....   | 156        |
| 200. Hatch cover supports, stoppers and supporting structures .....  | 156        |
| <b>CHAPTER T .....</b>   | <b>159</b> |
| <b>INSPECTIONS AND TESTS .....</b>   | <b>159</b> |

|   |            |
|---|------------|
| <b>T1. CARGO OR SERVICE HANDLING .....</b>                | <b>159</b> |
| 100. <i>Performance trials .....</i>                      | <i>159</i> |
| <b>T2. MOORING AND ANCHORING .....</b>                    | <b>159</b> |
| 200. <i>Test of anchor handling .....</i>                 | <i>159</i> |
| 300. <i>Integrity test .....</i>                          | <i>159</i> |
| <b>T3. MANOEUVRING SYSTEM .....</b>                       | <b>159</b> |
| 100. <i>Watertightness test of rudder and Kort Nozzle</i> | <i>159</i> |
| 200. <i>Hydraulic system test .....</i>                   | <i>159</i> |
| 300. <i>Rudder steering test .....</i>                    | <i>159</i> |
| 400. <i>Manual steering test.....</i>                     | <i>159</i> |
| <b>T4. LIFESAVING APPLIANCES.....</b>                     | <b>159</b> |
| 100. <i>Certificates .....</i>                            | <i>159</i> |
| 200. <i>Abandon ship test.....</i>                        | <i>159</i> |
| <b>T5. FIRE SAFETY EQUIPMENT .....</b>                    | <b>160</b> |
| 100. <i>Certificates and documents.....</i>               | <i>160</i> |
| 200. <i>Inspections and tests .....</i>                   | <i>160</i> |
| <b>T6. HULL OPENINGS-PROTECTION AND CLOSING .....</b>     | <b>160</b> |
| 100. <i>Tests of the cargo hatch covers.....</i>          | <i>160</i> |
| 200. <i>Testing of hull accesses.....</i>                 | <i>160</i> |
| <b>T7. HULL EQUIPMENT AND APPENDAGES..</b>                | <b>160</b> |
| 100. <i>Installation .....</i>                            | <i>160</i> |



## CHAPTER A APPROACH

### CHAPTER CONTENTS

#### A1. APPLICATION

#### A1. APPLICATION

##### 100. Nature of the systems

101. This section applies to hull equipment systems and to fire detection, prevention, protection and fighting. The systems approached are as mentioned in Chapter B.

102. This section applies to all vessels, except where specifically mentioned.

## CHAPTER B DOCUMENTS, REGULATIONS AND STANDARDS

### CHAPTER CONTENTS

#### B1. DOCUMENTS TO BE SUBMITTED TO RBNA

#### B2. REGULATIONS

#### B3. STANDARDS

#### B1. DOCUMENTS TO BE SUBMITTED TORBNA

##### 100. Lifting appliances

See RBNA Guidelines for Lifting Appliances.

##### 200. Anchoring mooring and towing systems

201. The documents will inform:

- a. Navigation area;
- b. Mission / service of the vessel;
- c. Displacement;
- d. Freeboard;
- e. Side and frontal profile for determining the wind area; and
- f. Selected equipment specifications including dimensional characteristics and building materials.

##### 300. Steering system

301. The documents will inform:

- a. Navigation area;
- b. Mission / service of the vessel;
- c. Draft and speed;
- d. Configuration, materials, dimensions, connections and bearings, rudder stock and rudder tiller.
- e. Driving system and transmission;
- f. System of command; and
- g. Emergency steering system.

##### 400. Life saving appliances (LSA)

401. A Safety Plan is to be presented.

##### 500. Fire prevention, detection and fighting

501. The following plans and documents are to be submitted for approval:

- a. Structural fire protection, showing the method of construction, purpose and category of the various spaces of the ships, the fire rating of bulkheads and decks, means of closings of openings in A and B class divisions, draught stops.
- b. Natural and mechanical ventilation systems showing the penetrations on A class divisions, location of dampers, means of closing, arrangements of air conditioning rooms
- c. Means of escape and, where required, the relevant dimensioning. Escape route signage
- d. Automatic fire detection systems and manually operated call points
- e. Fire pumps and fire main including pumps head and capacity, hydrant and hose locations
- f. Arrangement of fixed fire-extinguishing systems
- g. Arrangement of sprinkler or sprinkler equivalent systems including the capacity and head of the pumps
- h. Arrangements for gaseous fuel for domestic purposes
- i. Fire control plan

502. Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification

|   |   |
|---|---|
| such as:  | a. Hatch covers, if any   |
| a. service pressures  | a.1. Design loads on hatch covers   |
| b. capacity and head of pumps and compressors, if any   | a.2. Sealing and securing arrangements, type and position of locking bolts                                  |
| c. materials and dimensions of piping and associated fittings   | a.3. Distance of hatch covers from the summer load waterline and from the fore end                          |
| d. volumes of protected spaces, for gas and foam fire-extinguishing systems   | b. Movable decks and ramps, if any;   |
| e. surface areas of protected zones for automatic sprinkler and pressure water-spraying, low expansion foam and powder fireextinguishing systems  | c. Windows and side scuttles, arrangements and details  |
| f. capacity, in volume and/or in mass, of vessels or bottles containing the extinguishing media or propelling gases, for gas, automatic sprinkler, foam and powder fire-extinguishing systems                   | d. Windows and side scuttles, arrangements and details  |
| g. type, number and location of nozzles of extinguishing media for gas, automatic sprinkler, pressure water-spraying, foam and powder fire-extinguishing systems.   | e. Bulwarks and freeing ports   |
|   | e.1. Arrangement and dimensions of bulwarks and freeing ports on the freeboard deck and superstructure deck |
| 503. All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.  | f. Plan of watertight doors and manoeuvring devices   |
|   | f.1. Manoeuvring devices  |
|   | f.2. Electrical diagrams of power control and position indication circuits                                  |
| <b>600. Hull openigns –means of protection andclosure</b>   | g. Plan of outer doors and hatchways  |
| 601. The documents will inform  | h. Plan of manholes   |
| a. For hull openenings:   | i. Plans of access to and escape from spaces  |
| a.1. Position and dimension os the openings in the side shell plating and superstructrue external plating   | j. Equipment number calculation   |
| a.2. Dimensions and material of the means of closure.   | j.1. Geometrical elements for calculation   |
|   | j.2. List of equipment  |
|   | j.3. Construction and breaking load of steel wires  |
| 602. The plan "Hull Openings and Means of Protection and Closure" is to be elaborated showing all the hull access openings, including ventilation ducts and piping connections with valves and closing devices. | j.4. Material, construction, breaking load and relevant elongation of synthetic ropes                       |
|   | k. Emergency towing arrangement   |

## 700. Hull accessories

701. The documents and information required are as follows:

## B2. REGULATIONS AND STANDARDS

### 100. Application

101. For Brazilian flag vessels with GT < 500 the regulations of NORMAN 01 (Brazilian Maritime Authority Standards for Navigation in Open Seas) are applicable as relevant to the equipment and systems covered by this Section 3.

102. For foreign flag vessels with GT < 500 National Regulations apply. In the absence of such regulations, IMO



Conventions and Codes apply as far as possible.

103. For vessel having  $GT \geq 500$ , the requirements of the IMO Conventions and Codes are applicable as relevant to the equipment and systems covered by this Section 3.

104. The IACS regulations applicable to this Chapter are:

- a. IACS UR A - Requirements Concerning Mooring Anchoring and Towing
- b. IACS UR W18 - Anchor chain cables and accessories including chafing chain for emergency towing arrangements
- c. IACS UR W29 - Requirements for Manufacture of Anchors
- d. IACS Rec 10.- Equipment

**Note:** the following RBNA publications are complementary to this Chapter:

- a. RBNA Guide for Lifting Appliances
- b. RBNA Guide for Towing Operations

### B3. STANDARDS

#### 100. National and International Standards

101. Whenever there are not specific requirements in the Rules related to any system, the national and international standards are to be researched and applied.

102. Specific Chapters of this Section 3 are based on national and international standards. Where this is the case, such standards are clearly stated.

## CHAPTER C MATERIALS AND MANLABOUR

### CHAPTER CONTENTS

#### C1. MATERIALS FOR HULL EQUIPMENT

#### C2. MANLABOUR

#### C1. MATERIALS FOR HULL EQUIPMENT

##### 100. Application

101. The materials for the systems are presented in Part III Title 61 Section 2 and 3 of the Rules, as indicated the relevant Chapter of this Section 3.

#### C2. MANLABOUR

##### 100. Application

101. The application of the Rules takes for granted the adequate qualification and expertise of the manlabour to carry out the operation of the systems herein described.

## CHAPTER D SPECIFIC SYSTEM REQUIREMENTS

### CHAPTER CONTENTS

- D1. LIFTING APPLIANCES
- D2. ANCHORING, MOORING AND TOWING
- D3. MANOEUVERING SYSTEMS
- D4. LIFE SAVING APPLIANCES (LSA)
- D5. FIRE DETECTION, PREVENTION, PROTECTION AND FIGHTING
- D6. HULL OPENING: MEANS OF PROTECTION AND CLOSURE
- D7. HULL EQUIPMENT: FITTINGS AND ACCESSORIES

#### D1. LIFTING APPLIANCES

- See RBNA Guide for Lifting Appliances.

#### D2. ANCHORING, MOORING AND TOWING [IACS UR-A1]

##### 100. Application and design [IACS UR A1.1]

101. These requirements apply to all vessels. Ships in compliance with this chapter are fit to receive the class notation "E".

102. Equipment numeral (EN) is the parameter that defines the anchor, mooring and towing equipment, based on the displacement, the hull form, the wind surface, the sea currents and the relevant speed of winds.

103. The anchoring equipment required herewith is intended for temporary mooring of a vessel within a harbour or sheltered area when the vessel is awaiting berth, tide, etc

104. The equipment is therefore not designed to hold a ship off fully exposed coasts in rough weather or to stop a ship which is moving or drifting. In such conditions the loads on the anchoring equipment increase to such a degree that its components may be damaged or lost owing to the high energy forces generated, particularly in large ships.

105. The anchoring equipment presently required herewith is designed to hold a ship in good holding ground in conditions such as to avoid dragging of the anchor. In poor holding ground the holding power of the anchors will significantly reduced.

106. The equipment numeral (EN) formula for

anchoring equipment required hereunder is based on an assumed sea current speed of 2.5 m/sec, wind speed of 25 m/sec and a scope of chain cable between 6 and 10, the scope being the ratio between length of chain paid out and water depth.

107. It is assumed that under normal circumstances a ship will use only one bow anchor and chain cable at a time.

108. Manufacture of anchors and anchor chain cables is to be in accordance with Part II, Section 3, Subchapter B, B2.300 UR W 29) and B2.400 ( UR W18).

109. Manufacture of anchors and anchor chain cables is to be in accordance with Part III, Title 61, Section 3, Chapter B.

#### 200. Arrangement

201. For vessels which the length L is significative in relation to rivers and canals along which the vessel is sailing the installation of stern anchor(s) having the same mass as prescribed for the bow anchors will be analyzed. Additional stern anchors will have a mass at least equal to 35% of the bow anchors total mass.

202. For vessels that always occupy internal positions in convoys, not being the first nor the last, the anchoring equipment will not be required.

203. The anchors must be ready to use at all times. This comprehends the location of the anchors and the device for a quick release. The bower anchors are to be connected to their chain cables and are to be ready for use. The stream anchor is to be ready to be connected to its cable.

204. Chain stoppers are to be provided between the windlass and the hawse pipe in order to relieve the windlass of the pull of the chain cable when the ship is at anchor, holding the anchor firm to the side or place of stowage. The stopper is to be fitted with a quick release device.

- a. A chain stopper is to be capable of withstanding a pull of 80% of the breaking load of the chain cable. The deck at the chain stopper is to be suitably reinforced.
- b. For the same purpose, a piece of chain cable may be used with a rigging screw capable of supporting the weight of the anchor when housed in the hawse pipe or a chain tensioner. Such arrangements are not to be considered as chain stoppers.

205. The chains and cables must be designed to avoid sharp bending and remain within the allowed diameter of curvature. Cables must not chafe against fixed parts destined to change the cable direction.

- a. Where the windlass is at a distance from the hawse

pipes and no chain stoppers are fitted, suitable arrangements are to be provided to lead the chain cables to the windlass.

206. The hawse pipes are to be designed with a resistance equal to that of the hull structure. The deck and side shell ends of the hawse pipes are to be rounded up.

207. Two bitts are to be installed at the stern and two at the bow, dimensioned in accordance with the cable breaking strength.

208. A tow bitt is to be installed at the bow, scaled to two times the cable breaking strength.

209. Bitts and accessories are to be fitted over local reinforcements that distribute their loads to the structure, and fixed with continuous welding in accordance with Part II Section 2 of the Rules.

### 300. Equipment number and anchoring equipment table (for vessels of unrestricted service) [IACS UR.A.1.2]

301. The equipment of anchors and chain cables is to be as given in Table T.D2.301.1 and is to be based on an "equipment number" calculated as follows:

for  $l > 61$  m:

$$EN = \Delta^{2/3} + 2.0 h \cdot B + A/10$$

where:

$\Delta$ : moulded displacements, in t, to the summer load waterline;

B: moulded breadth, in metres;

h = effective height, in metres, from the summer load waterline to the top of the uppermost house; for the lowest tier "h" is to be measured at centerline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck;

For the lowest tier "h" is to be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck.

$$h = hbl + \sum hi:$$

where:

hbl = distance, in metres, from the summer load waterline amidships to the upper deck;

hi = height, in metres, on the centerline of each tier of houses having a breadth greater than  $b/4$ ;

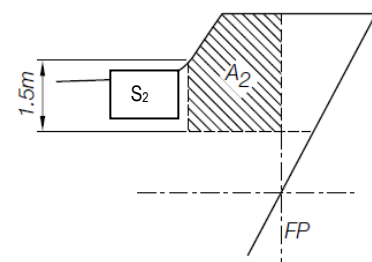
S = area, in square metres, in profile view, of the hull, superstructures and houses above the summer load waterline which are within the equipment length of the

vessel and also have a breadth greater than  $b/4$ .

302. Notes:

- When calculating h, sheer and trim are to be ignored, i.e., h is the sum of freeboard amidships plus the height (at centerline) of each tier of houses having a breadth greater than  $B/4$ .
- If a house having a breadth greater than  $B/4$  is above a house with a breadth of  $B/4$  or less then the wide house is to be included by the narrow house ignored.
- Screens of bulwarks 1,5 m in height are to be regarded as parts of houses when determining h and S. The height of the hatch coamings and that of any deck cargo such as containers may be disregarded when determining h and S. with regard to determining S when a bulwark is more than 1,5 m high, the area shown below as s shall be included in S.

FIGURE F.D2.302.1



- The equipment length of the vessel is the length between perpendiculars but is not to be less than 96% nor greater than 97% of the extreme length on the summer waterline (measured from the forward end of the waterline).
- The total length of chain given in table T.D2.301.1 col. 4 is to be divided in approximately equal parts between the two bower anchors.

303. For vessel transporting cargoes on deck whose height is larger than 1,5 metres, e.g, container ships, these areas will be taken into account in the calculation of hi x bi and S, in the same conditions as above.

**TABLE T.D2.301.1 – ANCHORING EQUIPMENT [IACS TABLE 1]**

| Equipment<br>Number | Stockless bower<br>anchors | Stud link chains for bower anchors<br><i>* Values according to IACS Rec 10</i> |                        |  |  |   |
|---------------------|----------------------------|--|------------------------|--|--|---|
|                     |                            | Mass per<br>anchor<br>(kg)   | Total<br>length<br>(m) | Minimum diameter                       |  |   |
|                     |                            |  |                        | Mild Steel<br><br>RBNA-Gr<br>1<br>(mm) | Special<br>Quality<br><br>RBNA-<br>Gr. 2<br>(mm) | Extra<br>Special<br>Quality<br><br>RBNA-<br>Gr. 3<br>(mm) |
| 1                   | 2                          | 3  | 4                      | 5                                      | 6  | 7   |
| 205-240             | 3                          | 660  | 302.5                  | 26                                     | 22   | 20.5  |
| 240-280             | 3                          | 780  | 330                    | 28                                     | 24   | 22  |
| 280-320             | 3                          | 900  | 357.5                  | 30                                     | 26   | 24  |
| 320-360             | 3                          | 1020   | 357.5                  | 32                                     | 28   | 24  |
| 360-400             | 3                          | 1140   | 385                    | 34                                     | 30   | 26  |
| 400-450             | 3                          | 1290   | 385                    | 36                                     | 32   | 28  |
| 450-500             | 3                          | 1440   | 412.5                  | 38                                     | 34   | 30  |
| 500-550             | 3                          | 1590   | 412.5                  | 40                                     | 34   | 30  |
| 550-600             | 3                          | 1740   | 440                    | 42                                     | 36   | 32  |
| 600-660             | 3                          | 1920   | 440                    | 44                                     | 38   | 34  |
|                     |                            |  |                        |  |  |   |
| 660-720             | 3                          | 2100   | 440                    | 46                                     | 40   | 36  |
| 720-780             | 3                          | 2280   | 467.5                  | 48                                     | 32   | 36  |
| 780-840             | 3                          | 2460   | 467.5                  | 50                                     | 44   | 38  |
| 840-910             | 3                          | 2640   | 467.5                  | 52                                     | 46   | 40  |
| 910-980             | 3                          | 2850   | 495                    | 54                                     | 48   | 42  |
| 980-1060            | 3                          | 3060   | 495                    | 56                                     | 50   | 44  |
| 1060-1140           | 3                          | 3300   | 495                    | 58                                     | 50   | 46  |
| 1140-1220           | 3                          | 3540   | 522.5                  | 60                                     | 52   | 46  |
| 1220-1300           | 3                          | 3780   | 522.5                  | 62                                     | 54   | 48  |
| 1300-1390           | 3                          | 4050   | 522.5                  | 64                                     | 56   | 50  |
|                     |                            |  |                        |  |  |   |
| 1390-1480           | 3                          | 4320   | 550                    | 66                                     | 58   | 50  |
| 1480-1570           | 3                          | 4590   | 550                    | 68                                     | 60   | 52  |
| 1570-1670           | 3                          | 4890   | 550                    | 70                                     | 62   | 54  |
| 1670-1790           | 3                          | 5250   | 577.5                  | 73                                     | 64   | 56  |
| 1790-1930           | 3                          | 5610   | 577.5                  | 76                                     | 66   | 58  |
| 1930-2080           | 3                          | 6000   | 577.5                  | 78                                     | 68   | 60  |
| 2080-2230           | 3                          | 6450   | 605                    | 81                                     | 70   | 62  |

| Equipment<br>Number | Stockless bower<br>anchors | Stud link chains for bower anchors<br><i>* Values according to IACS Rec 10</i> |                        |  |  |   |
|---------------------|----------------------------|--|------------------------|--|--|---|
|                     | No.<br>(See D2.306)        | Mass per<br>anchor<br>(kg)   | Total<br>length<br>(m) | Minimum diameter                       |  |   |
|                     |                            |  |                        | Mild Steel<br><br>RBNA-Gr<br>1<br>(mm) | Special<br>Quality<br><br>RBNA-<br>Gr. 2<br>(mm) | Extra<br>Special<br>Quality<br><br>RBNA-<br>Gr. 3<br>(mm) |
| 2230-2380           | 3                          | 6900   | 605                    | 84                                     | 73   | 64  |
| 2380-2530           | 3                          | 7350   | 605                    | 87                                     | 76   | 66  |
| 2530-2700           | 3                          | 7800   | 632.5                  | 90                                     | 78   | 68  |
|                     |                            |  |                        |  |  |   |
| 2700-2870           | 3                          | 8300   | 632.5                  | 92                                     | 81   | 70  |
| 2870-3040           | 3                          | 8700   | 632.5                  | 95                                     | 84   | 73  |
| 3040-3210           | 3                          | 9300   | 660                    | 97                                     | 84   | 76  |
| 3210-3400           | 3                          | 9900   | 660                    | 100                                    | 87   | 78  |
| 3400-3600           | 3                          | 10500  | 660                    | 102                                    | 90   | 78  |
| 3600-3800           | 3                          | 11100  | 687.5                  | 105                                    | 92   | 81  |
| 3800-4000           | 3                          | 11700  | 687.5                  | 107                                    | 95   | 84  |
| 4000-4200           | 3                          | 12300  | 687.5                  | 111                                    | 97   | 87  |
| 4200-4400           | 3                          | 12900  | 715                    | 114                                    | 100  | 87  |
| 4400-4600           | 3                          | 13500  | 715                    | 117                                    | 102  | 90  |
|                     |                            |  |                        |  |  |   |
| 4600-4800           | 3                          | 14100  | 715                    | 120                                    | 105  | 92  |
| 4800-5000           | 3                          | 14700  | 742.5                  | 122                                    | 107  | 95  |
| 5000-5200           | 3                          | 15400  | 742.5                  | 124                                    | 111  | 97  |
| 5200-5500           | 3                          | 16100  | 742.5                  | 127                                    | 111  | 97  |
| 5500-5800           | 3                          | 16900  | 742.5                  | 130                                    | 114  | 100   |
| 5800-6100           | 3                          | 17800  | 742.5                  | 132                                    | 117  | 102   |
| 6100-6500           | 3                          | 18800  | 742.5                  |  | 120  | 107   |
| 6500-6900           | 3                          | 20000  | 770                    |  | 124  | 111   |
| 6900-7400           | 3                          | 21500  | 770                    |  | 127  | 114   |
| 7400-7900           | 3                          | 23000  | 770                    |  | 132  | 117   |
|                     |                            |  |                        |  |  |   |
| 7900-8400           | 3                          | 24500  | 770                    |  | 137  | 122   |
| 8400-8900           | 3                          | 26000  | 770                    |  | 142  | 127   |
| 8900-9400           | 3                          | 27500  | 770                    |  | 147  | 132   |

| Equipment<br>Number | Stockless bower<br>anchors | Stud link chains for bower anchors<br><i>* Values according to IACS Rec 10</i> |                        |  |  |   |
|---------------------|----------------------------|--|------------------------|--|--|---|
|                     | No.<br>(See D2.306)        | Mass per<br>anchor<br>(kg)   | Total<br>length<br>(m) | Minimum diameter                       |  |   |
|                     |                            |  |                        | Mild Steel<br><br>RBNA-Gr<br>1<br>(mm) | Special<br>Quality<br><br>RBNA-<br>Gr. 2<br>(mm) | Extra<br>Special<br>Quality<br><br>RBNA-<br>Gr. 3<br>(mm) |
| 9400-<br>10000      | 3                          | 29000  | 770                    |  | 152  | 132   |
| 10000-<br>10700     | 3                          | 31000  | 770                    |  |  | 137   |
| 10700-<br>11500     | 3                          | 33000  | 770                    |  |  | 142   |
| 11500-<br>12400     | 3                          | 35500  | 770                    |  |  | 147   |
| 12400-<br>13400     | 3                          | 38500  | 770                    |  |  | 152   |
| 13400-<br>14600     | 3                          | 42000  | 770                    |  |  | 157   |
| 14600-<br>16000     | 3                          | 46000  | 770                    |  |  | 162   |



**304. Anchoring equipment for special purpose ships: tug boats [IACS UR A1.3]**

- a. For tugs of unrestricted service the equipment shall be provided in compliance with the present requirement. However, for the determination of the “equipment number”, in the formula given in Part II, Title 11, Section 3, Chapter D2, item 305, the following may be substituted for the term 2.0 hB:

$$2.0 * (a * B + \sum h_i * b_i)$$

where

**a, B** and **h<sub>i</sub>** are defined in D2.301 above

**b<sub>i</sub>** is the breadth, in metres, of the widest superstructure or deckhouse of each tier having a breadth greater than B/4.

The final formula:

$$EN = \Delta^{2/3} + 2.0 (aB + \sum h_i b_i) + A/10$$

- b. For tugs of restricted service the equipment shall be provided at the discretion of RBNA Head Office.

**Note:** (RBNA 2008): For pusher boats in a convoy or in an articulated configuration pusher-barge the parameters are calculated for the convoy or barge displacement, without the pusher boar.

**305. Anchoring equipment for special purpose ships: dredgers [IACS UR A1.3]**

- a. For dredgers of unrestricted service having normal shape of underwater part of the hull the anchoring equipment shall be provided in accordance with the present requirements. When calculating the Equipment Number bucket ladders and gallows are not to be included.
- b. If however a dredger has unusual design of the underwater part of the hull, each Classification Society is free to modify the requirements to anchoring equipment.
- c. As far as dredgers of limited service are concerned, the equipment is to be provided at the discretion of the RBNA Head Office.

**306. Installation of the anchors on board [IACS UR A.1.4.1. 2]**

- a. Two bower anchors of the three bower anchors under col. 2 of Table T.D2.301.1 are to be connected to their cables and positioned on board ready for use while the third anchor is intended as a spare bower anchor.
- b. Installation of the spare bower anchor on board is not compulsorily required. Other arrangements or not to require the spare anchor as a condition of classification may be allowed at the discretion of RBNA Head Office

- c. In case there are three or more propulsion lines, the condition of "ready to use" of the second anchor may be specially considered, but not excluded.

307. For unmanned ships, the anchors may have their mass reduced or be exempted after special analysis providing the Owners submit information about special conditions.

308. Pusher tugs, working in convoys, shall have the anchors located astern.

**400. Anchoring equipment for ships having NE below 205 to 50 [IACS Rec 10]**

401. The design of the anchoring equipment for ships having EN < 205 to 50 is that given in Subchapter D2 for ships having EN ≥ 205.

402. These requirements are applicable to ships operating in unrestricted service. Reductions of equipment may be permitted for ships operating in restricted service.

403. The equipment of anchors and chain cables is to be as given in Table T.D2.403.1 and it is to be based on an Equipment Number NE calculated in compliance with D2.301 above.

**TABLE T.D2.403.1 – ANCHORING EQUIPMENT FOR 50 <NE < 205 [IACS Rec10 TABLE 1]**

| Stockless bower anchor |     |                       | Stockless<br>stream<br>anchor | Stud link chain cable for bower<br>anchors |                                    |   | Stream wire or chain |                         |
|------------------------|-----|-----------------------|-------------------------------|--|------------------------------------|---|----------------------|-------------------------|
| NE                     | No. | Mass<br>per<br>anchor |                               | Total<br>length                            | Mild Steel<br>RBNA-Gr<br>1<br>(mm) | Special Quality<br>RBNA-Gr.<br>2 or 3<br>(mm) | Length<br>(m)        | Breaking strength<br>kN |
| 1                      | 2   | 3                     | 4                             | 5  | 6                                  | 7   | 8                    | 9                       |
| 50-70                  | 2   | 180                   | 60                            | 220  | 14                                 | 12,5  | 80                   | 65(64,6)                |
| 70-90                  | 2   | 240                   | 80                            | 220  | 16                                 | 14  | 85                   | 75(73,5)                |
| 90-110                 | 2   | 300                   | 100                           | 247,5                                      | 17,5                               | 16  | 85                   | 80(81,4)                |
| 110-130                | 2   | 360                   | 120                           | 247,5                                      | 19                                 | 17,5  | 90                   | 90(89,2)                |
| 130-150                | 2   | 420                   | 140                           | 275  | 20,5                               | 17,5  | 90                   | 100 ( 98,1)             |
| 150-175                | 2   | 480                   | 165                           | 275  | 22                                 | 19  | 90                   | 110(107,9)              |
| 175-205                | 2   | 570                   | 190                           | 302,5                                      | 24                                 | 20,5  | 90                   | 120(117,7)              |

**TABLE T.D2.403.1-A – ANCHORING EQUIPMENT FOR 30 <NE < 50 (rbna 2008)**

| Equipment<br><br>Number | Stockless<br>bower<br>anchors | Stud link chains for bower anchors |                        |                       |                        |                       |
|-------------------------|-------------------------------|------------------------------------|------------------------|-----------------------|------------------------|-----------------------|
|                         | No.                           | Mass<br>per<br>anchor<br>(kg)      | Total<br>length<br>(m) | Minimum diameter      |                        |                       |
|                         |                               |                                    |                        | Mild<br>Steel         | Special<br>Quality     | Extra Special Quality |
|                         |                               |                                    |                        | RBNA-<br>Gr 1<br>(mm) | RBNA-<br>Gr. 2<br>(mm) | RBNA-Gr. 3<br>(mm)    |
| 1                       | 2                             | 3                                  | 4                      | 5                     | 6                      | 7                     |
| 30-40                   | 2                             | 80                                 | 110                    | 12,5                  |                        |                       |
| 40-50                   | 2                             | 100                                | 110                    | 12,5                  |                        |                       |
|                         |                               |                                    |                        |                       |                        |                       |

404. **Installation of the anchors on board:** the bower anchors are to be connected to their chain cables and are to be ready for use. The streamanchor is to be ready to be connected with its cable.

**500. Chain cables for bower anchors**  
[IACS A1.5.1. and A1.5.2]

**501. Anchor chain cable design**[IACS A1.5.1]

- a. The chain cable is to be as required by Table T.D2.301.1 for the calculated equipment number for the vessel. The anchor cable is to be tested in accordance with Table T.D2.501.1 to the test loads corresponding to those for the required chain cable.
- b. Where the vessel may anchor in areas where the current exceeds 2.5 m/s, the need to provide a length of heavier chain cable locally between the anchor and the rest of the chain to enhance anchor bedding may be required at the discretion of the Classification Society.
- c. For certain restricted services the use of steel wire rope may be accepted in place of chain cable at the discretion of the classification society.

**502. Grades of chain cables**[IACS A1.5.2]. Bower anchors are to be associated with stud link chain cables for one of the grades listed in the column "Mild steel RBNA grade 1" of Table T.D2.501.1.

**TABLE T.D2.501.1 GRADES OF CHAIN CABLES**

| Grade | Material                          | Range of UTS<br>(N/mm <sup>2</sup> )         |
|-------|-----------------------------------|--|
| RB- 1 | Mild steel                        | 300 to 490<br>(31 to 50 kg/mm <sup>2</sup> ) |
| RB- 2 | Special<br>quality steel          | 490 to 690<br>(50 to 70 kg/mm <sup>2</sup> ) |
| RB- 3 | Extra<br>special<br>quality steel | > 690<br>(>70 kg/mm <sup>2</sup> )           |

**Note:** the designation "Grade 1" may be replaced, at discretion of the Society, by "Grade 1a" where UTS is greater than 300 but not exceeding 400 N/mm<sup>2</sup> or by "Grade 1b" where UTS is greater than 400 but not exceeding 490 N/mm<sup>2</sup>.

**503. [IACS A1.6] Permissible Wear-down of Stud Link Chain Cable for Bower Anchors:** when a length of chain cable is so worn that the mean diameter of a link, at its most worn part, is reduced by 12% or more from its required nominal diameter it shall be renewed. The mean diameter is half the value of the sum of the minimum diameter found in one cross-section of the link and of the diameter measured in a perpendicular direction in the same cross-section. Grades of chain cables: bower anchors are to be associated with stud link chain cables for one of the grades listed in Table T.D2.501.1.

**TABLE T.D2.504.1 MASS OF STUD LINK CHAIN CABLES.**

| Chain<br>Diameter<br><i>r</i> | Minimum mass<br>per length of<br>27.5 m |                             | Chain<br>Diameter<br><i>r</i> | Minimum mass<br>per length of<br>27.5 m |                             |
|-------------------------------|---|-----------------------------|-------------------------------|---|-----------------------------|
|                               | With<br>Dee<br>Shackle                  | With<br>Lugless<br>Shackles |                               | With<br>Dee<br>Shackle                  | With<br>Lugless<br>Shackles |
| <i>mm</i>                     | <i>kg</i>                               | <i>kg</i>                   | <i>mm</i>                     | <i>kg</i>                               | <i>kg</i>                   |
| 26                            | 410                                     | 405                         | 78                            | 3640                                    | 3535                        |
| 28                            | 480                                     | 475                         | 81                            | 3940                                    | 3820                        |
| 30                            | 550                                     | 545                         | 84                            | 4240                                    | 4105                        |
| 32                            | 620                                     | 615                         | 87                            | 4555                                    | 4405                        |
| 34                            | 700                                     | 690                         | 90                            | 4870                                    | 4705                        |
| 36                            | 785                                     | 778                         | 92                            | 5085                                    | 4905                        |
| 38                            | 875                                     | 860                         | 95                            | 5405                                    | 5210                        |
| 40                            | 965                                     | 950                         | 97                            | 5630                                    | 5425                        |
| 42                            | 1055                                    | 1040                        | 100                           | 5970                                    | 5745                        |
| 44                            | 1150                                    | 1130                        | 102                           | 6210                                    | 5970                        |
| 46                            | 1260                                    | 1240                        | 105                           | 6580                                    | 6320                        |
| 48                            | 1370                                    | 1345                        | 107                           | 6845                                    | 6575                        |
| 50                            | 1485                                    | 1455                        | 111                           | 7380                                    | 7080                        |
| 52                            | 1605                                    | 1575                        | 114                           | 7795                                    | 7475                        |
| 54                            | 1725                                    | 1690                        | 117                           | 8220                                    | 7870                        |
| 56                            | 1850                                    | 1810                        | 120                           | 8650                                    | 8270                        |
| 58                            | 1985                                    | 1945                        | 122                           | 8960                                    | 8550                        |
| 60                            | 2125                                    | 2075                        | 124                           | 9275                                    | 8835                        |
| 62                            | 2275                                    | 2220                        | 127                           | 9740                                    | 9270                        |
| 64                            | 2430                                    | 2370                        | 130                           | 10210                                   | 9710                        |
| 66                            | 2590                                    | 2525                        | 132                           | 10540                                   | 10005                       |
| 68                            | 2755                                    | 2685                        | 137                           | 12110                                   | 10750                       |
| 70                            | 2925                                    | 2850                        | 142                           | 12110                                   | 11500                       |
| 73                            | 3185                                    | 3100                        | 147                           | 12950                                   | 12300                       |
| 76                            | 3460                                    | 3360                        | 152                           | 13890                                   | 13200                       |

**504. [IACS Rec 10 1.1.3]**Chain cables and wire ropes for anchors for ships having NE below 205 to 50

- a. The anchor to be associated with stud link chain cables of one of the grades under D2.502 above, Table T.D2.504.1. However, for NE up to 90, as an alternative to stud link chain cables, short link chain cables may be considered, for acceptance, by the RBNA on the basis of their design, strength and steel quality.
- b. Wire ropes may be adopted in compliance with the present item 505.a
- c. In alternative to the stud link or short link chain cables, wire ropes may be used for:
  - c.1. both the bower anchors of ships below 30 m in length

- c.2. one of the two bower anchors of ships between 30 m and 40 m in length
- c.3. stream anchor as stipulated in T.D.2.403.1
- c.4. The wire ropes under a) and b) above are to have:
- c.5. length equal to 1,5 times the corresponding tabular length of chain cable (Table T.D.2.403.1)
- c.6. strength equal to that of tabular chain cable of Grade 1.

- d. A short length cable is to be fitted between the wire ropes and bower or stream anchor having a length of 12,5 m or the distance between anchor in stowed position and winch, whichever is less. The mass of the short cable, however, shall not be less than 25% of the mass of the anchor.

**505. Capacity and arrangement of anchor chains locker [IACS Rec 10 1.2]**

- a. The chain locker is to be of capacity and depth adequate to provide an easy direct lead of the cables through the chain pipes and a self-stowing of the cables. the chain locker is to be provided with an internal division so that the port and starboard chain cables may be fully and separately stowed.
- b. The chain locker boundaries and their access openings are to be watertight as necessary to prevent accidental flooding of the chain locker from damaging essential auxiliaries or equipment or affecting the proper operation of the vessel.
- c. The openings on deck for the anchor chain will be fitted with means to avoid flooding of the chain locker due to waves during the sea voyage (rbna 2008).
- d. Adequate drainage facilities of the chain locker are to be adopted.
- e. Securing of the inboard end of the cables

- e.1. the inboard ends of the chain cables are to be secured to the structures by a fastening able to withstand a force not less than 15% BL nor more than 30% BL (BL = breaking load of the chain cable).
- e.2. the fastening is to be provided with a mean suitable to permit, in case of emergency, an easy
- e.3. slipping of the chain cables to sea, operable from an accessible position outside the chain
- e.4. locker.

- f. The chain lockers internal division is to be calculated according to Part II, Title 11, Section 2 as tank bulkheads (ATQ) and extend up to the main deck. The compartment is to be fitted with a double bottom (removable or not) to provide for cleaning and drainage.

506. The following spaces are recommended for the stowage of the anchor chain:

- a. Volume occupied by the chains:

$$V = 1,8 * 10^{-5} * lA * d^2 m^3$$

where:

lA: length of the anchor chain, in m;

d: diameter of the link, in mm;

- b. Height of the free space above the volume V:

$$ht = 0,006 * L + 0,48 m$$

- c. Minimum height “hf” of the mud Box at the bottom of the chain locker, fitted with perforated lid and manhole = 0,60 m

**600. Windlass design and testing [NBR 8551 and IACS REC 10]**

601. This Chapter is in conformity with the standard **NBR 8551** for the design of the windlasses as well as in conformity with IACS Rec 10 - Equipment .

602. A windlass suitable for the size of chain cable and complying with the following criteria is to be fitted to the ship.

603. The windlass unit prime mover is to be able to supply for at least 30 minutes a continuous duty pull Tcont, corresponding to the grade of chain cables given by:

$$\begin{aligned} T_{cont} &= 37.5 d^2 N (4.33 d^2 \text{ kgf}) \text{ grade 1} \\ &42.5 d^2 N (4.33 d^2 \text{ kgf}) \text{ grade 2} \\ &47.5 d^2 N (4.84 d^2 \text{ kgf}) \text{ grade 3} \end{aligned}$$

where d = chain diameter (mm).

604. These figures were determined taking into account the following environmental conditions:

- a. wind force equal to 6 on Beaufort Scale, corresponding, approximately, to 14 m/sec;
- b. water current velocity 3 knots = 1,54 m/sec; e
- c. anchorage depth 100 m using ordinary stockless anchor.

605. For NE > 150 or anchors of weight above 4900 N (499 kgf) the windlass must be fitted with a prime mover.

The windlass unit prime mover is to provide the necessary temporary overload capacity for breaking out the anchor. The temporary overload capacity or "short term pull" shall not be less than 1.5 the continuous duty pull and shall be provided for at least two minutes. The speed in this period can be lower than nominal.

606. Notes

- a. The values of Tcont include the influences of buoyancy and hawse pipe efficiency which is assumed to be 70 percent;
- b. The anchor masses are assumed to be the masses, excluding tolerances, as given in Table T.D2.301.1 above and in Part III, Title 61, Section 3, Item B2.600, Table T.B2.601.1. The chain masses are assumed, owing to the buoyancy, smaller than those in Table T.D2.501.2 and as given by  $P = 0,0218 d^2 \text{kg}$  per meter length.
- c. Only one anchor is assumed to be raised at a time.

607. Nominal speed of the chain cable when hoisting the anchor and cable can be a mean speed only and this speed shall be not less than 0,15 m/sec. The speed is to be measured over two shots of chain cable during the total trip; the trial shall be commenced with 3 shots (82,5 m) of chain fully submerged.

608 The capacity of the windlass brake is to be sufficient for safe stopping of anchor and chain cable when paying out the chain cable. If a chain stopper is not fitted, the windlass is to be able to withstand a pull of 80% of the breaking load of the chain without any permanent deformation of the stressed part and without brake slip.

- a. If a chain stopper is fitted it shall withstand a pull of 80% of the breaking load of the chain.
- b. The windlass with brakes engaged and cable lifters disengaged is to be able to withstand a pull of 45% of the breaking load of the chain without any permanent deformation of the stressed parts and without brake slip.

609. [NBR8551] The driver unit is to be fitted with an automatic breaking system. The breaking system is to be operated manually when the windlass is not in operation.

610. [NBR8551] If the depth is larger than 82.5 metres, the following is to be added to the nominal load:

$$0,27 \cdot d^2 (D - 82,5)$$

where:

d = chain anchor diameter, in mm

D = depth in meter.

- a. An emergency stop is to be fitted for the driver system which is to be able to:
  - a.1. be shut off the power;
  - a.2. activate the automatic braking system

611. [NBR 8551] The wildcat (cable holder) is to comply with the following:

- a. be fitted with at least five recesses;
- b. be fitted with uncoupling and breaking devices;
- c. the angle of contact with the anchor chain is to be at least 115°; in case a wire rope is fitted, the angle is to be 150°.

[IACS REC 10]

612. The stresses in the involved parts of the windlass, windlass frame and stopper have to be below the yield point of the material used. The windlass, its frame and the stoppers are to be efficiently bedded to the deck.

613. Attention is to be paid to:

- a. stress concentrations in keyways and at other stress raisers;
- b. dynamic effects due to sudden starting or stopping of the prime mover or anchor chain;
- c. calculation methods and approximation used when deriving the design stresses.

614. The windlass shall be fastened by means of screws and to have a base that distributes its efforts to the deck, in structurally reinforced areas. The tensions in the elements shall attend to the equation:

$$\sigma = \sqrt{\sigma^2 + 3\tau^2} \leq 15,7 \text{ daN/mm}^2 \quad (16 \text{ kgf/mm}^2)$$

615. In case of manual driving, the force in the lever shall be smaller than 177 N (18 kgf).

**700. Mooring and towing ropes**  
[IACS Rec 10.2]

701. Mooring lines and towing line:

- a. the mooring lines and towing lines are given in table T.D2.701.1 based in an equipment number calculated in compliance with table T.D2.305.1
- b. for ferry boat ships, car ferries and passenger ships having the ratio  $a/n_e > 0,9$  the following number of ropes shall be added to the number required by table t.d2.701.1 for mooring lines:

- b.1. one rope where  $0,9 < A/EN < 1,1$
- b.2. two ropes where  $1,1 < A/EN < 1,2$
- b.3. three ropes where  $1,2 < A/EN$
- c. The tow lines given in column 6 of table T.D2.701.1 are intended as own towline of a ship to be towed by a tug or other ship.

#### 702. Mooring and towing ropes

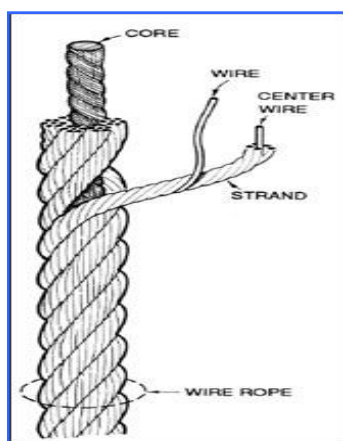
- a. Towlines and mooring lines may be of wire, natural fibre or synthetic fibre construction or of a mixture of wire and fibre. The length of individual mooring ropes may be reduced by up to 7% of the table length, provided that the total length of mooring ropes is not less than would have resulted had all ropes been of equal length.
- b. Notwithstanding the strength requirements given in Table T.D2.702.1, no fibre rope is to be less than 20 mm diameter. (RBNA 2008) Their strength to rupture shall be larger than those given in table T.D2.702.1., in the following proportions:
  - b.1. 30% for polypropylene; and
  - b.2. 20% for other materials.

703. Special cases for mooring cables selection may be accepted upon submitting the operating conditions to RBNA. (RBNA 2008)

#### 704. Wire ropes:

##### Guidance

**FIGURE F.D2.704.1. CONSTRUCTION OF A WIRE ROPE**



##### Definitions

**The strand** is the simplest construction: it consists of one or more layers of superimposed wires laid spirally around one or more central wires or around a fibre core. The

construction of the strand is identified by the number of wires in the individual layers, starting from the outer one (e.g. 12+6+1 or 15+9+FC). FC indicates a fibre core.

**The core of a wire rope** is the central member around which the main strands are laid. Its principal function is to support the strands, and maintain them in their proper position when loads are applied.

The three types of cores commonly used in wire ropes are:

**Independent Wire Rope Cores (IWRC)** - This is a separate wire rope used as a core in the main wire rope.

**Independent Wire Strand Core (IWSC)** - A single strand can be used as the core in a wire rope. The wire strand core may be of the same construction as the outer strands, or of different construction. A 6-strand rope with a wire strand core of a different construction from that of the main strands is called a 6-strand rope with WSC.

**Fibre Core (FC)** - These cores are fibre ropes, made from either natural fibres such as manila, sisal, jute, or cotton or synthetic fibres such as polypropylene or polyethylene.

**Characteristics of Wire Rope** The main types of wire rope used consist of 6, 7, 12, 19, 24, or 37 wires per strand. Usually, the wire rope has six strands laid around the core.

**Type of wire ropes.** Wire ropes are of the following type:

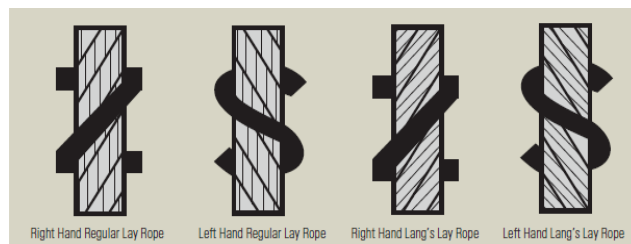
The strand construction refers to the pattern in which the wires are placed within the strands. Take for example this 6x19 FC wire.

The actual construction is 6x19 Filler (12/6+6F/1) fibre core. That is 6 strands each made up of 19 wires. Each wire made up of 12 outer wires over 6 inner wires plus 6 filler wires over 1 centre wire. The word filler relates to the strand pattern of which there are three.

**Filler** – characterised by the small spacer wires which lie in the interstices of the inner layer to help position and support the outer layer.

**Seale** – characterised by having equally sized wires in the outer layer with the same number of uniform but smaller sized wires in the inner layer.

**Warrington** – characterised by having one of its wire layers (usually the outer) made up of an arrangement of alternately large and small wires.





**The lay** of a wire rope is the description of the way the wires and strands are placed during manufacture.

- *Regular and Langs lay* refers to the way the wires in the strand are wound in relation to the strands.

**Right hand lay** means the strands pass in a left to right direction across the rope.

**Left hand lay** means the strands pass in a right to left direction across the rope.

**Regular or ordinary lay** refers to the way the wires are placed in each strand. Regular or Ordinary lay means that the wires in the strand are laid in an opposite direction to that of the strand. The crowns of the wires appear to be parallel to the axis of the rope. This is the most common lay.

**Langs lay** means that the wires in the strand are laid in the same direction as the strand. The crowns of the wires appear to be at an angle to the axis of the rope.

*End of guidance*

a. Where wire ropes are used, they are to be of a flexible construction with not less than:

- a.1. 72 wires in 6 strands with 7 fibre cores for the loads up to 216 kN
- a.2. 144 wires in 6 strands with 7 fibre cores for loads of 216 kN to 490 kN
- a.3. 222 wires in 6 strands with 1 fibre core for loads exceeding 490 kN.

b. Tensile strength of wires for wire rope mooring lines shall be within the following ranges:

1420 - 1570 N/mm<sup>2</sup>  
1570 - 1770 N/mm<sup>2</sup>  
1770 - 1960 N/mm<sup>2</sup>

- b.1. Wire ropes with 216 wires in 6 strands with 1 fibre core are substituted for 222 wired.
- b.2. Wire ropes for use in association with mooring winches where the rope is to be stored on the drum may be constructed with an independent wire rope core instead of fibre core.

705. Non-rotating cables for mooring or towing are not allowed (RBNA 2008).

## 800. Spare parts

801. Recommended spare parts:

- a. Kenter links;
- b. swivel; and
- c. shackles.

**TABELA T.D2.702.1. MOORING LINES AND TOW LINE**

| EQUIPMENT NUMBER |               |     | MOORING LINES                   |                                |     |      | TOW LINES          |                        |
|------------------|---------------|-----|---------------------------------|--------------------------------|-----|------|--------------------|------------------------|
| Exceeding        | Not exceeding | No. | Minimum length of each line (m) | Minimum breaking strength (kN) |     |      | Minimum length (m) | Breaking strength (kN) |
| 1                | 2             | 3   | 4                               | 5a                             | 5   | 5b*  | 6                  | 7                      |
| 50               | 70            | 3   | 80                              | 34                             |     | 34.3 | 180                | 98                     |
| 70               | 90            | 3   | 100                             | 37                             |     | 36.8 | 180                | 98                     |
| 90               | 110           | 3   | 110                             | 39                             |     | 39.2 | 180                | 98                     |
| 110              | 130           | 3   | 110                             | 44                             |     | 44.1 | 180                | 98                     |
| 130              | 150           | 3   | 120                             | 49                             |     | —    | 180                | 98                     |
| 150              | 175           | 3   | 120                             | 54                             |     | —    | 180                | 98                     |
| 175              | 205           | 3   | 120                             | 59                             |     | —    | 180                | 112                    |
| 205              | 240           | 4   | 120                             | 64                             |     | 63.7 | 180                | 129                    |
| 240              | 280           | 4   | 120                             | 69                             |     | 68.6 | 180                | 150                    |
| 280              | 320           | 4   | 140                             | 74                             |     | 73.6 | 180                | 174                    |
| 320              | 360           | 4   | 140                             | 78                             |     | 78.4 | 180                | 207                    |
| 360              | 400           | 4   | 140                             | 88                             |     | 88.3 | 180                | 224                    |
| 400              | 450           | 4   | 140                             | 98                             |     | 98.1 | 180                | 250                    |
| 450              | 500           | 4   | 140                             |                                | 108 |      | 180                | 277                    |
| 500              | 550           | 4   | 160                             |                                | 123 |      | 190                | 306                    |
| 550              | 600           | 4   | 160                             |                                | 132 |      | 190                | 338                    |
| 600              | 660           | 4   | 160                             |                                | 147 |      | 190                | 370                    |
| 660              | 720           | 4   | 160                             |                                | 157 |      | 190                | 406                    |
| 720              | 780           | 4   | 170                             |                                | 172 |      | 190                | 441                    |
| 780              | 840           | 4   | 170                             |                                | 186 |      | 190                | 479                    |
| 840              | 910           | 4   | 170                             |                                | 201 |      | 190                | 518                    |
| 910              | 980           | 4   | 170                             |                                | 216 |      | 190                | 559                    |
| 980              | 1060          | 4   | 180                             |                                | 230 |      | 200                | 603                    |
| 1060             | 1140          | 4   | 180                             |                                | 250 |      | 200                | 647                    |
| 1140             | 1220          | 4   | 180                             |                                | 270 |      | 200                | 691                    |
| 1220             | 1300          | 4   | 180                             |                                | 284 |      | 200                | 738                    |
| 1300             | 1390          | 4   | 180                             |                                | 309 |      | 200                | 786                    |
| 1390             | 1480          | 4   | 180                             |                                | 324 |      | 200                | 836                    |
| 1480             | 1570          | 5   | 190                             |                                | 324 |      | 220                | 888                    |
| 1570             | 1670          | 5   | 190                             |                                | 333 |      | 220                | 941                    |
| 1670             | 1790          | 5   | 190                             |                                | 353 |      | 220                | 1024                   |
| 1790             | 1930          | 5   | 190                             |                                | 378 |      | 220                | 1109                   |
| 1930             | 2080          | 5   | 190                             |                                | 402 |      | 220                | 1168                   |
| 2080             | 2230          | 5   | 200                             |                                | 422 |      | 240                | 1259                   |
| 2230             | 2380          | 5   | 200                             |                                | 451 |      | 240                | 1356                   |
| 2380             | 2530          | 5   | 200                             |                                | 480 |      | 240                | 1453                   |
| 2530             | 2700          | 6   | 200                             |                                | 480 |      | 260                | 1471                   |
| 2700             | 2870          | 6   | 200                             |                                | 490 |      | 260                | 1471                   |
| 2870             | 3040          | 6   | 200                             |                                | 500 |      | 260                | 1471                   |
| 3040             | 3210          | 6   | 200                             |                                | 520 |      | 280                | 1471                   |
| 3210             | 3400          | 6   | 200                             |                                | 554 |      | 280                | 1471                   |
| 3400             | 3600          | 6   | 200                             |                                | 588 |      | 280                | 1471                   |

### EQUIPMENT NUMBER MOORING LINES TOWING LINE

| EQUIPMENT NUMBER |               | No. | MOORING LINES                   |                                | TOW LINES |                    |                        |      |
|------------------|---------------|-----|---------------------------------|--------------------------------|-----------|--------------------|------------------------|------|
| Exceeding        | Not exceeding |     | Minimum length of each line (m) | Minimum breaking strength (kN) |           | Minimum length (m) | Breaking strength (kN) |      |
| 1                | 2             | 3   | 4                               | 5a                             | 5         | 5b*                | 6                      | 7    |
| 3600             | 3800          | 6   | 200                             |                                | 618       |                    | 300                    | 1471 |
| 3800             | 4000          | 6   | 200                             |                                | 647       |                    | 300                    | 1471 |
| 4000             | 4200          | 7   | 200                             |                                | 647       |                    | 300                    | 1471 |
| 4200             | 4400          | 7   | 200                             |                                | 657       |                    | 300                    | 1471 |
| 4400             | 4600          | 7   | 200                             |                                | 667       |                    | 300                    | 1471 |
| 4600             | 4800          | 7   | 200                             |                                | 677       |                    | 300                    | 1471 |
| 4800             | 5000          | 7   | 200                             |                                | 686       |                    | 300                    | 1471 |
| 5000             | 5200          | 8   | 200                             |                                | 686       |                    | 300                    | 1471 |
| 5200             | 5500          | 8   | 200                             |                                | 696       |                    | 300                    | 1471 |
| 5500             | 5800          | 8   | 200                             |                                | 706       |                    | 300                    | 1471 |
| 5800             | 6100          | 9   | 200                             |                                | 706       |                    | 300                    | 1471 |
| 6100             | 6500          | 9   | 200                             |                                | 716       |                    |                        |      |
| 6500             | 6900          | 9   | 200                             |                                | 726       |                    |                        |      |
| 6900             | 7400          | 10  | 200                             |                                | 726       |                    |                        |      |
| 7400             | 7900          | 11  | 200                             |                                | 726       |                    |                        |      |
| 7900             | 8400          | 11  | 200                             |                                | 736       |                    |                        |      |
| 8400             | 8900          | 12  | 200                             |                                | 736       |                    |                        |      |
| 8900             | 9400          | 13  | 200                             |                                | 736       |                    |                        |      |
| 9400             | 10000         | 14  | 200                             |                                | 736       |                    |                        |      |
| 10000            | 10700         | 15  | 200                             |                                | 736       |                    |                        |      |
| 10700            | 11500         | 16  | 200                             |                                | 736       |                    |                        |      |
| 11500            | 12400         | 17  | 200                             |                                | 736       |                    |                        |      |
| 12400            | 13400         | 18  | 200                             |                                | 736       |                    |                        |      |
| 13400            | 14600         | 19  | 200                             |                                | 736       |                    |                        |      |
| 14600            | 16000         | 21  | 200                             |                                | 736       |                    |                        |      |

\* The values of column 5b may be adopted in alternative to the corresponding values of column 5a.

For individual mooring lines with breaking strength above 490 kN (50000 kg) the latter may be reduced with corresponding increase of the number of the mooring lines and vice versa, provided that the total breaking load of all lines aboard the ship is not less than the Rules value. The number of lines is not to be less than 6 and no one line is to have a strength less than 490 kN (50000 kg).

## 900. Mooring winches

901. Each winch shall be fitted with drum brakes the strength of which is sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80 percent of the breaking strength of the rope as fitted on the first layer.

902. For powered winches the maximum hauling tension which can be applied to the mooring line (the reeled first layer) shall not be less than 1/4.5 times the rope's breaking strength and not more than 1/3 times the rope's breaking strength. For automatic winches these figures shall apply when the winch is set on the maximum power with automatic control.

903. For rendering which the winch can exert on the mooring line (reeled 1st layer) shall not exceed 1.5 times, nor be less than 1.05 times the hauling tension for that particular power setting of the winch on automatic control. The winch is to be marked with the range of rope strength for which it is designed.

## D3. MANOEUVERING SYSTEM

See Part II, Title 11, Section 3, Chapter G

## D4. LIFE SAVING APPLIANCES (LSA)

### 100. Aplicação

101. This subchapter is applicable to all Life Saving Appliances.

102. For Brazilian Flag vessels under 500 GT, the NORMAM 01 and NORMAM 05 requirements apply.

103. For foreign flag vessels under 500 GT, National Regulations apply. In the absence of such regulations, the SOLAS Convention and of the IMO LSA Code requirements apply as far as practicable.

104. For all vessel with GT equal to or over 500 GT, the SOLAS Convention and the IMO LSA Code apply.

## D5. FIRE FIGHTING EQUIPMENT

### 100. Aplicação

101. The requirements of this subchapter apply to equipment and accessories used for prevention and fire fighting, referred to elsewhere in this Section.

102. **Vessels with GT < 500:** The requirements of NORMAM 01 (Brazilian Maritime Authority Norm for Open Sea Navigation) apply.

103. **Vessels with GT < 500 under foreign flags;** The

National RBNA regulations apply. Where there are no National Regulations available the requirements of the present Rules apply.

104. **For all vessels with GT ≥ 500** intended for national or international navigation, the International Convention SOLAS and the International Code for Fire Safety System – FSS apply.

105. For prevention and fire fighting systems see Chapter E, as relevant.

106. The requirements for water and fixed fire fighting systems are in Part II, Title 11, Section 6.

## 200. Portable extinguishers for vessels with GT < 500

201. The requirements of the present Chapter are to be followed. The requirements of National RBNA, however, are to be taken into account.

- a. Wherever there is conflict between the requirements of the Rules and of the National RBNA, the stricter requirements are to be taken into account;
- b. For vessels under the Brazilian flag with GT < 500, the National RBNA the requirements of NORMAM 01 apply.
- c. All the fire extinguishers shall be of approved design and type.
- d. The minimum quantity, type and capacity of fire extinguishers required to protect an isolated risk include:
  - d.1. Nature of fire to extinguish;
  - d.2. Substance used for fire extinguishing;
  - d.3. Quantity of the substance and its corresponding extinguishing unit; and
  - d.4. Class occupational of the risk and its area

202. The nature of the fire to extinguish is classified according to the type of materials. The four classes and the materials to be used for fire extinction are those of Table T.D5.202.1 below.

**TABLE T.D5.202.1 – CLASS OF FIRES AND EXTINGUISHING SUBSTANCES**

| CLASS    | NATURE   | EXTINGUISHING SUBSTANCE   |
|----------|--|---|
| <b>A</b> | Fire in combustible materials such as cellulose materials (wood, cotton cloth, paper), where the effect of “cooling” by water or solutions containing a lot of water, is of paramount importance | Water, foam, soda or foam and solutions of same effect                              |
| <b>B</b> | Fire in flammable liquids, greases, oils and similar, fuels where damping effect is essential  | Foam, chemical compounds in powder, carbon gas compound ...(MA030)                  |
| <b>C</b> | Fire in electrical equipment, where the extinction shall be performed with non-conductive electrical material  | Chemical compounds in powder (chemical powder), carbon dioxide compounds... (MA030) |
| <b>D</b> | Metal fire where the extinction must be made by special means. For example, magnesium metal fire, bulkheads, powder etc.   | Special chemical compounds, iron filing, rock salt, sand and others.                |

203. For the purposes of this regulation, an “extinguishing unit” is a device containing the capacity and substance as specified below in table T. D 5.203.1:

**TABLE T.D5.203.1. – CLASSES OF FIRE EXTINGUISHERS**

| CLASS | WATER | MECHANICAL FOAM | CO <sub>2</sub> | CHEMICAL POWDER |
|-------|-------|-----------------|-----------------|-----------------|
| A2    | 10 l  | 9 l             | -               | -               |
| B1    | -     | 9 l             | 4               | 1               |
| B2    | -     | 9 l             | 6               | 4               |
| B3    | -     | 45 l            | 10              | 6               |
| B4    | -     | 75 l            | 25              | 12              |
| B5    | -     | 152 l           | 50              | 25              |
| C1    | -     | -               | 4               | 1               |
| C2    | -     | -               | 6               | 4               |

204. The fire extinguishers shall be checked or recharged or checked in the periods and conditions recommended by the respective manufacturers.

205. The location of fire extinguishers will meet the following requirements:

- a. To be installed in locations where:
  - a.1. There is less probability of having the access being blocked by a fire;
  - a.2. Clearly visible, so that all crew members are familiar with their location; and
  - a.3. Protected from impact.
- b. Not to be installed in locations where:
  - b.1. The upper part is located over 1.7 meters above the deck; and
  - b.2. Side bulkhead of staircases.

206. The extinguishers must be mandatorily fitted with the labels of “Surveyed” and/or “Conformity”.

207. For vessels with GT < 500 under the Brazilian flag, the minimum number and distribution of portable extinguishers shall be in compliance with NORMAM 01 Annex 4-Gregulations, and the following requirements:

208. In the engine room:

**TABLE T.D5.208.1 – PORTABLE EXTINGUISHERS**

| Power of main engine - kW (HP) | Quantity  |
|--------------------------------|---|
| < 1000                         | 2   |
| ≥ 1000                         | One additional extinguishing unit for every 1000 kW or fraction |

209. In the boiler room:

- a. One portable foam extinguishing units with applicator, next to the boiler; and
- b. One box with sand and shovel.

210. **In the accommodation / service spaces**

- a. One extinguishing unit per each deck main alley so that no space is distant more than 20 m from the unit.
- b. One extinguishing unit at the entrance of the galley or of any compartment with fuel oil.

211. **In the safety areas:**

- a. One extinguishing unit in the bridge and chart room;
- b. One extinguishing unit in the radio room.

212. **In spaces containing internal combustion engines:**

- a. At least one portable foam applicator type extinguisher class B-5 or B-4.
- b. The furthest distance between a fire extinguisher and another is 10 m, and there must be at least two fire extinguishers in each space. In smaller areas of the cargo ship the RBNA can attenuate the requirements.
- c. There must be at least one powder or CO2 fire extinguisher in the vicinity of any electrical panel or of some section on board of 20KW power and up.

213. **In other machinery spaces:** additional extinguishing units may be required for any machinery space not specified in the Rules and where RBNA judges there is some fire hazard. Such compartments shall be equipped with a sufficient number of fire extinguishers or some other means of extinction that RBNA deems efficient.

214. The number, location and type of the fire extinguishers for the spaces above mentioned are summarized in Table T.D5.214, in accordance with Annex 4-G of NORMAM 01.

- a. Other accredited classes for fire extinguishers will be considered once submitted to RBNA.



**TABLE T.D5.214.1 - NUMBER, LOCATION AND TYPE OF THE FIRE EXTINGUISHERS  
[NORMAM 01]**

| AREA                                |   | QUANTITY AND LOCATION   | CLASS OF THE EXTINGUISHERS |
|-------------------------------------|---|---|----------------------------|
| SAFETY AREA                         | Bridge and Chart Room   | One   | C-2                        |
|                                     | Radio Room  | One (next do the exit)  | C-2 <sup>(*)1</sup>        |
| ACCOMMODATION AREAS                 | Cabins, toilets, public spaces, offices etc and store rooms, lockers, Galley and associated lockers                                       | One in each deck main alley suitably located so that no space is to be more than 20 m distant from an extinguisher. | A-2 or B-2                 |
| SERVICE AREAS                       | Galley  | One for each 200m <sup>2</sup> or fraction,<br>Suitable to the actual risk  | B-2 or C-2                 |
|                                     | Warehouses, including paint and lamp lockers  | One for each 200m <sup>2</sup> or fraction, adequate to the local risks   | A-2 or B-2                 |
| MACHINERY SPACES<br><sup>(*)2</sup> | Spaces containing oil-fired boilers (main or auxiliary) or any fuel oil unit subject to pressure discharge from the service fuel oil pump | Two <sup>(*)3</sup>   | B-2                        |
|                                     | Spaces containing internal combustion engines or gas turbines for propulsion  | One   | B-5 <sup>(4)</sup>         |
|                                     |   | One for each 1000 BHP, but no less than two nor more than six <sup>(*)5</sup>                                       | B-2                        |
|                                     | Auxiliary spaces containing internal combustion engines or gas turbines   | One <sup>(*)6</sup> <sup>(*)7</sup>   | B-3                        |
|                                     |   | One next to the exit <sup>(*)7</sup>  | B-2                        |
|                                     | Auxiliary spaces containing emergency generators  | One next to the exit  | C-2                        |
| CARGO AREAS                         | Pump-rooms  | One   | B-2                        |
|                                     | Cargo Area  | See Titles 32, 33, 34   | See Titles 32, 33, 34      |

NOTES:

(1)-Vessels not employed in international sailing can replace by 2 C-1.

(2) One fire extinguisher C-2 shall be immediately available to the generator service areas and the main switchboard and, additionally, one C-2 must be located at a convenient distance at a distance without obstructions not exceeding 15 m from any point of the main machinery space. These fire extinguishers need not be required in addition to the other regulatory fire extinguishers.

(3)-GT <500 vessels need only one.

(4)- GT <500 vessels can replace with one B-4.

(5)-One is only required for vessels with less than 20 m in length.

(6) If an auxiliary boiler is installed in the space, the B-5 extinguisher previously required for the boiler can be replaced. It is not required when a fixed system is installed.

(7)-not required for vessels of GT < 300.

### 300. Fire extinguishers for vessels having Gross Tonnage GT ≥ 500

See Chapter E10 below.

### 400. Emergency Equipment Breathing Device – EEBD for vessels with GT ≥ 500

401. Emergency escape breathing devices shall comply with the Fire Safety Systems Code, which is provided in chapter II-2 of the International Convention for the Safety of Life at Sea (SOLAS), 1974.

402. Spare emergency escape breathing devices shall be kept on board.

403. The EEBD's shall not be used to fight fires, to enter in empty spaces or in tanks where there is oxygen deficiency, nor be used for fire-fighting personnel.

404. The EEBD's shall have a capacity to work for at least 10 minutes.

405. On all ships, emergency escape breathing devices shall be situated ready for use at easily visible places, which can be reached quickly and easily at any time in the event of fire.

406. The location of emergency escape breathing devices shall take into account the layout of the machinery space and the number of persons normally working in the spaces

407. The number and location of the EEBD's shall be indicated in the fire control plan. [MSC.Circ 1081]

408. The minimum number of EEBDs to be kept within accommodation spaces shall be as follows:

- a. for cargo ships: two (2) EEBDs and one (1) spare EEBD;
- b. for passenger ships carrying not more than 36 passengers: two (2) EEBDs for each main vertical zone, except those defined in the regulation 13.3.4.5, and a total of two (2) spare EEBDs; and
- c. for passenger ships carrying more than 36 passengers: four (4) EEBDs for each main vertical zone, except those defined in the regulation 13.3.4.5, and a total of two (2) spare EEBDs.

409. In machinery spaces for category A containing internal combustion machinery used for main propulsion, EEBDs shall be positioned as follows:

- a. one (1) EEBD in the engine control room, if located within the machinery space;

- b. one (1) EEBD in workshop areas. If there is, however, a direct access to an escape way from the workshop, an EEBD is not required; and
- c. one (1) EEBD on each deck or platform level near the escape ladder constituting the second means of escape from the machinery space (the other means being an enclosed escape trunk or watertight door at the lower level of the space).
- d. Alternatively, different number or location may be determined by the RBNA taking into consideration the layout and dimensions or the normal manning of the space.

410. For machinery spaces of category A other than those containing internal combustion machinery used for main propulsion, one (1) EEBD shall, as a minimum, be provided on each deck or platform level near the escape ladder constituting the second means of escape from the space (the other means being an enclosed escape trunk or watertight door at the lower level of the space).

411. For other machinery spaces, the number and location of EEBDs are to be determined by the RBNA.

## D6. HULL OPENINGS: MEANS OF PROTECTION AND

### 100. Definitions

101. Terms used herein.

- a. Weather-tight: closing openings capable of supporting test of hose jets of the types:
  - a.1. Type 1: exhibiting no leak in the opposite side to the application of a water jet applied slow and gradually around the whole sealed area, such as "rain", at 2 kgf/cm<sup>2</sup> pressure, apart between 2.5 and 3.0 meters, for at least 3 minutes and with a 45° heel angle, being the device closed with fasteners tightened by hand, without the aid of tools; and
  - a.2. Type 2: exhibiting no leak in the opposite side to the application of a water jet applied slow and gradually around the whole sealed area, of type "solid Jet", at 2 kgf/cm<sup>2</sup> pressure, to a maximum distance of 1.5 meters, for at least 3 minutes and with a 45° heel angle, being the device closed with fasteners tightened by hand, without the aid of tools (except between hatch covers or panel junction, where the angle of application of the jet shall be 90° and the clamps can be closed with tools

where it is considered in the design).

- b. Watertight: closing openings capable of supporting the pressure exerted on tank top bulkhead or bottom, with liquid from one side, at test pressure.

#### 200. Access scuttles

201. The minimum thickness of steel covers will be: 4.5 mm or  $h/100$ , where  $h$  is the height of the coaming.

202. The scuttle covers will be provided with fasteners and rubber gaskets for sealing.

#### 300. Manholes

301. The number of manholes shall be compatible with the size and location of the tank they were serving. In tanks with any dimension greater than 6 (six) meters there shall be two manholes, diametrically opposed.

302. The covers will be secured with bolts and gaskets that shall be compatible with the liquid of the respective tank. The seal shall withstand the test pressure of the tank.

303. Where bow doors are installed and a sloping loading ramp is part of the extension of the collision bulkhead above the bulkhead deck, the ramp shall be weather-tight throughout its length.

#### 400. Openings in the side shell

401. The lower edge of the opening shall not be below a line parallel to the deck of the freeboard at side, located at 2.5% of the breadth (B) or 500 mm, whichever is greater, above the loaded waterline at any condition expected to trim.

402. The covers will be watertight, in the definition of these Rules, or be provided with portholes or dead eyes, which are:

- a. Solid construction made;
- b. Provided with deadlights weather-tight type 2; and
- c. Equipped with thick tempered glass compatible with its diameter.

#### 500. Drain plugs and bottom plugs

501. Compartments of superstructures and deckhouses as store rooms are to be provided with drain plugs, threaded and with handle to prevent loss.

502. Bottom and bilge tanks shall have bottom plugs, threaded and with locking and / or self-tightening threads.

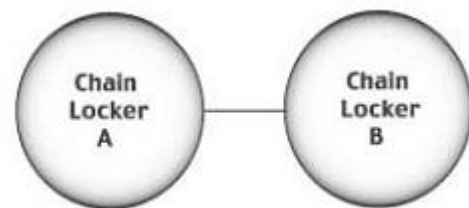
503. The bedplate of the plugs shall have beveled edges and enhanced thickness for welding with the plating.

504. The plugs shall be fitted with tags.

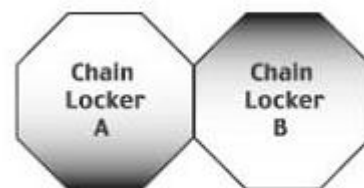
#### 600. Closure of Chain Lockers [IACS L4]

601. This requirement is applicable to ships with a length of 24 m and above built in accordance with the 1966 Load Line Convention or the 1988 Protocol to the Load Line Convention and the keels of which are laid or which are at a similar stage of construction on or after 1 July 2003.

602. Spurling pipes and cable lockers are to be watertight up to the weather deck. Bulkheads between separate cable lockers (see Arrangement 1), or which form a common boundary of cable lockers (see Arrangement 2), need not however be watertight.



Arrangement 1



Arrangement 2

603. Where means of access is provided, it is to be closed by a substantial cover and secured by closely spaced bolts.

604. Where a means of access to spurling pipes or cable lockers is located below the weather deck, the access cover and its securing arrangements are to be in accordance with recognized standards (see footnote) or equivalent for watertight manhole covers. Butterfly nuts and/or hinged bolts are prohibited as the securing mechanism for the access cover.

605. Spurling pipes through which anchor cables are led are to be provided with permanently attached closing appliances\* to minimize water ingress.

606. Examples of the recognized standards are such as:

- a. ISO 5894-1999
- b. China: GB 11628-1989 Ship Manhole Cover
- c. India: IS 15876-2009 "Ships and Marine Technology manholes with bolted covers"
- d. Japan: JIS F2304, "Ship's Manholes" and JIS F2329, "Marine Small Size Manhole"
- e. Korea: KSV 2339:2006 and KS VISO5894
- f. Norway: NS 6260:1985 to NS 6266:1985
- g. Russia: GOST 2021-90 "Ship's steel manholes specifications"

#### 700. Other protections.

701. For remaining protections of openings, as coaming heights, air vents, ventilation ducts, discharges etc., see:

For vessels of GT < 500 under the Brazilian flag, the requirements of NORMAM 01 chapter 7;

- a. For vessels of GT < 500 under foreign flags, National Regulation requirements. In the absence of such requirements, the regulations of the IMO ILLC Convention;
- b. For vessels of GT ≥ 500, the regulations of the IMO ILLC Convention.

### D7. HULL EQUIPMENT: ACCESSORIES AND FITTINGS

#### 100. Ladders in tanks or access ladders

101. Ladders or other means for safe close visual inspection are to be fitted.

#### 200. Davits

201. Davits or other auxiliary means of moving weights will be designed for one and a half times the safety work load and are to be tested in the presence of the surveyor.

#### 300. Handrails

301. All walkways and side throughways of the vessel shall be provided with handrails at least on one side.

302. The handrails will be built with a pipe at the top, two rods in intermediate lines below, brackets spaced not exceeding three frames apart and an overall height

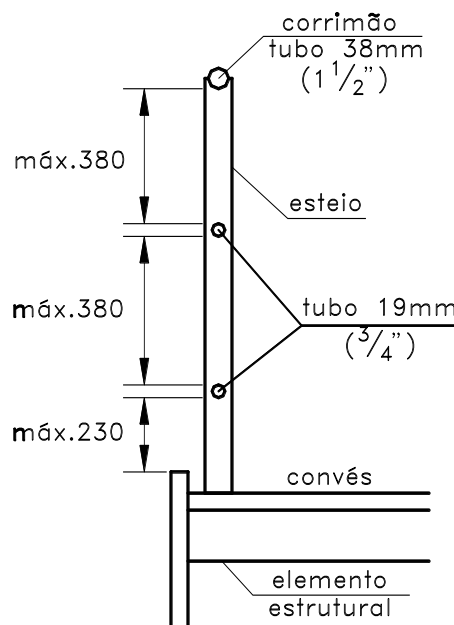
of about 1.05 m.

303. The top tube, the stays and the embedding to the hull are to be aligned with a structural element, and shall withstand a horizontal load on upper edge of 78.5 N/m (80 kgf/m), so that the tensile stress meets the equation:

$$\sigma = \sqrt{\sigma^2 + 3\tau^2} = 15,6 \text{ daN/mm}^2 \quad (16 \text{ kgf/mm}^2)$$

304. The following spaces between elements are required:

FIGURE F.D7.304.1 – HAND-RAILS



### D8. SINGLE POINT MOORING [IACS Rec. 13]

#### 100. Equipment standards for single point mooring.

101. Upon request of the Shipowner the RBNA is prepared to certify that the ship is especially endowed in accordance with Sections 2.1, 4.2 and 6 of the "Standards for Equipment Employed in the Mooring of Ships at Single Point Moorings," published by Oil Companies International Marine Forum, 1978 as amended. Plans showing the arrangements are to be submitted to RBNA for approval.

102. The chain hole, chafing chain, Smit bracket and other devices to fix the anchor chain to the vessel and structure to which are attached shall be capable of supporting a strain that is not lower than the tensile strength of the anchor chain corresponding to the size of the vessel as set out in Section 6 of the standards. The calculations to demonstrate such capacity shall be

submitted for RBNA.

103. The surface of bow fairleads described in Section 6.1 of the standards shall have a diameter of at least seven times that of anchor chain associated.

104. The shipboard installation shall be checked and approved by a surveyor of the RBNA.

105. The compliance with the standards adopted shall be properly documented.

## **D9. FREEING PORTS** **[IACS UI LL60, NORMAM 01]**

### **100. Vessels with GT < 500**

101. Freeing ports for vessels with GT<500 under the Brazilian flag are to be dimensioned according to NORMAM 01, 706.d.

a. For vessels under 500 GT under foreign flags, National Regulations are to be complied with, in the absence of which compliance with the ILLC Convention regulations is required.

102. Freeing port areas

103. All the deck structures where water may be accumulated shall have devices that allow rapid evacuation (water outlets).

104. The minimum area of discharge on each side shell and in each well on the freeboard deck will be calculated as follows:

a. Bulwark length of the in the well up to 20 meters:

$$A=0.03 \times L1 + 0.60 \quad (1)$$

b. Bulwark length of the in the well greater than 20 meters:

$$A=0.06 \times L1 \quad (2)$$

Where:

A = minimum area of water outlets, in m<sup>2</sup>; and

L1 = Bulwark length, in meters.

105. If there are water outlets for the wells on the decks of the superstructure, the area of the water outlets will be equivalent to half of the above

106. Fail to comply with its purpose due to the existence of a pronounced sagging, the installation may be waived, nor will be also required water outlets in bulwarks in the bow of the vessels.

### **200. Vessels with GT ≥ 500**

201. Freeing ports for vessels with GT ≥ 500 are to be dimensioned according to the IMO ILLC Code, 03/88 I/II/24 and IACS UI LL60 “Freeing ports”:

202. Where bulwarks on the weather portions of freeboard or superstructure decks form wells, ample provision shall be made for rapidly freeing the decks of water and for draining them.

203. Except as provided in Item 205 and 210, the minimum freeing port area (A) on each side of the ship for each well on the freeboard deck shall be that given by the following formulae in cases where the sheer in way of the well is standard or greater than standard. (*Standard sheer as defined in the International Convention on Load Lines, 1966*)

204. The minimum area for each well on superstructure decks shall be one-half of the area given by the following formulae:

Where the length of bulwark (l) in the well is 20 m or less:

$$A = 0.7 + 0.035 \times l \quad (\text{m}^2)$$

where l exceeds 20 m:  $A = 0.07 \times l \quad (\text{m}^2)$ .

l need in no case be taken as greater than 0.7L.

If the bulwark is more than 1.2 m in average height, the required area shall be increased by 0.004 m<sup>2</sup> per metre.

If length of well for each 0.1 m difference in height. If the bulwark is less than 0.9 m in average height, the required area may be decreased by 0.004 m<sup>2</sup> per m of length of well for each 0.1 m difference in height.

205. In ships with no sheer, the area calculated according to paragraph (b) shall be increased by 50%. Where the sheer is less than the standard, the percentage shall be obtained by linear interpolation.

206. On a flush deck ship with a deckhouse amidships having a breadth at least 80% of the beam of the ship and the passageways along the side of the ship not exceeding 1.5 m in width, two wells are formed. Each shall be given the required freeing port area based upon the length of each well.

207. Where a screen bulkhead is fitted completely across the ship at the forward end of a midshipdeckhouse, the exposed deck is divided into two wells and there is no limitation on the breadth of the deckhouse.

208. Wells on raised quarterdecks shall be treated as being on freeboard decks.

209. Gutter bars greater than 300 mm in height fitted around the weather decks of tankers in way of cargo manifolds and cargo piping shall be treated as bulwarks. Freeing ports shall be arranged in accordance with this



regulation. Closures attached to the freeing ports for use during loading and discharge operations are to be arranged in such a way that jamming cannot occur while at sea.

210. Where a ship is fitted with a trunk, and open rails are not fitted on weather parts of the freeboard deck in way of the trunk for least half their length, or where continuous or substantially continuous hatchway side coamings are fitted between detached superstructures, the minimum area of the freeing port openings shall be calculated from the Table T.D9.210.1

**TABLE T.D9.210.1 MINIMUM AREA OF FREEING PORTS**

| Breadth of hatchway or trunk in relation to the breadth [B] of ship | Area of freeing ports in relation to the total area of the bulwarks |
|---|---|
| 40% or less   | 20%   |
| 75% or more   | 10%   |

NOTE: The area of freeing ports at intermediate breadths shall be obtained by linear interpolation.

211. The effectiveness of the freeing area in bulwarks required by Items 202-209 depends on the free flow area across the deck of a ship.

212. The free flow area on deck is the net area of gaps between hatchways, and between hatchways and superstructures and deckhouses up to the actual height of the bulwark.

213. The freeing port area in bulwarks shall be assessed in relation to the net free flow area as follows:

- If the free flow area is not less than the freeing area calculated from Item 210 as if the hatchway coamings were continuous, then the minimum freeing port area calculated from Items 202-209 shall be deemed sufficient.
- If the free flow area is equal to, or less than the area calculated from Items 202-209, the minimum freeing area in the bulwarks shall be determined from Item 210.
- If the free flow area is smaller than calculated from Item 210, but greater than calculated from Items 202-209, the minimum freeing area in the bulwark shall be determined from the following formula:

$$F = F_1 + F_2 - f_p (m^2)$$

where:

$F_1$  is the minimum freeing area calculated from Items 202-209;

$F_2$  is the minimum freeing area calculated from Item 210; and

$f_p$  is the total net area of passages and gaps between hatch ends and superstructures or deckhouses up to the actual height of bulwark.

214. In ships having superstructures on the freeboard deck or superstructure decks, which are open at either or both ends to wells formed by bulwarks on the open decks, adequate provision for freeing the open spaces within the superstructures shall be provided.

215. The minimum freeing port area on each side of the ship for the open superstructure ( $A_s$ ) and for the open well ( $A_w$ ), shall be calculated in accordance with the following procedure:

- Determine the total well length ( $l_t$ ) equal to the sum of the length of the open deck enclosed by bulwarks ( $l_w$ ) and the length of the common space within the open superstructure ( $l_s$ ).
- To determine  $A_s$ :
  - calculate the freeing port area ( $A$ ) required for an open well of length  $l_t$  in accordance with Items 202-209 with standard height bulwark assumed;
  - multiply by a factor of 1.5 to correct for the absence of sheer, if applicable, in accordance with Item 205;
  - multiply by the factor ( $b_o/l_t$ ) to adjust the freeing port area for the breadth ( $b_o$ ) of the openings in the end bulkhead of the enclosed superstructure;
  - to adjust the freeing port area for that part of the entire length of the well which is enclosed by the open superstructure, multiply by the factor:
$$1 - (l_w/l_t)^2$$

where  $l_w$  and  $l_t$  are defined in Item 215(a);
  - to adjust the freeing port area for the distance of the well deck above the freeboard deck, for decks located more than  $0.5 h_s$  above the freeboard deck, multiply by the factor:
$$0.5 (h_s/h_w)$$

where  $h_w$  is the distance of the well deck above the freeboard deck and  $h_s$  is one standard superstructure height.

c. To determine  $A_w$ :

- the freeing port area for the open well ( $A_w$ ) shall be calculated in accordance with Item 216 (b)(i), using  $l_w$  to calculate a nominal freeing port area ( $A'$ ), and then adjusted for



the actual height of the bulwark ( $h_b$ ) by the application of one of the following area corrections, whichever is applicable:

- c.2. for bulwarks greater than 1.2 m in height:  
 $A_c = l_w \times [(h_b - 1.2)/0.10] \times (0.004) \quad (\text{m}^2)$ ;
- c.3. For bulwarks less than 0.9 m in height:  
 $A_c = l_w \times [(h_b - 0.9)/0.10] \times (0.004) \quad (\text{m}^2)$ ;  
for bulwarks between 1.2 m and 0.9 m in height there is no correction (i.e.  $A_c = 0$ );
- c.4. the corrected freeing port area ( $A_w = A' + A_c$ ) shall then be adjusted for absence of sheer, if applicable, and height above freeboard deck as in Items 215. (b)(ii) and 215.(b)(v) above, using  $h_s$  and  $h_w$ .

d. The resulting freeing port areas for the open superstructure ( $A_s$ ) and for the open well ( $A_w$ ) shall be provided along each side of the open space covered by the open superstructure and each side of the open well, respectively.

e. The above relationships are summarised by the following equations, assuming  $l_t$ , the sum of  $l_w$  and  $l_s$ , is greater than 20 m:

- e.1. freeing port area  $A_w$  for the open well:

$$A_w = (0.07 \times l_w + A_c) \times (\text{sheer correction}) \times (0.5 h_s / h_w);$$

- e.2. freeing port area  $A_s$  for the open superstructure:

$$A_s = (0.07 \times l_t) \times (\text{sheer correction}) \times (b_o / l_t) \times [1 - (l_w / l_t)^2] \times (0.5 h_s / h_w);$$

where

$l_t$  is 20 m or less, the basic freeing port area is

$$A = 0.7 + 0.035 \times l_t$$

in accordance with Items 202-209 above

**216. Construction of freeing ports.** The lower edges of freeing ports shall be as near the deck as practicable. Two-thirds of the freeing port area required shall be provided in the half of the well nearest the lowest point of the sheer curve. One third of the freeing port area required shall be evenly spread along the remaining length of the well. With zero or little sheer on the exposed freeboard deck or an exposed superstructure deck the freeing port area shall be evenly spread along the length of the well.

**217.** All freeing port openings in the bulwarks shall be protected by rails or bars spaced approximately 230 mm

apart. If shutters are fitted to freeing ports, ample clearance shall be provided to prevent jamming. Hinges shall have pins or bearings of non-corrodible material. Shutters shall not be fitted with securing appliances.

**218. Cargo manifold gutter bars - freeing arrangements and intact stability.** [According to ILLC Regulation 24(1)(g) and Regulation 26 or IACS' unified interpretation LL59] Where gutter bars are installed on the weather decks of tankers in way of cargo manifolds and are ex-tended aft as far as the after house front for the purpose of containing cargo spills on deck during loading and discharge operations, the free surface effects caused by containment of a cargo spill during liquid transfer operations or of boarding seas while underway require consideration with respect to the vessel's available margin of positive initial stability ( $GM_o$ ).

**219.** Where the gutter bars installed are greater than 300 mm in height, they are to be treated as bulwarks according to the *International Load Line Convention* with freeing ports arranged in accordance with *Regulation 24* and effective closures provided for use during loading and discharge operations. Attached closures are to be arranged in such a way that jamming cannot occur while at sea, ensuring that the freeing ports will remain fully effective.

**220.** On ships without deck camber, or where the height of the installed gutter bars exceeds the camber, and for tankers having cargo tanks exceeding 60% of the vessel's maximum beam at midships regardless of gutter bar height, gutter bars shall not be accepted without an assessment of the initial stability ( $GM_o$ ) for compliance with the relevant intact stability requirement taking into account the free surface effect caused by liquids contained by the gutter bars.

## **D10. SHIPBOARD FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING ON CONVENTIONAL VESSELS**

[IACS A.2]

### **100. Application and Definitions**

**101.** The present subchapter D10 is to apply to design and construction of shipboard fittings and supporting structures used for the normal towing and mooring operations. For the emergency towing arrangements, ships subject to SOLAS regulation II-1/3-4 are to comply with Part II, Title 32, Section 3 of the Rules.

**102.** The net minimum scantlings of the supporting hull structure are to comply with the requirements given in D10.208 and D10.305 below. The net thicknesses,  $t_{net}$ , are the member thicknesses necessary to obtain the above required minimum net scantlings.

**103.** The required gross thicknesses are obtained by

adding the total corrosion additions, tc, given in D10.500, totnet.

104. Requirements under the present subchapter D1 apply to:

- a. conventional vessels means new displacement-type vessels of 500 GT and above, excluding high speed craft, special purpose vessels, and offshore units of all types.
- b. shipboard fittings mean those components limited to the following: bollards and bitts, fairleads, stand rollers, chocks used for the normal mooring of the vessel and the similar components used for the normal towing of the vessel. Other components such as capstans, winches, etc. are not covered by this Requirement. Any weld or bolt or equivalent device connecting the shipboard fitting to the supporting structure is part of the shipboard fitting and subject to the Industry standard applicable to this shipboard fitting.
- c. Supporting hull structures means that part of the ship structure on/in which the shipboard fitting is placed and which is directly submitted to the forces exerted on the shipboard fitting. The supporting hull structure of capstans, winches, etc. used for the normal towing and mooring operations mentioned above is also subject to this Requirement.
- d. Industry standard means international standard (ISO, etc.) or standards issued by national association such as DIN or JMSA, etc. which are recognized in the country where the ship is built.

#### Guidance

*“Normal towing operations” means harbour operations or manoeuvring. “Escort towing operations” means towing operation other than normal towing operations and emergency towing operation.*

*Shipboard fittings are limited to the following components: bollards and bitts, fairleads, stand rollers, chocks used for the mooring and similar components used for the normal towing of the ship. Other components such as capstans, winches, etc. are not covered by the present subchapter.*

#### End of guidance

105. Note: The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of “contract for construction”, refer to Part I, Title 01, Section 1, Chapter B, item B2.100.

## 200. Towing

201. **Strength.** The strength of shipboard fittings used for normal towing operations at bow, sides and stern and their supporting hull structures are to comply with the requirements of this Requirement.

202. **Arrangement.** Shipboard fittings for towing are to be located on longitudinals, beams and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the towing load. Other arrangements may be accepted (for Panama chocks, etc.) provided the strength is confirmed adequate for the intended service.

203. **Load considerations.** Unless greater safe working load (SWL) of shipboard fittings is specified by the applicant, the minimum design load to be used is the following value of (a) or (b), whichever is applicable:

- a. for normal towing operations (e.g. harbour/manoeuvring), 1.25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan.
- b. for other towing service (e.g. escort), the nominal breaking strength of the tow line according to the D2.700 above for the ship’s corresponding EN is to be applied. (see Note)

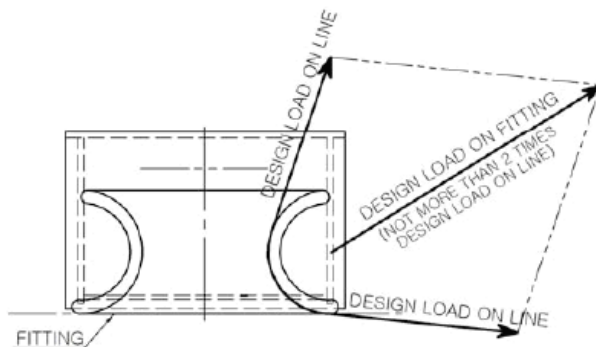
Note: Side projected area including maximum stacks of deck cargoes is to be taken into account for selection of towing lines. For the application of present requirements of the Subchapter D10, the breaking loads of towing lines specified in D2.700 above are mandatory in order to determine the design load applied to shipboard fittings and supporting hull structure.

204. The design load is to be applied through the tow line according to the arrangement shown on the towing and mooring arrangements plan.

205. When a specific SWL is applied for a shipboard fitting at the request of the applicant, by which the design load will be greater than the above minimum values, the strength of the fitting is to be designed using this specific design load.

206. The method of application of the design load to the fittings and supporting hull structures is to be taken into account such that the total load need not be more than twice the design load, i.e. no more than one turn of one line (see figure F.D10.206.1 below).

**FIGURE F.D10.206.1 THE METHOD OF APPLICATION OF THE DESIGN LOAD TO THE FITTINGS AND SUPPORTING HULL STRUCTURES.**



**207. Shipboard fittings.** The selection of shipboard fittings is to be made by the shipyard in accordance with an Industry standard (e.g. ISO3913 Shipbuilding Welded Steel Bollards) accepted by the society. When the shipboard fitting is not selected from an accepted Industry standard, the design load used to assess its strength and its attachment to the ship is to be in accordance with item D10.203 above.

**208. Supporting hull structure**

- a. **Arrangement.** The reinforced members (carling) beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces (which is to be not less than the Design Load as per item D10.203. above) acting through the arrangement of connection to the shipboard fittings.
- b. **Acting point of towing force.** The acting point of the towing force on shipboard fittings is to be taken at the attachment point of a towing line or at a change in its direction.
- c. **Allowable stresses.** Allowable stresses under the design load conditions as specified in D10.203 above are as follows:
  - c.1. Normal stress: 100% of the specified minimum yield point of the material;
  - c.2. Shearing stress: 60% of the specified minimum yield point of the material;
  - c.3. No stress concentration factors being taken into account.
  - c.4. Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress.

**209. Safe Working Load (SWL)**

- a. The SWL used for normal towing operations (e.g. harbour/manoeuvring) is not to exceed 80% of the design load per D10.203(a) and the SWL used for other towing operations (e.g. escort) is not to exceed the design load per D10.203(b). For fittings used for both normal and other towing operations, the greater of the design loads of D10.203(a) and D10.203(b) above is to be used.
- b. The SWL of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for towing.
- c. The above requirements on SWL apply for a single post basis (no more than one turn of one cable).
- d. The towing and mooring arrangements plan mentioned in D10.400 below is to define the method of use of towing lines.

**300. Mooring  
[IACS A 2.2.]**

**301. Strength.** The strength of shipboard fittings used for mooring operations and their supporting hull structures are to comply with the requirements of this requirement.

**302. Arrangement.** Shipboard fittings for mooring are to be located on longitudinals, beams and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load. Other arrangements may be accepted (for Panama chocks, etc.) provided the strength is confirmed adequate for the service.

**303. Load considerations**

- a. Unless greater safe working load (SWL) of shipboard fittings is specified by the applicant, the design load applied to shipboard fittings and supporting hull structures is to be 1.25 times the breaking strength of the mooring line according to the IACS Recommendation No. 10 "Equipment" for the ship's corresponding EN. (see Note)
- b. Notes:
  - b.1. Side projected area including maximum stacks of deck cargoes is to be taken into account for assessment of lateral wind forces, arrangements of tug boats and selection of mooring lines.
  - b.2. For the application of the present requirement, the breaking loads of mooring lines specified in IACS Recommendation 10 are mandatory in order to determine the design load applied to shipboard fittings and supporting hull structure.

b.3. In line with the footnote of Table T.D2.701.1 of Item D2.700 above, for the individual mooring lines with breaking strength above 490 kN, this breaking strength may be reduced with corresponding increase of number of the mooring lines, provided that the total breaking load of all lines aboard the ship is not less than the total loads as specified. The number of mooring lines is not to be less than 6 and no one line is to have strength less than 490 kN. (See also D10.400 below, Mooring arrangement plan.)

- c. The design load applied to supporting hull structures for winches, etc. is to be 1,25 times the intended maximum brake holding load and, for capstans, 1,25 times the maximum hauling-in force.
- d. The design load is to be applied through the mooring line according to the arrangement shown on the towing and mooring arrangements plan.
- e. The method of application of the design load to the fittings and supporting hull structures is to be taken into account such that the total load need not be more than twice the design load specified in 1) above, i.e. no more than one turn of one line.
- f. When a specific SWL is applied for a shipboard fitting at the request of the applicant, by which the design load will be greater than the above minimum values, the strength of the fitting is to be designed using this specific design load.

**304. Shipboard fittings.** The selection of shipboard fittings is to be made by the shipyard in accordance with an Industry standard (e.g. ISO 3913 Shipbuilding Welded Steel Bollards) accepted by the society. When the shipboard fitting is not selected from an accepted Industry standard, the design load used to assess its strength and its attachment to the ship is to be in accordance with D10.303

#### 305. Supporting hull structure.

- a. **Arrangement.** Arrangement of the reinforced members (carling) beneath shipboard fittings is to consider any variation of direction (horizontally and vertically) of the mooring forces (which is to be not less than the Design Load as per D10.303 above) acting through the arrangement of connection to the shipboard fittings.
- b. **Acting point of mooring force.** The acting point of the mooring force on shipboard fittings is to be taken at the attachment point of a mooring line or at a change in its direction.
- c. **Allowable stresses.** Allowable stresses under the design load conditions as specified in D10.303 above are as follows:

- c.1. Normal stress: 100% of the specified minimum yield point of the material;
- c.2. Shearing stress: 60% of the specified minimum yield point of the material;
- c.3. No stress concentration factors being taken into account. Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress.

#### 306. Safe Working Load (SWL)

- a. The SWL is not to exceed 80% of the design load D10.303 above.
- b. The SWL of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for mooring.
- c. The above requirements on SWL apply for a single post basis (no more than one turn of one cable).
- d. The towing and mooring arrangements plan mentioned in D10.400 below is to define the method of use of mooring lines.

#### 400. Towing and mooring arrangements plan

- a. The SWL for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master.
- b. Information provided on the plan is to include in respect of each shipboard fitting:
  - b.1. location on the ship;
  - b.2. fitting type;
  - b.3. SWL;
  - b.4. purpose (mooring/harbour towing/escort towing); and
  - b.5. manner of applying towing or mooring line load including limiting fleet angles.
- c. where the arrangements and details of deck fittings and their supporting hull structures are designed based on the mooring arrangements as permitted in Item D10.303a(i) above, the following information is to be clearly indicated on the plan:
- d. the arrangement of mooring lines showing number of lines (N), together with the breaking strength of each mooring line (BS).
- e. This information is to be incorporated into the pilot

card in order to provide the pilot proper information on harbour/escorting operations.

#### **500. Corrosion Addition**

501. The total corrosion addition,  $t_c$ , in mm, for both sides of the hull supporting structure is not to be less than the following values:

- a. Ships covered by IACS Common Structural Rules (CSR) for bulk carriers and for double hull oil tankers: Total corrosion additions defined in these Rules.
- b. Other ships: 2.0

#### **600. Survey After Construction**

601. The condition of deck fittings, their pedestals, if any, and the hull structures in the vicinity of the fittings are to be examined in accordance with the society's Rules. The wastage allowances as specified by the society's Rules are not to exceed the corrosion addition as specified in D10.500 above.

### **D11. SIDE SCUTTLES AND WINDOWS**

#### **100. Side scuttles and windows**

See Part III, Title 61, Section 3, Subchapter F3.

## **CHAPTER E FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION FOR SHIPS HAVING GROSS TONNAGE $GT \geq 500$**

### **CHAPTER CONTENTS**

#### **E1. GENERAL**

#### **E2. FIRE SAFETY OBJECTIVES AND FUNCTIONAL REQUIREMENTS**

#### **E3. DEFINITIONS**

#### **E4. PROBABILITY OF IGNITION**

#### **E5. FIRE GROWTH POTENTIAL**

#### **E6. SMOKE GENERATION POTENTIAL AND TOXICITY**

#### **E7. DETECTION AND ALARM**

#### **E8. CONTROL OF SMOKE SPREAD**

#### **E9. CONTAINMENT OF FIRE**

#### **E10. STRUCTURAL INTEGRITY**

#### **E11. FIRE FIGHTING**

#### **E12. MEANS OF ESCAPE**

#### **E13. ALTERNATIVE DESIGN ARRANGEMENTS**

#### **E14. PROTECTION OF VEHICLE, SPECIAL CATEGORY AND Ro-Ro SPACES**

#### **E15. CASUALTY THRESHOLD, SAFE RETURN TO PORT AND SAFE AREAS**

#### **E16. DESIGN CRITERIA FOR SYSTEMS TO REMAIN OPERATIONAL AFTER A FIRE CASUALTY**

#### **E17. SAFETY CENTRE ON PASSENGER SHIPS**

### **E1. GENERAL**

#### **100. Application**

101. This Chapter is applicable to all ships having Gross Tonnage  $GT \geq 500$  engaged in national or international voyages.

102. **National RBNA Regulations:** when the RBNA of the State whose flag the ship is entitled to fly has issued specific rules covering fire protection, the RBNA may accept such rules for classification purposes in lieu of



those given in this Chapter.

103. References for this Chapter E:

104. Requirements of Chapter II-2 of SOLAS 1974 as amended and relevant IMO Resolutions and Circulars. In reproducing the above text in this Chapter applicable for the purpose of classification, the word "RBNA", wherever mentioned, has been replaced by the word "RBNA".

105. Resolutions published as Codes:

106. International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (1998 Edition).

107. International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (1983 Edition) and amendments adopted by resolution MSC 32(63) on 23 May 1994.

108. Code of Safe Practice for Solid Bulk Cargoes (2001 Edition).

109. International Maritime Dangerous Goods Code (IMDG Code)(2000 Edition).

110. ISO Standards

111. ISO 1716: 2002 Reaction to fire tests for building products- determination of the heat of combustion.

112. ISO 15371: 2000 Ships and marine technology- Fire extinguishing systems for protection of galley deep fat cooking equipment- Fire tests.

113. Publications of the International Electrotechnical Commission.

114. IEC Standards

115. IEC 60034: Part 5: (2000-12) Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP Code) – Classification.

116. IEC 60068: Part 2: Section 1 (1990-05) Environmental testing – Part 2: Tests A: Cold

117. IEC 60079: Parts 0 – 20 Electrical apparatus for explosive gas atmospheres.

118. IEC 60092: Part 506: (1996-05) Electrical installations in ships - part 506: Special features – ships carrying specific dangerous goods and materials hazardous only in bulk.

## Guidance

### **Major repairs, alterations and modifications**

*The present Chapter applies to ships undergoing repairs, alterations and modifications only within the parts of the ship in which the repairs alterations and modifications are made. However, the Rules shall not apply to existing bulkheads, decks and ceilings, linings, materials or fittings within such parts provided they are unaffected by the repairs, alterations and modifications.*

## End of guidance

### **200. Applicable requirements depending on ship type**

201. Unless expressly provided otherwise:

- a. Requirements not referring to a specific ship type shall apply to ships of all types;
- b. Where liquid cargoes other than those referred to in the present paragraphs E1.201.a and b, or liquefied gases which introduce additional fire hazards are intended to be carried, additional safety measures shall be required, having due regard to the provisions of Part II, Title 33 (International Bulk Chemical Code) and Part II Title 34 (International Gas Carrier Code), as appropriate.

## **E2. FIRE SAFETY OBJECTIVES AND FUNCTIONAL REQUIREMENTS**

### **100. Fire safety objectives**

101. Prevent the occurrence of fire and explosion.
102. Reduce the risk to life caused by fire.
103. Reduce the risk of damage caused by fire to the ship, its cargo and the environment.
104. Contain, control and suppress fire and explosion in the compartment of origin.
105. Provide adequate and readily accessible means of escape for passengers and crew.

### **200. Functional requirements**

201. In order to achieve the fire safety objectives set out in E2.100, the following functional requirements are embodied in the regulations of this chapter as appropriate:
  - a. division of the ship into main vertical and horizontal zones by thermal and structural boundaries;

- b. separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries;
- c. restricted use of combustible materials;
- d. detection of any fire in the zone of origin;
- e. containment and extinction of any fire in the space of origin;
- f. protection of means of escape and access for fire fighting;
- g. ready availability of fire-extinguishing appliances; and
- h. minimization of possibility of ignition of flammable cargo vapour.

### 300. Achievement of the fire safety objectives

301. The fire safety objectives set out in E2.100 shall be achieved by ensuring compliance with the prescriptive requirements specified in:

- a. E4 through E6;
- b. E7 through E11;
- c. E12;
- d. E14 through E17,
- e. or by alternative design and arrangements which comply with E13.

302. A ship shall be considered to meet the functional requirements set out in paragraph E2.200 and to achieve the fire safety objectives set out in E2.100 when either:

- a. the ship's design and arrangements, as a whole, comply with the relevant prescriptive requirements in
  - a.1. E4 through E6;
  - a.2. E7 through E11;
  - a.3. E12;
  - a.4. E14 through E17,
- b. the ship's design and arrangements, as a whole, have been reviewed and approved in accordance with E13; or
- c. part(s) of the ship's design and arrangements have been reviewed and approved in accordance with E17 and the remaining parts of the ship comply with the relevant prescriptive requirements in

- c.1. E4 through E6;
- c.2. E7 through E11;
- c.3. E12;
- c.4. E14 through E17,

## E3. DEFINITIONS

### 100. Definitions

101. For the purpose of this chapter, unless expressly provided otherwise, the following definitions shall apply:

102. **Accommodation spaces** are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, game and hobby rooms, barber shops, pantries containing no cooking appliances and similar spaces.

103. **"A" class divisions** are those divisions formed by bulkheads and decks which comply with the following criteria:

- a. they are constructed of steel or other equivalent material;
- b. they are suitably stiffened;
- c. they are insulated with approved non combustible materials such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180°C above the original temperature, within the time listed below:

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

### Guidance [IACS MSC/Circ. 1120 ]

*Light-weight constructions" (honeycomb type, etc.) of steel or equivalent material may be used as non load-bearing internal "A" class divisions in accommodation and service spaces, provided they have successfully passed the relevant standard fire test according to resolution A.754(18). These "light-weight constructions" shall not be used as an integral part of main fire zone bulkheads and stairway enclosures on passenger ships.*

### [IACS UI SC239][MSC.1/Circ.1434]

**Insulation with approved non-combustible materials**  
*Insulated "A" class bulkheads and decks used on board*



*ships, including the means of affixing the insulation to the "A" class structural members, shall be consistent with the materials, details and arrangements used during, and documented in the test reports issued for, the approval test for that insulating material.*

*End of guidance*

d. they are constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test; and

e. the RBNA required a test of a prototype bulkhead or deck in accordance with the IMO Fire Test Procedures Code to ensure that it meets the above requirements for integrity and temperature rise.

104. **Atriums** are public spaces within a single main vertical zone spanning three or more open decks.

105. **"B" class divisions** are those divisions formed by bulkheads, decks, ceilings or linings which comply with the following criteria:

- a. they are constructed of approved non-combustible materials and all materials used in the construction and erection of "B" class divisions are non combustible, with the exception that combustible veneers may be permitted provided they meet other appropriate requirements of this chapter;
- b. they have an insulation value such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 225°C above the original temperature, within the time listed below:

class "B-15" 15 min

class "B-0" 0 min

c. they are so constructed as to be capable of preventing the passage of flame to the end of the first half hour of the standard fire test; and

d. the RBNA required a test of a prototype division in accordance with the IMO Fire Test Procedures Code to ensure that it meets the above requirements for integrity and temperature rise.

e. **IACS UI SC125** (B and C Class Divisions: A division consisting of a non-combustible core and combustible veneers may be accepted as a B or C class division, provided that the non-combustible core is tested in accordance with the FTP Code, part 1, that the B class division is tested in accordance with the FTP Code, part 3, and that the veneers are tested in accordance with the FTP Code part 5 and part 2, if applicable.

106. **Bulkhead deck** is the uppermost deck up to which the transverse watertight bulkheads are carried.

107. **Cargo area** is that part of the ship that contains cargo holds, cargo tanks, slop tanks and cargo pump rooms including pump-rooms, cofferdams, ballast and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the ship over the afore-mentioned spaces.

108. **Cargo spaces** are spaces used for cargo, cargo oil tanks, tanks for other liquid cargo and trunks to such spaces.

109. **Central control station** is a control station in which the following control and indicator functions are centralized:

- a. fixed fire detection and fire alarm systems;
- b. automatic sprinkler, fire detection and fire alarm systems;
- c. fire door indicator panels;
- d. fire door closure;
- e. watertight door indicator panels;
- f. watertight door closures;
- g. ventilation fans;
- h. general/fire alarms;
- i. communication systems including telephones; and
- j. microphones to public address systems.

*Guidance*

*Central control stations*

*The communications systems referred to in this definition of 'central control station' do not include fire systems which are not required by the Rules*

*End of guidance.*

110. **"C" class divisions** are divisions constructed of approved non-combustible materials. They need meet neither requirements relative to the passage of smoke and flame nor limitations relative to the temperature rise. Combustible veneers are permitted provided they meet the requirements of this chapter. Adhesives used in the construction of the "C" class divisions are not required to be non-combustible; however, they are to have low flame-spread characteristics.

111. **Chemical tanker** is a cargo ship constructed or adapted and used for the carriage in bulk of any liquid

product of a flammable nature listed in chapter 17 of the IMO International Bulk Chemical Code.

112. **Closed ro-ro spaces** are ro-ro spaces which are neither open ro-ro spaces nor weather decks.

113. **Closed vehicle spaces** are vehicle spaces which are neither open vehicle spaces nor weather decks.

114. **Combination carrier** is a cargo ship designed to carry both oil and solid cargoes in bulk.

115. **Combustible material** is any material other than a non-combustible material.

116. **Continuous "B" class ceilings or linings** are those "B" class ceilings or linings which terminate at an "A" or "B" class division.

117. **Continuously manned central control station** is a central control station which is continuously manned by a responsible member of the crew.

118. **Control stations** are those spaces in which the ship's radio or main navigating equipment or the emergency source of power is located or where the fire recording or fire control equipment is centralized. Spaces where the fire recording or fire control equipment is centralized are also considered to be a fire control station.

#### *Guidance*

#### **Control stations**

*Spaces in which the sprinkler pumps, drencher pumps and fire pumps are situated shall not be regarded as control stations. Such spaces in passenger ships are categorised as 'auxiliary machinery spaces' and in cargo ships as 'other machinery spaces'.*

*A control room situated in a machinery space, which does not contain the propulsion machinery and boilers, shall still be regarded as a control station even when the space contains pumps, purifiers etc. necessary for the operation of the propulsion machinery and boilers. Moreover, spaces containing batteries which are reserve power sources for radio installations, emergency generator starting or transitional emergency power supply, are control stations*

#### **Explanation for control stations[MSC/Circ.120]**

*Main navigational equipment includes, in particular, the steering stand and the compass, radar and position-finding equipment.*

*Steering gear rooms containing an emergency steering position are not considered to be control stations.*

*Where in the regulations of Chapter E relevant to fixed fire-extinguishing systems there are no specific requirements for the centralization within a control station*

*of major components of a system, such major components may be placed in spaces which are not considered to be a control station.*

*Spaces containing, for instance, the following battery sources shall be regarded as control stations regardless of the battery capacity:*

- *emergency batteries in a separate battery room for power supply from blackout till start of the emergency generator;*
- *emergency batteries in a separate battery room as a reserve source of energy to radio installation;*
- *batteries for start of the emergency generator; and*
- *in general, all emergency batteries required in pursuance of Part II, Title 11, Section 7, Subchapter F.5.*

#### *End of guidance*

119. **Crude oil** is any oil occurring naturally in the earth, whether or not treated to render it suitable for transportation, and includes crude oil where certain distillate fractions may have been removed from or added to.

120. **Dangerous goods** are those goods belonging to one of the following classes

- a. class 1 – Explosives
- b. class 2 - Gases: compressed, liquefied or dissolved under pressure
- c. class 3 - Flammable liquids
- d. class 4.1 - Flammable solids
- e. class 4.2 - Substances liable to spontaneous combustion
- f. class 4.3 - Substances which, in contact with water, emit flammable gases
- g. class 5.1 - Oxidising substances
- h. class 5.2 - Organic peroxides
- i. class 6.1 - Poisonous (toxic) substances
- j. class 6.2 - Infectious substances
- k. class 7 - Radioactive materials
- l. class 8 – Corrosives
- m. class 9 - Miscellaneous dangerous substances (that is any other substance which experience has shown,

or may show, to be of such a dangerous character that the provisions of Part A, Chapter VII of SOLAS Convention are to be applied).

121. **Deadweight** is the difference in tonnes between the displacement of a ship in water of a specific gravity of 1.025 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the ship.

122. **Fire Safety Systems Code** means the International Code for Fire Safety Systems as adopted by the Maritime Safety Committee of the RBNA by resolution MSC.98(73).

123. **Fire Test Procedures Code** means the International Code for Application of Fire Test Procedures as adopted by the Maritime Safety Committee of the RBNA by resolution MSC.61(67)

124. **Flashpoint** is the temperature in degrees Celsius (closed cup test) at which a product will give off enough flammable vapour to be ignited, as determined by an approved flashpoint apparatus.

125. **Gas carrier** is a cargo ship constructed or adapted and used for the carriage in bulk of any liquefied gas or other products of a flammable nature listed in chapter 19 of the Rules in Part II, Title 34 (International Gas Carrier Code).

126. **Helideck** is a purpose-built helicopter landing area located on a ship including all structure, fire fighting appliances and other equipment necessary for the safe operation of helicopters.

127. **Helicopter facility** is a helideck including any refuelling and hangar facilities.

128. **Lightweight** is the displacement of a ship in tonnes without cargo, fuel, lubricating oil, ballast water, fresh water and feedwater in tanks, consumable stores, and passengers and crew and their effects.

129. **Low flame-spread** means that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the Fire Test Procedures Code.

130. **Machinery spaces** are machinery spaces of category A and other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

131. **Machinery spaces of category A** are those spaces and trunks to such spaces which contain either:

a. internal combustion machinery used for main propulsion;

b. internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

c. any oil-fired boiler or oil fuel unit, or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

132. **Main vertical zones** are those sections into which the hull, superstructure and deckhouses are divided by "A" class divisions, the mean length and width of which on any deck does not in general exceed 40 m.

133. **Non combustible material** is a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C, this being determined in accordance with the Fire Test Procedures Code.

134. **Oil fuel unit** is the equipment used for the preparation of oil fuel for delivery of oil fuel, heated or not to an oil-fired boiler (including inert gas generators), or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0.18 N/mm<sup>2</sup>.

135. **Open ro-ro spaces** are those ro-ro spaces which are either open at both ends or have an opening at one end, and are provided with adequate natural ventilation effective over their entire length through permanent openings distributed in the side plating or deckhead or from above, having a total area of at least 10% of the total area of the space sides.

136. **Open vehicle spaces** are those vehicle spaces which are either open at both ends, or have an opening at one end and are provided with adequate natural ventilation effective over their entire length through permanent openings distributed in the side plating or deckhead or from above, having a total area of at least 10% of the total area of the space sides.

137. **Passenger ship** is a ship that carries more than 12 passengers.

138. **Prescriptive requirements** means the construction characteristics, limiting dimensions, or fire safety systems.

139. **Public spaces** are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

140. **Rooms containing furniture and furnishings of restricted fire risk**, for the purpose of subchapter E.9 below, are those rooms containing furniture and furnishings of restricted fire risk (whether cabins, public spaces, offices or other types of accommodation) in which:

a. case furniture such as desks, wardrobes, dressing

tables, bureaux or dressers are constructed entirely of approved non-combustible materials, except that a combustible veneer not exceeding 2 mm may be used on the working surface of such articles;

- b. free-standing furniture such as chairs, sofas or tables, are constructed with frames of non-combustible materials;
- c. draperies, curtains and other suspended textile materials have qualities of resistance to the propagation of flame not inferior to those of wool having a mass of 0.8 kg/m<sup>2</sup>, this being determined in accordance with the Fire Test Procedures Code;
- d. floor coverings have low flame-spread characteristics;
- e. exposed surfaces of bulkheads, linings and ceilings have low flame-spread characteristics;
- f. upholstered furniture has qualities of resistance to the ignition and propagation of flame, this being determined in accordance with the Fire Test Procedures Code; and
- g. bedding components have qualities of resistance to the ignition and propagation of flame, this being determined in accordance with the Fire Test Procedures Code.

141. **Ro-ro spaces** are spaces not normally subdivided in any way and normally extending to either a substantial length or the entire length of the ship in which motor vehicles with fuel in their tanks for their own propulsion and/or goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or other receptacles) can be loaded and unloaded normally in a horizontal direction.

142. **Ro-ro passenger ship** means a passenger ship with ro-ro spaces or special category spaces.

143. **Steel or other equivalent material** means any non combustible material which, by itself or due to insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable exposure to the standard fire test (e.g., aluminium alloy with appropriate insulation).

144. **Sauna** is a hot room with temperatures normally varying between 80°C and 120°C where the heat is provided by a hot surface (e.g. by an electrically heated oven). The hot room may also include the space where the oven is located and adjacent bathrooms.

145. **Service spaces** are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store-rooms, workshops other than those forming part of the machinery spaces, and similar spaces

and trunks to such spaces.

146. **Special category spaces** are those enclosed vehicle spaces above and below the bulkhead deck, into and from which vehicles can be driven and to which passengers have access. Special category spaces may be accommodated on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m.

147. **Standard fire test** is a test in which specimens of the relevant bulkheads or decks are exposed in a test furnace to temperatures corresponding approximately to the standard time-temperature curve in accordance with the test method specified in the Fire Test Procedures Code.

148. **Tanker** is a cargo ship constructed or adapted for the carriage in bulk of liquid cargoes of an inflammable nature.

#### *Guidance*

*For the purpose of this Chapter, the term tanker includes the following service notations (see Part II, Title 32, Section 1):*

- Chemical tanker
- Combination carrier/OBO
- Combination carrier/OOC
- Flammable liquid substances tanker
- Oil recovery ship
- Oil tanker.

#### *End of guidance*

149. **Vehicle spaces** are cargo spaces intended for carriage of motor vehicles with fuel in their tanks for their own propulsion.

150. **Weather deck** is a deck which is completely exposed to the weather from above and from at least two sides.

## **E4. PROBABILITY OF IGNITION**

### **100. Purpose**

101. The purpose of this subchapter E4 is to prevent the ignition of combustible materials or flammable liquids. For this purpose, the following functional requirements shall be met:

- a. means shall be provided to control leaks of flammable liquids;
- b. means shall be provided to limit the accumulation of flammable vapours;
- c. the ignitability of combustible materials shall be restricted;

- d. ignition sources shall be restricted;
- e. ignition sources shall be separated from combustible materials and flammable liquids; and
- f. the atmosphere in cargo tanks shall be maintained out of the explosive range.

## 200. Arrangements for fuel oil, lubrication oil and other flammable oils

See Part II, Title 11, Section 6, Subchapter G1.

### 201. Arrangements for fuel oil

See Part II, Title 11, Section 6, Subchapter G1.

### 202. Prevention of overpressure

See Part II, Title 11, Section 6, Subchapter G1.

### 203. Fuel oil piping

See Part II, Title 11, Section 6, Subchapter G1

### 204. Protection of high temperature surfaces.

See Part II, Title 11, Section 6, Subchapter G1.

### 205. Arrangements for lubricating oil

See Part II, Title 11, Section 6, Subchapter G2.

## 300. Arrangements for gaseous fuel for domestic purposes

301. Gaseous fuel systems used for domestic purposes shall be approved by the RBNA.

302. Storage of gas bottles shall be located on the open deck or in a well ventilated space which opens only to the open deck.

303. A portion of open deck, recessed into a deck structure, machinery casing, deck house, etc., utilized for the exclusive storage of gas bottles is considered acceptable for the purpose of regulation II-2/4.3 provided that:

- a. such a recess has an unobstructed opening, except for small appurtenant structures, such as opening corner radii, small sills, pillars, etc.. The opening may be provided with grating walls and door; and
- b. the depth of such a recess is not greater than 1 m.

#### Guidance

*A portion of open deck, recessed into a deck structure, machinery casing, deck house, etc., utilized for the*

*exclusive storage of gas bottles is considered acceptable for the purpose of the present item E4.200 provided that:*

- *such a recess has an unobstructed opening, except for small appurtenant structures, such as opening corner radii, small sills, pillars, etc.. The opening may be provided with grating walls and door; and*
- *the depth of such a recess is not greater than 1 m.*

*A portion of open deck meeting the above shall be considered as open deck in applying tables in Chapter E.10.*

*End of guidance*

## 400. Miscellaneous items of ignition sources and ignitability

401. **Electric radiators**, if used, shall be fixed in position and so constructed as to reduce fire risks to a minimum. No such radiators shall be fitted with an element so exposed that clothing, curtains, or other similar materials can be scorched or set on fire by heat from the element. Reference is made to IEC Publication 60092 – Electrical installations in ships.

#### Guidance [MCA]

***Electric space heaters:** in this Regulation 'similar materials' includes free standing furniture, particularly those items with upholstered parts, which shall not be placed near to the heater.*

*End of guidance*

402. **Waste receptacles** shall be constructed of non-combustible materials with no openings in the sides or bottom.

#### Guidance [IACS UI SC166]

*This regulation is not intended to preclude the use of containers constructed of combustible materials in galleys, pantries, bars, garbage handling or storage spaces and incinerator rooms provided they are intended purely for the carriage of wet waste, glass bottles and metal cans and are suitably marked.*

*End of guidance*

403. **Insulation surfaces protected against oil penetration:** in spaces where penetration of oil products is possible, the surface of insulation shall be impervious to oil or oil vapours. The fire insulation in such spaces can be covered by metal sheets (not perforated) or by vapour barrier glass cloth accurately sealed at the joint.

#### Guidance

#### **Surface protection of insulation**

*The fire insulation in such spaces can be covered by metal sheets (not perforated) or by vapour barrier glass cloth*



*accurately sealed at the joint.*

**Oil and vapour barriers - Flexible vapour barriers**

*Any joint in a flexible oil and oil vapour barrier shall be sealed with tape of the same material as the vapour barrier or a compatible material having a minimum width of 50mm using an adhesive which is also compatible. The advice of the manufacturer of the insulation or vapour barrier shall be sought where there is doubt as to the compatibility of materials.*

*It shall be noted that in no case where a vapour barrier is fitted shall the wire netting securing an 'A' Class insulation be dispensed with.*

*Where there is a risk of an 'A' Class insulation becoming damaged by the shipping or unshipping of items of machinery or similar operations, then a metal oil and oil vapour barrier referred to in the following paragraph will afford some protection to the insulation.*

**Metal vapour barriers** - in no case must a metal vapour barrier be fitted directly on the face of an 'A' Class insulation in lieu of the wire netting or otherwise, because fire casualties have revealed that the restraint afforded by the steel pins against expansion has buckled the metal vapour barrier causing serious damage to the insulation and forcing the spring washers off the pins resulting in the falling down of the barrier and insulation.

**Metal oil and oil vapour barriers** shall be attached to the ship's structure independently of an 'A' Class insulation with a gap of at least 20mm between the exposed face of the insulation and the vapour barrier. The number and size of the means of securing the vapour barrier to the structure shall be kept to a minimum in order to ensure that heat transfer through the insulation is minimal. A penetration shall not exceed 100mm<sup>2</sup> in cross sectional area, nor shall it be spaced less than 500mm from another penetration. The metal shall be unperforated.

*End of guidance*

404. **Primary deck coverings**:, if applied within accommodation and service spaces and control stations, shall be of approved material which will not readily ignite, this being determined in accordance with the Fire Test Procedures Code.

**E5. FIRE GROWTH POTENTIAL**

**100. Purpose**

101. The purpose of this regulation is to limit the fire growth potential in every space of the ship. For this purpose, the following functional requirements shall be met:

- a. means of control for the air supply to the space shall be provided;
- b. means of control for flammable liquids in the space shall be provided; and
- c. the use of combustible materials shall be restricted.

**200. Control of air supply and flammable liquid to the space**

201. The main inlets and outlets of all ventilation systems shall be capable of being closed from outside the spaces being ventilated. The means of closing shall be easily accessible as well as prominently and permanently marked and shall indicate whether the shut-off is open or closed.

**Guidance [IACS UI SC240]**

*Battery room ventilators are to be fitted with a means of closing whenever:*

*The battery room does not open directly onto an exposed deck.*

*The ventilation opening for the battery room is required to be fitted with a closing device according to the Load Line Convention (i.e. the height of the opening does not extend to more than 4.5 m (14.8 feet) above the deck for position 1 or to more than 2.3 m (7.5 feet) above the deck in position 2; or*

*The battery room is fitted with a fixed gas fire extinguishing system.*

*Where a battery room ventilator is fitted with a closing device, then a warning notice stating, for example "This closing device is to be kept open and only closed in the event of fire or other emergency – Explosive gas", is to be provided at the closing device to mitigate the possibility of inadvertent closing.*

*End of guidance*

202. Power ventilation of accommodation spaces, service spaces, cargo spaces, control stations and machinery spaces shall be capable of being stopped from an easily accessible position outside the space being served. This position shall not be readily cut off in the event of a fire in the spaces served.

203. In passenger ships carrying more than 36 passengers, power ventilation, except machinery space and cargo space ventilation and any alternative system which may be required shall be fitted with controls so grouped that all fans may be stopped from either of two separate positions which shall be situated as far apart as practicable. Fans serving power ventilation systems to cargo spaces shall be capable of being stopped from a safe position outside such spaces.

**Guidance [IACS UI SC148]**

**Ventilation by fan coil units**

*The fan in a cabin HVAC temperature control unit is not considered to be a ventilation fan as addressed in the present E5.203 and E7.800, if it is not capable of supplying outside air to the cabin when the power ventilation is shut down.*

*End of guidance*

**300. Means of control in machinery spaces**

301. Means of control shall be provided for opening and closure of skylights, closure of openings in funnels which normally allow exhaust ventilation and closure of ventilator dampers.

**[IACS Unified Interpretation SC100]**

***Closing appliances of ventilation inlets and outlets:***

*Guidance*

*Ventilation inlets and outlets located at outside boundaries are to be fitted with closing appliances as required by E5.301 above and need not comply with E7.800. The controls are to be easily accessible as well as prominently and permanently marked and indicate whether the shut off is open or closed.*

*End of guidance*

302. Means of control shall be provided for stopping ventilating fans. Controls provided for the power ventilation serving machinery spaces shall be grouped so as to be operable from two positions, one of which shall be outside such spaces. The means provided for stopping the power ventilation of the machinery spaces shall be entirely separate from the means provided for stopping ventilation of other spaces.

303. Means of control shall be provided for stopping forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps, lubricating oil service pumps, thermal oil circulating pumps and oil separators (purifiers). However, paragraphs E5.304 and E5.305 below need not apply to oily water separators.

304. The controls required in paragraphs E5.301 to E5.302 and in regulation Part II, Title 11, Section 6, Chapter G1 shall be located outside the space concerned so they will not be cut off in the event of fire in the space they serve.

*Guidance*

***Location of ventilation controls in category A machinery spaces***

*In machinery spaces of category A, controls to close off ventilation ducts and pipes shall be installed with due*

*regard to the hot gases produced by a fire in the space concerned.*

*End of guidance*

305. In passenger ships, the controls required in paragraphs E5.301 to E5.304 and in item E9.802.c and the controls for any required fire-extinguishing system shall be situated at one control position or grouped in as few positions as possible to the satisfaction of the RBNA. Such positions shall have a safe access from the open deck.

**400. Additional requirements for means of control in periodically unattended machinery spaces**

401. For periodically unattended machinery spaces, the RBNA shall give special consideration to maintaining the fire integrity of the machinery spaces, the location and centralization of the fire-extinguishing system controls, the required shutdown arrangements (e.g., ventilation, fuel pumps, etc.) and that additional fire-extinguishing appliances and other fire-fighting equipment and breathing apparatus may be required. Reference is made to Part II, Title 102, Section 5.

402. In passenger ships, these requirements shall be at least equivalent to those of machinery spaces normally attended

*Guidance*

***Remote means of control***

*Controls required for the closure of certain oil fuel suction valves, closing of openings, stopping of ventilation and forced draft fans etc., shall be centralised as far as is reasonable and practicable. In respect of oil fuel suction valves, means shall be provided at the remote station to show when the closure of the valve has been initiated. Where the means for the remote closing of oil valves is by extended spindle, no special fire protection need be fitted, provided no low melting point materials are used. Otherwise and where the means of closing is electric, pneumatic or hydraulic, the operating system shall be capable of withstanding the appropriate fire test. The source of power to effect the closure of such power operated systems shall be located outside the space in which the valves are situated.*

*Power operated means for the closure of openings shall, if they are the only means, be treated in a similar manner to power operated means provided for the closure of oil fuel. With regard to the remote means provided for stopping oil fuel pressure pumps, surveyors shall ensure that such a facility is not merely part of a remote control system, i.e. designed to stop and start the said pumps, unless a manual reset is provided which must be operated before starting can be effected.*

*The remote controls for stopping ventilation fans serving accommodation spaces shall be extended to include*



*remote stops for fans used in conjunction with air conditioning units. Any controls for operating the re-circulation of air shall be capable of being rapidly put into the non-recirculation mode. This is to enable the units to be rapidly stopped from the centralised position to prevent circulation of smoke throughout the accommodation.*

**[IACS UI SC240]**

*Battery room ventilators are to be fitted with a means of closing whenever:*

*The battery room does not open directly onto an exposed deck.*

*The ventilation opening for the battery room is required to be fitted with a closing device according to the Load Line Convention (i.e. the height of the opening does not extend to more than 4.5 m (14.8 feet) above the deck for position 1 or to more than 2.3 m (7.5 feet) above the deck in position 2; or*

*The battery room is fitted with a fixed gas fire extinguishing system.*

*Where a battery room ventilator is fitted with a closing device, then a warning notice stating, for example “This closing device is to be kept open and only closed in the event of fire or other emergency – Explosive gas”, is to be provided at the closing device to mitigate the possibility of inadvertent closing.*

*End of guidance*

**500. Fire protection materials: use of non-combustible materials**

**501. Insulating materials**

- a. Insulating materials shall be non-combustible, except in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces. Vapour barriers and adhesives used in conjunction with insulation, as well as the insulation of pipe fittings for cold service systems, need not be of non-combustible materials, but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame-spread characteristics.

*Guidance*

**Meaning of “cold service systems”**

*Cold service is understood to mean refrigeration systems and chilled water piping for air conditioning systems.*

*End of guidance*

**502. Ceilings and linings**

- a. In passenger ships, except in cargo spaces, all linings, grounds, draught stops and ceilings shall be of non-combustible material except in mail rooms, baggage rooms, saunas or refrigerated compartments of service spaces. Partial bulkheads or decks used to subdivide a space for utility or artistic treatment shall also be of non-combustible materials.
- b. In cargo ships, all linings, ceilings, draught stops and their associated grounds shall be of non-combustible materials in the following spaces:
  - b.1. in accommodation and service spaces and control stations for ships where method IC is specified as referred to in E9.303a E9.401.a; and.
  - b.2. in corridors and stairway enclosures serving accommodation and service spaces and control stations for ships where method IIC and IIIC are specified as referred to in E9.303.a E9.401.a.

**600. Fire protection materials: Use of combustible materials**

601. In passenger ships, "A", "B" or "C" class divisions in accommodation and service spaces which are faced with combustible materials, facings, mouldings, decorations and veneers shall comply with the provisions of paragraphs E5.301 to E5.304 and Chapter E6. However, traditional wooden benches and wooden linings on bulkheads and ceilings are permitted in saunas and such materials need not be subject to the calculations prescribed in paragraphs E2.603 and E2.604.

602. In cargo ships, non-combustible bulkheads, ceilings and linings fitted in accommodation and service spaces may be faced with combustible materials, facings, mouldings, decorations and veneers provided such spaces are bounded by non-combustible bulkheads, ceilings and linings in accordance with the provisions of paragraphs E2.603 to E2.605 and Chapter E6.

603. **Maximum calorific value** of combustible materials Combustible materials used on the surfaces and linings specified in paragraph E2.602 shall have a calorific value\* not exceeding 45 MJ/m<sup>2</sup> of the area for the thickness used. The requirements of this paragraph are not applicable to the surfaces of furniture fixed to linings or bulkheads.

*Guidance*

**Calorific value**

*Reference is made to the recommendations published by the International RBNA for Standardization, in particular, Publication ISO 1716:2002 on Determination of the heat of combustion.*

*End of guidance*

604. Total volume of combustible materials following requirements:

- a. The total volume of combustible facings, mouldings, decorations and veneers in accommodation and service spaces shall not exceed a volume equivalent to 2.5 mm veneer on the combined area of the walls and ceiling linings. Furniture fixed to linings, bulkheads or decks need not be included in the calculation of the total volume of combustible materials; and
- b. In the case of ships fitted with an automatic sprinkler system complying with the provisions of the Fire Safety Systems Code, the above volume may include some combustible material used for erection of "C" class divisions.

605. **Low flame-spread characteristics of exposed surfaces** the following surfaces shall have low flame-spread characteristics in accordance with the Fire Test Procedures Code:

a. **In passenger ships:**

- a.1. exposed surfaces in corridors and stairway enclosures and of bulkhead and ceiling linings in accommodation and service spaces (except saunas) and control stations; and
- a.2. surfaces and grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations.

b. **In cargo ships:**

- b.1. exposed surfaces in corridors and stairway enclosures and of ceilings in accommodation and service spaces (except saunas) and control stations; and
- b.2. surfaces and grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations.

606. **Furniture in stairway enclosures of passenger ships** Furniture in stairway enclosures shall be limited to seating. It shall be fixed, limited to six seats on each deck in each stairway enclosure, be of restricted fire risk determined in accordance with the Fire Test Procedure Code, and shall not restrict the passenger escape route.

RBNA may permit additional seating in the main reception area within a stairway enclosure if it is fixed, non-combustible and does not restrict the passenger escape route. Furniture shall not be permitted in passenger and crew corridors forming escape routes in cabin areas. In addition to the above, lockers of non-combustible material, providing storage for non-hazardous safety equipment required by these regulations, may be permitted. Drinking water dispensers and ice cube machines may be permitted in corridors provided they are fixed and do not restrict the width of the escape routes. This applies as well to decorative flower or plant arrangements, statues or other objects of art such as paintings and tapestries in corridors and stairways.

*Guidance*

**Insulating materials**

*The 'exception' referred to in paragraph E5.501 regarding insulation of pipe fittings for cold service systems, may include the refrigerating machinery. When considering exposed surfaces in connection with insulating materials such surfaces shall include the substrate insulation in the thickness used, or the greatest thickness permitted by the test method for the specimen construction, whichever is greatest.*

*Where organic foam, cork or other highly flammable materials or materials known to readily emit toxic products when decomposing are used to insulate refrigerated compartments, the compartments shall be located as remotely as practicable from the accommodation spaces. However when such spaces*

**Materials used on passenger ships for bulkheads of accommodation spaces as defined in Chapter E3**

**Fire protection materials for cargo ships**

*With respect to materials and components used for bulkheads in accommodation spaces, as defined in Chapter E3, see tables below.*

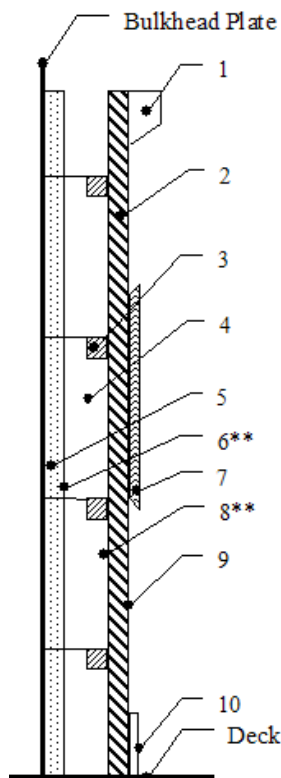
*Materials used on passenger ships for bulkheads of accommodation spaces as defined in Chapter E3:*

**Surfaces**

**Application to materials used on surfaces of bulkheads, ceilings and linings**

*Surfaces referred to in E5.605.a and E5.605.b are those of bulkheads, decks, floor coverings, wall linings and ceilings as appropriate. The requirements described within these regulations are not meant to apply to plastic pipes, electric cables and furniture.*

**MATERIALS USED FOR BULKHEADS OF ACCOMMODATION SPACES AS DEFINED IN CHAPTER E**



| Materials used for bulkheads of accommodation spaces as defined in regulation II-2/3.1 |   |                           |                             |  |  |
|--|---|---------------------------|-----------------------------|--|--|
| Bulkhead components  | Requirements in SOLAS chapter II-2 for components |                           |                             |  |  |
|  | Non-combustible material<br>E5.501                | Calorific value<br>E5.603 | Equivalent volume<br>E5.604 | Low flame spread<br>E5.605*              | Smoke production, toxic products<br>E6 |
|  | (A)   | (B)                       | (C)                         | (D)                                      | (E)                                    |
| 1 moulding   |   |                           | X                           |  |  |
| 2 wall panel (lining)  | X   |                           |                             |  |  |
| 3 grounds and supports   | X   |                           |                             |  |  |
| 4 draft stops  | X   |                           |                             |  |  |
| 5 insulation   | X   |                           |                             |  |  |
| 6 insulation surface**   |   |                           |                             | X<br>(5.3.2.4.1.2)                       |  |
| 7 decoration   |   |                           | X                           |  |  |
| 8 painted surface** or fabric or veneer**  |   | --<br>X                   |                             | X<br>(5.3.2.4.1.2)<br>X<br>(5.3.2.4.1.2) |  |
| 9 painted surface or fabric or veneer  |   | --<br>X                   | X<br>X                      | X<br>(5.3.2.4.1.1)<br>X<br>(5.3.2.4.1.1) | X<br>X                                 |
| 10 skirting board  |   |                           | X                           |  |  |

**E6. SMOKEGENERATION POTENTIAL AND TOXICITY**

**100. Purpose**

101. The purpose of this regulation is to reduce the hazard to life from smoke and toxic products generated during a fire in spaces where persons normally work or live. For this purpose, the quantity of smoke and toxic products released from combustible materials, including surface finishes, during fire shall be limited.

**200. Paints, varnishes and other finishes**

201. Paints, varnishes and other finishes used on exposed interior surfaces shall not be capable of producing excessive quantities of smoke and toxic products, this being determined in accordance with the Fire Test Procedures Code.

202. On passenger ships constructed on or after 1 July 2008, paints, varnishes and other finishes used on exposed surfaces of cabin balconies, excluding natural hard wood decking systems, shall not be capable of producing excessive quantities of smoke and toxic products, this being determined in accordance with the Fire Test Procedures Code.

*Guideline*

*Paints, varnishes and other finishes:*

[IACS UI SC127] This regulation only applies to accommodation spaces, service spaces and control stations as well as stairway enclosures

*End of guidance*

**300. Primary deck coverings**

301. Primary deck coverings, if applied within accommodation and service spaces and control stations, shall be of approved material which will not give rise to smoke or toxic or explosive hazards at elevated temperatures, this being determined in accordance with the Fire Test Procedures Code.

302. On passenger ships constructed on or after 1 July 2008, primary deck coverings on cabin balconies shall not give rise to smoke, toxic or explosive hazards at elevated temperatures, this being determined in accordance with the Fire Test Procedures Code.

*Guidance*

*Chapter E5 does not indicate that low flame spread rating applies to the surfaces of furniture, furnishings, machinery and similar items. However furniture, other than any upholstered parts, shall not be constructed of organic foams, cork or any other highly flammable materials or other materials capable of producing large quantities of smoke or toxic products. This does not apply to wood or wood products, surface finishes such as laminates and*

veneers and plastic trim, skirtings etc. Also whilst E5.603 permits decorative flower or plant arrangements in corridors it is recommended that any such items and their supports be not readily ignitable to a suitable standard<sup>2</sup>.  
**Paints, varnishes and other finishes.** Paints, varnishes and other finishes used on exposed interior surfaces shall not be capable of producing excessive quantities of smoke and toxic products, this being determined in accordance with the Fire Test Procedures Code.

#### Smoke and toxicity rating of finishes

This requirement applies to the finishes of bulkheads, linings, ceilings and the surface deck coverings in corridors, stairway enclosures and rooms containing furniture and furnishings of restricted fire risk

#### Primary deck coverings

Primary deck coverings, if applied within accommodation and service spaces and control stations, shall be of approved material which will not give rise to smoke or toxic or explosive hazards at elevated temperatures, this being determined in accordance with the Fire Test Procedures Code.

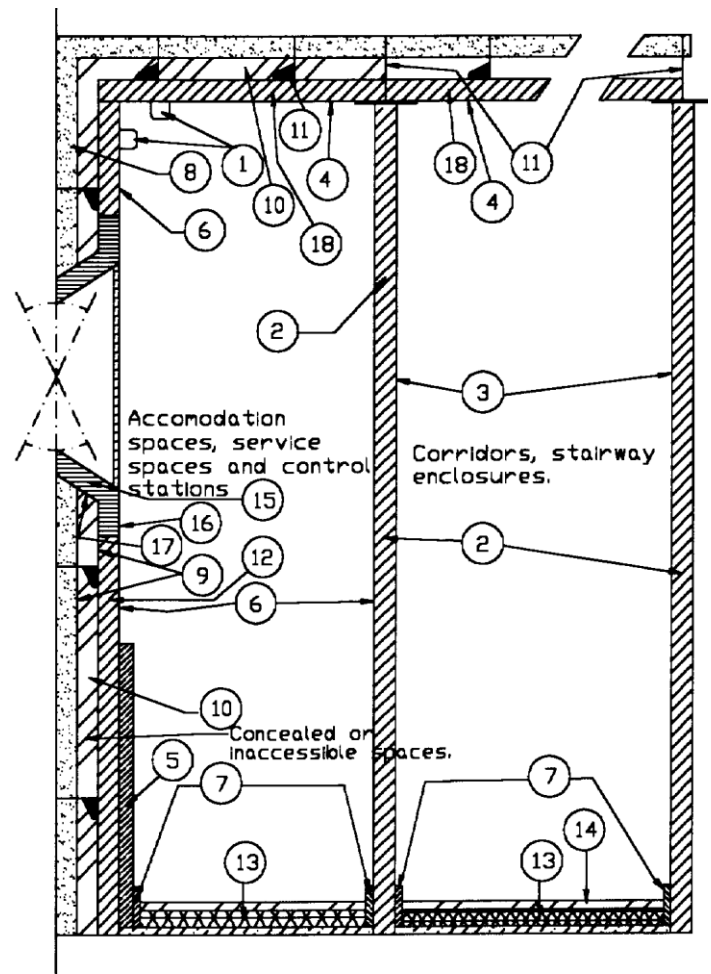
A primary deck covering is to be regarded as the first layer of a floor construction which is applied directly on top of the deck plating and is inclusive of any priming coat, anti-corrosive compound or adhesive which is necessary to provide protection or adhesion to the deck plating. This is the definition of a primary deck covering in Annex 1 Part 5.3.2.2 of the Fire Test Procedures Code.

Every primary deck covering used in accommodation spaces, service spaces and control stations is to be of an approved type and shall be laid in accordance with the conditions in the approval certificate. Also see E4.400 referring to not readily ignitable

#### [UI SC126]

For the application of E5.200 and E6.200, reference is to be made to the attached Figure F.E6.200.1 and associated Tables T.E6.200.1 and T.E6.200.2.

**FIGURE F.E6.200.1: CONSTRUCTURAL ELEMENTS IN ACCOMMODATION SPACES**



**TABLE T.E6.200.1 - METHODS IC**

|    |   | Requirements for Components         |                                     |                             |                           |                         |                          |                                |
|----|---|-------------------------------------|-------------------------------------|-----------------------------|---------------------------|-------------------------|--------------------------|--------------------------------|
|    |   | A<br>Non<br>combustible<br>material | B<br>Non<br>combustible<br>material | C<br>Low<br>flame<br>spread | D<br>Equivalent<br>volume | E<br>Calorific<br>value | F<br>Smoke<br>production | G<br>Not<br>readily<br>ignited |
| 1  | Moulding  |                                     |                                     |                             | X                         |                         |                          |                                |
| 2  | Panel   | X                                   |                                     |                             |                           |                         |                          |                                |
| 3  | Painted<br>surfaces or<br>veneer or<br>fabric or<br>foils           |                                     |                                     | X                           | X                         | X                       | X                        |                                |
| 4  | Painted<br>surfaces or<br>veneer or<br>fabric or<br>foils           |                                     |                                     | X                           | X                         | X                       | X                        |                                |
| 5  | Decoration  |                                     |                                     |                             | X                         |                         | X <sup>(2)</sup>         |                                |
| 6  | Painted<br>surfaces or<br>veneer or<br>fabric or<br>foils           |                                     |                                     |                             | X                         | X                       | X <sup>(2)</sup>         |                                |
| 7  | Skirting<br>board   |                                     |                                     |                             | X                         |                         |                          |                                |
| 8  | Insulation  |                                     | X <sup>(1)</sup>                    | X <sup>(1)</sup>            |                           |                         |                          |                                |
| 9  | Surfaces and<br>paints in<br>concealed or<br>inaccessible<br>spaces |                                     |                                     |                             |                           |                         |                          |                                |
| 10 | Draught<br>stops  | X                                   |                                     |                             |                           |                         |                          |                                |
| 11 | Grounds and<br>supports   | X                                   |                                     | X                           |                           |                         |                          |                                |
| 12 | Lining  | X                                   |                                     |                             |                           |                         |                          |                                |
| 13 | Primary<br>deck<br>covering 1 <sup>st</sup><br>layer                |                                     |                                     |                             |                           |                         | X                        |                                |
| 14 | Floor<br>finishing  |                                     |                                     | X <sup>(3)</sup>            |                           |                         | X <sup>(3)</sup>         | C                              |
| 15 | Window box  | X                                   |                                     |                             |                           |                         |                          |                                |
| 16 |   |                                     |                                     | X <sup>(3)</sup>            | X                         | X                       | X <sup>(3)</sup>         |                                |
| 17 | Window box<br>surface   |                                     |                                     | X                           |                           |                         |                          |                                |
| 18 | Ceiling<br>panel  | X                                   |                                     |                             |                           |                         |                          |                                |

(1) Vapour barriers used on pipes for cold systems (see UI SC 102) may be of combustible materials providing that their surface has low flame spread characteristics(Reg. II-2/5.3.1.1)

(2) Applicable to paints, varnishes and other finishes (Reg. II-2/6.2)

(3) Only in corridors and stairway enclosures.

- Regulation II-/6.2 only applies to accommodation spaces, service spaces and control stations as well as stairway enclosures (UI SC 127)

- As far as window boxes construction is concerned, reference is also to be made to MSC/Circ.917 and MSC/Circ. 917 Add. 1

**TABLE T.E6.200.2 - METHOD IIC AND IIIC**

|    |   | Requirements for Components |                          |                  |                   |                 |                  |                     |
|----|---|-----------------------------|--------------------------|------------------|-------------------|-----------------|------------------|---------------------|
|    |   | A                           | B                        | C                | D                 | E               | F                | G                   |
|    |   | Non combustible material    | Non combustible material | Low flame spread | Equivalent volume | Calorific value | Smoke production | Not readily ignited |
| 1  | Moulding  |                             |                          |                  | X                 |                 |                  |                     |
| 2  | Panel   | X <sup>(4)</sup>            |                          |                  |                   |                 |                  |                     |
| 3  | Painted surfaces or veneer or fabric or foils           |                             |                          | X                | X                 | X               | X                |                     |
| 4  | Painted surfaces or veneer or fabric or foils           |                             |                          | X                | X                 | X               | X                |                     |
| 5  | Decoration  |                             |                          |                  | X                 |                 | X <sup>(2)</sup> |                     |
| 6  | Painted surfaces or veneer or fabric or foils           |                             |                          |                  | X                 | X               | X <sup>(2)</sup> |                     |
| 7  | Skirting board  |                             |                          |                  | X                 |                 |                  |                     |
| 8  | Insulation  |                             | X <sup>(1)</sup>         |                  |                   |                 |                  |                     |
| 9  | Surfaces and paints in concealed or inaccessible spaces |                             |                          | X                |                   |                 |                  |                     |
| 10 | Draught stops   |                             |                          |                  |                   |                 |                  |                     |
| 11 | Grounds and supports                                    | X <sup>(4)</sup>            |                          | X                |                   |                 |                  |                     |
| 12 | Lining  | X <sup>(4)</sup>            |                          |                  |                   |                 |                  |                     |
| 13 | Primary deck covering 1 <sup>st</sup> layer             | X <sup>(4)</sup>            |                          |                  |                   |                 | X                | X                   |
| 14 | Floor finishing   |                             |                          | X <sup>(3)</sup> |                   |                 | X <sup>(3)</sup> |                     |
| 15 | Window box  | X <sup>(4)</sup>            |                          |                  |                   |                 |                  |                     |
| 16 |   |                             |                          | X <sup>(3)</sup> |                   | X               | X <sup>(3)</sup> |                     |
| 17 | Window box surface                                      |                             |                          | X <sup>(3)</sup> | X                 |                 |                  |                     |
| 18 | Ceiling panel   | X <sup>(4)</sup>            |                          |                  |                   |                 |                  |                     |

((1) Vapour barriers used on pipes for cold systems (see UI SC 102) may be of combustible materials providing that their surface has low flame spread characteristics (SOLAS Reg. II-2/5.3.1.1)

((2) Where fire material is fitted on non combustible bulkheads, ceiling and lining in accommodation and service spaces (SOLAS Reg. II-2/5.3.2.2)

((3) To be applied to those accommodation and service spaces bounded by non combustible bulkheads, ceiling and lining (SOLAS Reg. II-2/ 5.3.2.3.1)



(4) Only in corridor and stairway enclosures serving accommodation and service spaces and control stations (SOLAS Reg. II-2/5.3.1.2.2.2)

(5) Applicable to paints, varnishes and other finishes (SOLAS Reg. II-2/6.2)

(6) Only in corridors and stairway enclosures.

- SOLAS Regulation II-/6.2 only applies to accommodation spaces, service spaces and control stations as well as stairway enclosures (UI SC 127)

- As far as window boxes construction is concerned, reference is also to be made to MSC/Circ.917 and MSC/Circ. 917 Add.

## E7. DETECTION AND ALARM

### 100. Purpose

101. The purpose of this regulation is to detect a fire in the space of origin and to provide for alarm for safe escape and fire fighting activity. For this purpose, the following functional requirements shall be met:

102. Fixed fire detection and fire alarm system installations shall be suitable for the nature of the space, fire growth potential and potential generation of smoke and gases;

103. Manually operated call points shall be placed effectively to ensure a readily accessible means of notification; and

104. Fire patrols shall provide an effective means of detecting and locating fires and alerting the navigation bridge and fire teams.

### 200. General requirements

201. A fixed fire detection and fire alarm system shall be provided in accordance with the provisions of this regulation.

202. A fixed fire detection and fire alarm system and a sample extraction smoke detection system required in this regulation and other regulations in this part shall be of an approved type and comply with the Fire Safety Systems Code.

203. Where a fixed fire detection and fire alarm system is required for the protection of spaces other than those specified in paragraph 5.1, at least one detector complying with the Fire Safety Systems Code shall be installed in each such space.

#### Guidance

A **section** is defined as a group of detectors and manually operated call points as reported in the required indicating unit(s).

A **detector loop** is defined as an electrical circuit linking detectors of various sections in a sequence and connected (input and output) to the indicating unit(s). Zone address identification capability is a system with individually identifiable fire detectors.

*Acceptable activating arrangements; the fire control panel may be permitted to:*

- a. activate a paging system;
- b. activate the fan stops;
- c. activate the closure of fire doors;
- d. activate the closure of fire dampers;
- e. activate the sprinkler system;
- f. activate the smoke extraction system; and
- g. activate the low-location lighting system.

*Fire detection systems with a zone address identification capability. Shall comply with:*

*Detectors installed within cold spaces such as refrigerated compartments shall be tested according to IEC 68-2-1 (1990) - Section one - Test Aa. The temperature of operation of heat detectors in spaces covered by this Regulation may be 130°C, in saunas up to 140°C*

*End of guidance.*

### 300. Initial and periodical test

301. The function of fixed fire detection and fire alarm systems required by the relevant regulations of this chapter shall be tested under varying conditions of ventilation after installation.

302. The function of fixed fire detection and fire alarm systems shall be periodically tested to the satisfaction of the RBNA by means of equipment producing hot air at the appropriate temperature, or smoke or aerosol particles having the appropriate range of density or particle size, or other phenomena associated with incipient fires to which the detector is designed to respond.

#### Guidance

*Every vessel shall have developed a regular routine to ensure that detectors are functioning correctly, the test interval will take into account the degree of self-monitoring provided by the system. Addressable detectors shall be tested every year and non addressable detectors every 3 months*

*End of guidance*

#### 400. Protection of machinery spaces

401. **Installation:** a fixed fire detection and fire alarm system shall be installed in:

- a. periodically unattended machinery spaces; and
- b. machinery spaces where:
  - b.1. the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the space; and
  - b.2. the main propulsion and associated machinery including sources of the main sources of electrical power, are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room.

#### 402. Design

- a. The fixed fire detection and fire alarm system required in E7.400.a shall be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures.
- b. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors shall not be permitted.
- c. The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigation bridge and by a responsible engineer officer.
- d. When the navigation bridge is unmanned, the alarm shall sound in a place where a responsible member of the crew is on duty.

#### 500. Protection of accommodation and service spaces and control stations

##### 501. Smoke detectors in accommodation spaces

- a. Smoke detectors shall be installed in all stairways, corridors and escape routes within accommodation spaces as provided in paragraphs E7.502, E7.503 and E7.504. Consideration shall be given to the installation of special purpose smoke detectors within ventilation ducting.

##### 502. Requirements for passenger ships carrying more than 36 passengers

- a. A fixed fire detection and fire alarm system shall be installed and arranged as to provide smoke detection in service spaces, control stations and accommodation spaces, including corridors, stairways and escape routes within accommodation spaces.
- b. Smoke detectors need not be fitted in private bathrooms and galleys. Spaces having little or no fire risk such as voids, public toilets, carbon dioxide rooms and similar spaces need not be fitted with a fixed fire detection and alarm system.

*Guidance*

[IACS UI SC130]

##### *Fire Detection and Sprinkler Systems in Refrigerated Chambers and Similar Spaces:*

*Heat detectors are acceptable in refrigerated chambers and in other spaces where steam and fumes are produced such as saunas and laundries. Refrigerated chambers may be fitted with dry pipe sprinkler systems.*

*End of guidance*

##### 503. Requirements for passenger ships carrying not more than 36 passengers

- a. There shall be installed throughout each separate zone, whether vertical or horizontal, in all accommodation and service spaces and, where it is considered necessary by the RBNA, in control stations, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc., either:
- b. a fixed fire detection and fire alarm system so installed and arranged as to detect the presence of fire in such spaces and providing smoke detection in corridors, stairways and escape routes within accommodation spaces; or
- c. an automatic sprinkler, fire detection and fire alarm system of an approved type complying with the relevant requirements of the Fire Safety Systems Code and so installed and arranged as to protect such spaces and, in addition, a fixed fire detection and fire alarm system and so installed and arranged as to provide smoke detection in corridors, stairways and escape routes within accommodation spaces.

##### 504. Protection of atriums in passenger ships

- a. The entire main vertical zone containing the atrium shall be protected throughout with a smoke detection system.

#### 505. Cargo ships

- a. Accommodation and service spaces and control stations of cargo ships shall be protected by a fixed fire detection and fire alarm system and/or an automatic sprinkler, fire detection and fire alarm system as follows depending on a protection method adopted in accordance with E9.303.
- b. **Method IC** - A fixed fire detection and fire alarm system shall be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.
- c. **Method IIC** - An automatic sprinkler, fire detection and fire alarm system of an approved type complying with the relevant requirements of the Fire Safety Systems Code shall be so installed and arranged as to protect accommodation spaces, galleys and other service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system shall be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.
- d. **Method IIIC** - A fixed fire detection and fire alarm system shall be so installed and arranged as to detect the presence of fire in all accommodation spaces and service spaces, providing smoke detection in corridors, stairways and escape routes within accommodation spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system shall be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

#### Guidance

##### **Method IIC**

*In a ship in which Method IIC has been adopted the following applies:*

*The sprinkler system is required to be fitted in all accommodation spaces and service spaces in which fire may be expected to originate. Sprinklers need not be fitted in either private and communal sanitary accommodation not fitted with electric space heaters or void spaces. Surveyors shall note that the Regulations do not require sprinklers to be fitted in fire control stations.*

##### **Method IIIC**

*In a ship in which Method IIIC has been adopted the following applies:*

#### [IACS UISC48]

##### **Fire protection arrangements in cargo spaces:**

*Ships of less than 2.000 tons gross tonnage carrying petroleum products having a flash point exceeding 60°C (c.c. test) are not required to be fitted with a fixed fire extinguishing system.*

#### [IACS UI SC160]

##### **Method IIIC Construction**

*In the case of ships built in accordance with Method IIIC, the detection system is only relevant to the accommodation block. Service spaces built away from the accommodation block need not be fitted with a fixed fire detection system.*

#### [IACS UI SC241]

##### **Manually operated call points**

*The phrase 'Manually operated call points complying with the Fire Safety Systems Code shall be installed throughout the accommodation spaces, service spaces and control stations' does not require the fitting of a manually operated call point in an individual space within the accommodation spaces, service spaces and control stations. However, a manually operated call point shall be located at each exit (inside or outside) to the open deck from the corridor such that no part of the corridor is more than 20 m from a manually operated call point*

*Service spaces and control stations which have only one access, leading directly to the open deck, shall have a manually operated call point not more than 20 m (measured along the access route using the deck, stairs and/or corridors) from the exit. A manually operated call point is not required to be installed for spaces having little or no fire risk, such as voids and carbon dioxide rooms, nor at each exit from the navigation bridge, in cases where the control panel is located in the navigation bridge.*

#### End of guidance

#### **600. Protection of cargo spaces in passenger ships**

601. A fixed fire detection and fire alarm system or a sample extraction smoke detection system shall be provided in any cargo space which, in the opinion of the RBNA, is not accessible, except where it is shown to the satisfaction of the RBNA that the ship is engaged on voyages of such short duration that it would be unreasonable to apply this requirement.

#### **700. Manually operated call points**

701. Manually operated call points complying with the Fire Safety Systems Code shall be installed throughout the accommodation spaces, service spaces and control stations.

702. One manually operated call point shall be located at each exit.

703. Manually operated call points shall be readily accessible in the corridors of each deck such that no part of the corridor is more than 20 m from a manually operated call point.

*Guidance*

*Manual fire alarm systems may be combined with an automatic fire detection and alarm system and shall be so arranged that a fire alarm can be raised, even though a zone or zones in the automatic detection system have been disconnected for maintenance or repair*

*End of guidance*

**800. Fire alarm signalling systems in passenger ships**

Refer to the Code on Alarms and Indicators adopted by IMO by resolution A.830(19).

801. Passenger ships shall at all times when at sea, or in port (except when out of service), be so manned or equipped as to ensure that any initial fire alarm is immediately received by a responsible member of the crew.

802. The control panel of fixed fire detection and fire alarm systems shall be designed on the fail safe principle (e.g., an open detector circuit shall cause an alarm condition).

*Guidance*

**[IACS UI SC129]**

*Fire Detection in Unmanned Machinery Spaces:*

*This requirement applies to machinery spaces of category A.*

*End of guidance*

803. Passenger ships carrying more than 36 passengers shall have the fire detection alarms for the systems required by paragraph 5.2 centralized in a continuously manned central control station. In addition, controls for remote closing of the fire doors and shutting down the ventilation fans shall be centralized in the same location. The ventilation fans shall be capable of reactivation by the crew at the continuously manned control station. The control panels in the central control station shall be capable of indicating open or closed positions of fire doors and closed or off status of the detectors, alarms and fans. The control panel shall be continuously powered and shall have an automatic change over to standby power supply in case of loss of normal power supply. The control panel shall be powered from the main source of electrical power and the emergency source of electrical power unless other

arrangements are permitted by the regulations, as applicable.

804. A special alarm, operated from the navigation bridge or fire control station, shall be fitted to summon the crew. This alarm may be part of the ship's general alarm system and shall be capable of being sounded independently of the alarm to the passenger spaces.

**E8. CONTROL OF SMOKE SPREAD**

**100. Purpose**

101. The purpose of this regulation is to control the spread of smoke in order to minimize the hazards from smoke. For this purpose, means for controlling smoke in atriums, control stations, machinery spaces and concealed spaces shall be provided.

**200. Protection of control stations outside machinery spaces**

201. Practicable measures shall be taken for control stations outside machinery spaces in order to ensure that ventilation, visibility and freedom from smoke are maintained so that, in the event of fire, the machinery and equipment contained therein may be supervised and continue to function effectively.

202. Alternative and separate means of air supply shall be provided and air inlets of the two sources of supply shall be so disposed that the risk of both inlets drawing in smoke simultaneously is minimized.

203. At the discretion of the RBNA, such requirements need not apply to control stations situated on, and opening on to, an open deck or where local closing arrangements would be equally effective.

*Guidance*

***Air supply to control stations***

*The two entirely separate means of supplying air to control stations referred to in paragraph 2 may serve other spaces but in no case shall they serve the same spaces. However it would be preferable for at least one of the means of supplying air to be independent of any other space. Local closing arrangements mean, in the case of ventilation trunks, fire or smoke dampers capable of being closed manually from within the station.*

***Equally effective local ventilation closing arrangements for control stations***

*Equally effective local closing arrangements means that in case of ventilators these shall be fitted with fire dampers or smoke dampers which could be closed easily within the*



*control station in order to maintain the absence of smoke in the event of fire.*

*End of guidance*

### **300. Release of smoke from machinery spaces**

301. The provisions of this paragraph shall apply to machinery spaces of category A and, where the RBNA considers desirable, to other machinery spaces.

302. Suitable arrangements shall be made to permit the release of smoke, in the event of fire, from the space to be protected, subject to the provisions of E9.802. The normal ventilation systems may be acceptable for this purpose.

303. Means of control shall be provided for permitting the release of smoke and such controls shall be located outside the space concerned so that they will not be cut off from the space they serve.

304. In passenger ships, the controls required by paragraph E8.303 shall be situated at one control position or grouped in as few positions as possible to the satisfaction of the RBNA. Such positions shall have a safe access from the open deck.

*Guidance*

#### **Location of ventilation controls in category A machinery spaces**

*In machinery spaces of category A, controls to close off ventilation ducts and pipes shall be installed with due regard to the hot gases produced by a fire in the space concerned.*

*End of guidance*

### **400. Draught stops**

401. Air spaces enclosed behind ceilings, panelling or linings shall be divided by close-fitting draught stops spaced not more than 14m apart. In the vertical direction, such enclosed air spaces, including those behind linings of stairways, trunks, etc., shall be closed at each deck.

*Guidance*

#### **Draught stops - extent**

*Care shall be taken to ensure that where 'C' and 'B' Class ceilings and linings are not extended respectively to the ship's side and deckhead, the combined length of the air spaces behind the ceiling and lining is used to determine the spacing of draught stops.*

*Draught stops shall generally be fitted in the air space behind ceilings which are perforated or slatted when the air space exceeds 14m in length or breadth because a fire could quite rapidly develop in such a space and would*

*nearly be as difficult to control as a fire behind an unperforated ceiling.*

#### **Closure of decks**

*Paragraph 4 requires air spaces behind ceilings and linings to be closed at each deck. The integrity and insulation standards of decks as specified in the tables of Chapter E9 are to be maintained in the air spaces behind ceilings and linings as though such air spaces are part of the accommodation spaces, service spaces or control stations, as appropriate, from which they are separated. The air spaces behind ceilings and linings cannot be regarded as void spaces because the ceilings and linings separating the air spaces from the accommodation spaces, service spaces and control stations would have to be 'A' Class divisions in compliance with respective tables.*

*Any draught stop fitted in the corridors or stairway enclosures shall be constructed as indicated below in "Draught stops construction".*

*Draught stops other than those fitted in corridors and stairway enclosures may be constructed as indicated in E5.502.b and may be constructed of combustible board type materials such as plywood or chipboard of not less than 6mm thickness supported by steel or wooden grounds attached to the ships structure, bulkheads, ceilings or linings and fitted tightly to such structure and divisions subject to compliance with E5.605.b.*

#### **Draught stops - construction**

*Where draught stops are required by E5.501 to be constructed of non-combustible materials any of the following methods of construction may be used to form draught stops:*

- the extension of 'B' Class bulkheads, ceilings or linings the details of which are shown on the appropriate approved drawings;*
- the extension of 'C' Class bulkheads, ceilings or linings;*
- steel curtain plates, stringers or webs intermittently welded to the structure, stiffened where necessary and attached to the top profiles of bulkheads or fitted tightly to ceilings or linings. Any lightening holes in ships structure which is used as part of a draught stop shall be plated over;*
- approved non-combustible board type materials supported by steel flat bars or steel angle or channel profiles attached to the ships structure, bulkheads, ceilings or linings and fitted tightly to such structure or divisions;*

#### **Smoke extraction systems in atriums of passenger ships**

*Atriums shall be equipped with a smoke extraction system. The smoke extraction system shall be activated by the*

*required smoke detection system and be capable of manual control. The fans shall be sized such that the entire volume within space can be exhausted in 10 min or less.*

*End of guidance*

## **500. Smoke extraction systems in atriums of passenger ships**

501. Atriums shall be equipped with a smoke extraction system. The smoke extraction system shall be activated by the required smoke detection system and be capable of manual control. The fans shall be sized such that the entire volume within space can be exhausted in 10 min or less.

## **E9. CONTAINMENT OF FIRE**

### **100. Purpose**

101. The purpose of this regulation is to contain a fire in the space of origin. For this purpose, the following functional requirements shall be met:

- a. the ship shall be subdivided by thermal and structural boundaries;
- b. thermal insulation of boundaries shall have due regard to the fire risk of the space and adjacent spaces; and
- c. the fire integrity of the divisions shall be maintained at openings and penetrations.

### **200. Thermal and structural boundaries**

201. Thermal and structural subdivision Ships of all types shall be subdivided into spaces by thermal and structural divisions having regard to the fire risks of the space.

### **300. Passenger ships**

#### **301. Main vertical zones and horizontal zones**

- a. In ships carrying more than 36 passengers, the hull, superstructure and deckhouses shall be subdivided into main vertical zones by "A 60" class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary they shall also be "A 60" class divisions. Where a category (5), (9) or (10) space defined in paragraph E9.303.b is on one side or where fuel oil tanks are on both sides of the division the standard may be reduced to "A 0".
- b. In ships carrying not more than 36 passengers, the hull, superstructure and deckhouses in way of accommodation and service spaces shall be subdivided into main vertical zones by "A" class divisions. These divisions shall have insulation

values in accordance with tables in paragraph E9.304.

- c. As far as practicable, the bulkheads forming the boundaries of the main vertical zones above the bulkhead deck shall be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck. The length and width of main vertical zones may be extended to a maximum of 48 m in order to bring the ends of main vertical zones to coincide with watertight subdivision bulkheads or in order to accommodate a large public space extending for the whole length of the main vertical zone provided that the total area of the main vertical zone is not greater than 1,600 m<sup>2</sup> on any deck. The length or width of a main vertical zone is the maximum distance between the furthestmost points of the bulkheads bounding it.
- d. Such bulkheads shall extend from deck to deck and to the shell or other boundaries.
- e. Where a main vertical zone is subdivided by horizontal "A" class divisions into horizontal zones for the purpose of providing an appropriate barrier between a zone with sprinklers and a zone without sprinklers, the divisions shall extend between adjacent main vertical zone bulkheads and to the shell or exterior boundaries of the ship and shall be insulated in accordance with the fire insulation and integrity values given in table T.E9.304.2.
- f. On ships designed for special purposes, such as automobile or railroad car ferries, where the provision of main vertical zone bulkheads would defeat the purpose for which the ship is intended, equivalent means for controlling and limiting a fire shall be substituted and specifically approved by the RBNA. Service spaces and ship stores shall not be located on ro-ro decks unless protected in accordance with the applicable regulations.
- g. However, in a ship with special category spaces, such spaces shall comply with the applicable provisions of regulation 20 and, where such compliance would be inconsistent with other requirements for passenger ships specified in this chapter, the requirements of regulation 20 shall prevail.

*Guidance*

### **[IACS UI SC101]**

*Main vertical zones:*

*If a stairway serves two main vertical zones, the maximum length of one main vertical zone shall be measured from the far side of the main vertical zone stairway enclosure. In this case, all boundaries of the stairway enclosure be insulated as main vertical zone bulkheads and access doors leading into the stairway shall be*



*provided from the zones. However, the stairway shall not be included in calculating the size of the main vertical zone if it is treated as its own main vertical zone.*

**Construction of extended bulkhead behind continuous ceilings or linings MSC/Circ.1120**

*The extension of the bulkhead shall be made of non-combustible material and the construction of the extension shall correspond to the fire class of extended bulkhead.*

*If the extended bulkhead is of B-0, then the extension may be made of thin steel plates of 1 mm thickness and tightened (e.g., with mineral wool). Alternatively, B-0 class extensions may be constructed of a suitably supported mineral wool (density at least 100 kg/m<sup>3</sup>, thickness at least 50 mm).*

*End of guidance*

**302. Bulkheads within a main vertical zone**

- a. For ships carrying more than 36 passengers, bulkheads which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in the tables in paragraph E9.303.
- b. For ships carrying not more than 36 passengers, bulkheads within accommodation and service spaces which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in the tables in paragraph E9.304. In addition, corridor bulkheads, where not required to be "A" class, shall be "B" class divisions which shall extend from deck to deck except:
  - b.1. when continuous "B" class ceilings or linings are fitted on both sides of the bulkhead, the portion of the bulkhead behind the continuous ceiling or lining shall be of material which, in thickness and composition, is acceptable in the construction of "B" class divisions, but which shall be required to meet "B" class integrity standards only in so far as is reasonable and practicable in the opinion of the RBNA; and

- b.2. in the case of a ship protected by an automatic sprinkler system complying with the provisions of the Fire Safety Systems Code, the corridor bulkheads may terminate at a ceiling in the corridor provided such bulkheads and ceilings are of "B" class standard in compliance with paragraph E9.304. All doors and frames in such bulkheads shall be of non combustible materials and shall have the same fire integrity as the bulkhead in which they are fitted.

- c. Bulkheads required to be "B" class divisions, except corridor bulkheads as prescribed in paragraph E9.302.b, shall extend from deck to deck and to the shell or other boundaries. However, where a continuous "B" class ceiling or lining is fitted on both sides of a bulkhead which is at least of the same fire resistance as the adjoining bulkhead, the bulkhead may terminate at the continuous ceiling or lining.

**303. Fire integrity of bulkheads and decks in ships carrying more than 36 passengers**

- a. In addition to complying with the specific provisions for fire integrity of bulkheads and decks of passenger ships, the minimum fire integrity of all bulkheads and decks shall be as prescribed in tables T.E9.303.1 and T.E9.303.2. Where, due to any particular structural arrangements in the ship, difficulty is experienced in determining from the tables the minimum fire integrity value of any divisions, such values shall be determined to the satisfaction of the RBNA.
- b. The following requirements shall govern application of the tables:
  - b.1. Table T.E9.303.1 shall apply to bulkheads not bounding either main vertical zones or horizontal zones. Table T.E9.303.2 shall apply to decks not forming steps in main vertical zones nor bounding horizontal zones.

**TABLE T.E9.303.1 - BULKHEADS NOT BOUNDING EITHER MAIN VERTICAL ZONES OR HORIZONTAL ZONES IN PASSENGER SHIPS CARRYING MORE THAN 36 PASSENGERS**

| SPACES  | (1)        | (2)        | (3)  | (4)  | (5) | (6)            | (7)            | (8)            | (9)         | (10)       | (11)        | (12)        | (13)        | (14)        |
|---|------------|------------|------|------|-----|----------------|----------------|----------------|-------------|------------|-------------|-------------|-------------|-------------|
| Control stations (1)  | B-0<br>[a] | A-0        | A-0  | A-0  | A-0 | A-60           | A-60           | A-60           | A-0         | A-0        | A-60        | A-60        | A-60        | A-60        |
| Stairways (2)   |            | A-0<br>[a] | A-0  | A-0  | A-0 | A-0            | A-15           | A-15           | A-0<br>[c]  | A-0        | A-15        | A-30        | A-15        | A-30        |
| Corridors (3)   |            |            | B-15 | A-60 | A-0 | B-15           | B-15           | B-15           | B-15        | A-0        | A-15        | A-30        | A-0         | A-30        |
| Evacuation stations and external escape routes (4)  |            |            |      | –    | A-0 | A-60<br>[b][d] | A-60<br>[b][d] | A-60<br>[b][d] | A-60<br>[d] | A-0        | A-60<br>[b] | A-60<br>[b] | A-60<br>[b] | A-60<br>[b] |
| Open deck spaces (5)  |            |            |      |      | –   | A-0            | A-0            | A-0            | A-0         | A-0        | A-0         | A-0         | A-0         | A-0         |
| Accommodation spaces of minor fire risk (6)   |            |            |      |      |     | B-0            | B-0            | B-0            | C           | A-0        | A-0         | A-30        | A-0         | A-30        |
| Accommodation spaces of moderate fire risk (7)  |            |            |      |      |     |                | B-0            | B-0            | C           | A-0        | A-15        | A-60        | A-15        | A-60        |
| Accommodation spaces of greater fire risk (8)   |            |            |      |      |     |                |                | B-0            | C           | A-0        | A-30        | A-60        | A-15        | A-60        |
| Sanitary and similar spaces (9)   |            |            |      |      |     |                |                |                | C           | A-0        | A-0         | A-0         | A-0         | A-0         |
| Tanks, voids and auxiliary machinery spaces having little or no fire risk (10)  |            |            |      |      |     |                |                |                |             | A-0<br>[a] | A-0         | A-0         | A-0         | A-0         |
| Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk (11) |            |            |      |      |     |                |                |                |             |            | A-0<br>[a]  | A-0         | A-0         | A-15        |
| Machinery spaces and main galleys (12)  |            |            |      |      |     |                |                |                |             |            |             | A-0<br>[a]  | A-0         | A-60        |
| store-rooms, workshops, pantries etc. (13)  |            |            |      |      |     |                |                |                |             |            |             |             | A-0<br>[a]  | A-0         |
| Other spaces in which flammable liquids are stowed (14)   |            |            |      |      |     |                |                |                |             |            |             |             |             | A-30        |

**Note 1:** (to be applied to Tab 1 and Tab 2, as appropriate)

[a] : Where adjacent spaces are in the same numerical category and letter “a” appears, a bulkhead or deck between such spaces need not be fitted if deemed unnecessary by the Society. For example, in category (12) a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkheads and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and machinery space even though both spaces are in category (12).

[b] : The ship's side, to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to liferafts and evacuation slides may be reduced to A-30.

[c] : Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure can be of B class integrity.

[d] : Where spaces of category (6), (7), (8) and (9) are located completely within the outer perimeter of the assembly station, the bulkheads of these spaces are allowed to be of B-0 class integrity. Control positions for audio, video and light installations may be considered as part of the assembly station.

**TABLE T.E9.303.2 - DECKS NOT FORMING STEPS IN MAIN VERTICAL ZONES NOR BOUNDING HORIZONTAL ZONES IN PASSENGER SHIPS CARRYING MORE THAN 36 PASSENGERS**

| SPACE below   | SPACE above |      |         |      |     |      |      |      |     |         |         |          |      |      |
|---|-------------|------|---------|------|-----|------|------|------|-----|---------|---------|----------|------|------|
|   | (1)         | (2)  | (3)     | (4)  | (5) | (6)  | (7)  | (8)  | (9) | (10)    | (11)    | (12)     | (13) | (14) |
| Control stations (1)  | A-30        | A-30 | A-15    | A-0  | A-0 | A-0  | A-15 | A-30 | A-0 | A-0     | A-0     | A-60     | A-0  | A-60 |
| Stairways (2)   | A-0         | A-0  | A-0     | A-0  | A-0 | A-0  | A-0  | A-0  | A-0 | A-0     | A-0     | A-30     | A-0  | A-30 |
| Corridors (3)   | A-15        | A-0  | A-0 [a] | A-60 | A-0 | A-0  | A-15 | A-15 | A-0 | A-0     | A-0     | A-30     | A-0  | A-30 |
| Evacuation stations and external escape routes (4)  | A-0         | A-0  | A-0     | A-0  | –   | A-0  | A-0  | A-0  | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Open deck spaces (5)  | A-0         | A-0  | A-0     | A-0  | –   | A-0  | A-0  | A-0  | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Accommodation spaces of minor fire risk (6)   | A-60        | A-15 | A-0     | A-60 | A-0 | A-0  | A-0  | A-0  | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Accommodation spaces of moderate fire risk (7)  | A-60        | A-15 | A-15    | A-60 | A-0 | A-0  | A-15 | A-15 | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Accommodation spaces of greater fire risk (8)   | A-60        | A-15 | A-15    | A-60 | A-0 | A-15 | A-15 | A-30 | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Sanitary and similar spaces (9)   | A-0         | A-0  | A-0     | A-0  | A-0 | A-0  | A-0  | A-0  | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Tanks, voids and auxiliary machinery spaces having little or no fire risk (10)  | A-0         | A-0  | A-0     | A-0  | A-0 | A-0  | A-0  | A-0  | A-0 | A-0 [a] | A-0     | A-0      | A-0  | A-0  |
| Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk (11) | A-60        | A-60 | A-60    | A-60 | A-0 | A-0  | A-15 | A-30 | A-0 | A-0     | A-0 [a] | A-0      | A-0  | A-30 |
| Machinery spaces and main galleys (12)  | A-60        | A-60 | A-60    | A-60 | A-0 | A-60 | A-60 | A-60 | A-0 | A-0     | A-30    | A-30 [a] | A-0  | A-60 |
| store-rooms, workshops, pantries, etc. (13)   | A-60        | A-30 | A-15    | A-60 | A-0 | A-15 | A-30 | A-30 | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| Other spaces in which flammable liquids are stowed (14)   | A-60        | A-60 | A-60    | A-60 | A-0 | A-30 | A-60 | A-60 | A-0 | A-0     | A-0     | A-0      | A-0  | A-0  |
| <b>Note 1:</b> The notes of Tab 1 apply to Tab 2, as appropriate.   |             |      |         |      |     |      |      |      |     |         |         |          |      |      |

b.2. For determining the appropriate fire integrity standards to be applied to boundaries between adjacent spaces, such spaces are classified according to their fire risk as shown in categories “c” to “r” below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30% communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms shall be as prescribed in tables T.E9.303.1 and T.E9.303.2. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row in the tables.

**c. Control stations**

c.1. Spaces containing emergency sources of power and lighting.

c.2. Wheelhouse and chartroom.

c.3. Spaces containing the ship's radio equipment.

c.4. Fire control stations

c.5. Control room for propulsion machinery when located outside the propulsion machinery space.

c.6. Spaces containing centralized fire alarm equipment.

c.7. Spaces containing centralized emergency public address system stations and equipment.

**d. Stairways**

d.1. Interior stairways, lifts, totally enclosed emergency escape trunks, and escalators (other than those wholly contained within the machinery spaces) for passengers and crew and enclosures thereto.

d.2. In this connection, a stairway which is enclosed at only one level shall be regarded as part of the space from which it is not separated by a fire door.

e. **Corridors**

- e.1. Passenger and crew corridors and lobbies.

f. **Evacuation stations and external escape routes**

- f.1. Survival craft stowage area.
- f.2. Open deck spaces and enclosed promenades forming lifeboat and liferaft embarkation and lowering stations.
- f.3. Assembly stations, internal and external.
- f.4. External stairs and open decks used for escape routes.
- f.5. The ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to the liferaft and evacuation slide embarkation areas.

g. **Open deck spaces**

- g.1. Open deck spaces and enclosed promenades clear of lifeboat and liferaft embarkation and lowering stations. To be considered in this category, enclosed promenades shall have no significant fire risk, meaning that furnishings shall be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings.
- g.2. Air spaces (the space outside superstructures and deckhouses).

h. **Accommodation spaces of minor fire risk**

- h.1. Cabins containing furniture and furnishings of restricted fire risk.
- h.2. Offices and dispensaries containing furniture and furnishings of restricted fire risk.
- h.3. Public spaces containing furniture and furnishings of restricted fire risk and having a deck area of less than 50 m<sup>2</sup>.

i. **Accommodation spaces of moderate fire risk**

- i.1. Spaces as in category (6) above but containing furniture and furnishings of other than restricted fire risk.
- i.2. Public spaces containing furniture and furnishings of restricted fire risk and having a deck area of 50 m<sup>2</sup> or more.
- i.3. Isolated lockers and small store rooms in accommodation spaces having areas less

than 4 m<sup>2</sup> (in which flammable liquids are not stowed).

- i.4. Sale shops. Motion picture projection and film stowage rooms. Diet kitchens (containing no open flame).
- i.5. Cleaning gear lockers (in which flammable liquids are not stowed).
- i.6. Laboratories (in which flammable liquids are not stowed).
- i.7. Pharmacies
- i.8. Small drying rooms (having a deck area of 4 m<sup>2</sup> or less).
- i.9. Specie rooms.
- i.10. Operating rooms.

*Guidance*

**Electrical distribution boards [IACS UI SC167]**

*Distribution boards may be located behind panels/linings within accommodation spaces including stairway enclosures, without the need to categorize the space, provided no provision is made for storage.*

*If distribution boards are located in an identifiable space having a deck area of less than 4 m<sup>2</sup>, this space may be categorized in (7), according to E9.303.b, or (5), according to E9.304.b, E9.304.c and E9.504.*

*End of guidance*

j. **Accommodation spaces of greater fire risk**

- j.1. Public spaces containing furniture and furnishings of other than restricted fire risk and having a deck area of 50 m<sup>2</sup> or more.
- j.2. Barber shops and beauty parlours.
- j.3. Saunas.

k. **Sanitary and similar spaces**

- k.1. Communal sanitary facilities, showers, baths, water closets, etc.
- k.2. Small laundry rooms.
- k.3. Indoor swimming pool area.
- k.4. Isolated pantries containing no cooking appliances in accommodation spaces.

k.5. Private sanitary facilities shall be considered a portion of the space in which they are located.

**l. Tanks, voids and auxiliary machinery spaces having little or no fire risk**

l.1. Water tanks forming part of the ship's structure.

l.2. Voids and cofferdams.

l.3. Auxiliary machinery spaces which do not contain machinery having a pressure lubrication system and where storage of combustibles is prohibited, such as ventilation and air conditioning rooms; windlass room; steering gear room; stabiliser equipment room; electrical propulsion motor room; rooms containing section switchboards and purely electrical equipment other than oil filled electrical transformers (above 10 kVA); shaft alleys and pipe tunnels; spaces for pumps and refrigeration machinery (not handling or using flammable liquids).

l.4. Closed trunks serving the spaces listed above.

l.5. Other closed trunks such as pipe and cable trunks.

**m. Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk**

m.1. Cargo oil tanks.

m.2. Cargo holds, trunkways and hatchways.

m.3. Refrigerated chambers.

m.4. Oil fuel tanks (where installed in a separate space with no machinery).

m.5. Shaft alleys and pipe tunnels allowing storage of combustibles.

m.6. Auxiliary machinery spaces as in category (10) which contain machinery having a pressure lubrication system or where storage of combustibles is permitted.

m.7. Oil fuel filling stations.

m.8. Spaces containing oil filled electrical transformers (above 10 kVA).

m.9. Spaces containing turbine and reciprocating steam engine driven auxiliary generators and

small internal combustion engines of power output up to 110 kW driving generators, sprinkler, drencher or fire pumps, bilge pumps, etc.

m.10. Closed trunks serving the spaces listed above.

**n. Machinery spaces and main galleys Main propulsion machinery rooms (other than electric propulsion motor rooms) and boiler rooms**

n.1. Auxiliary machinery spaces other than those in categories (10) and (11) which contain internal combustion machinery or other oil burning, heating or pumping units.

n.2. Main galleys and annexes.

n.3. Trunks and casings to the spaces listed above.

**o. Store rooms, workshops, pantries, etc.**

o.1. Main pantries not annexed to galleys.

o.2. Main laundry.

o.3. Large drying rooms (having a deck area of more than 4 m<sup>2</sup>)

o.4. Miscellaneous stores.

o.5. Mail and baggage rooms.

o.6. Garbage rooms.

o.7. Workshops (not part of machinery spaces, galleys, etc.).

o.8. Lockers and store rooms having areas greater than 4 m<sup>2</sup>, other than those spaces that have provisions for the storage of flammable liquids.

**p. Other spaces in which flammable liquids are stowed**

p.1. Paint lockers.

p.2. Store rooms containing flammable liquids (including dyes, medicines, etc.).

p.3. Laboratories (in which flammable liquids are stowed);

p.4. Where a single value is shown for the fire integrity of a boundary between two spaces, that value shall apply in all cases.

p.5. Notwithstanding the provisions of paragraph E9.302 there are no special requirements for



material or integrity of boundaries where only a dash appears in the tables.

- p.6. The RBNA shall determine in respect of category (5) spaces whether the insulation values in table T.E9.303.1 shall apply to ends of deckhouses and superstructures, and whether the insulation values in table T.E9.303.2 shall apply to weather decks. In no case shall the requirements of category (5) of tables T.E9.303.1 or T.E9.303.2 necessitate enclosure of spaces which in the opinion of the RBNA need not be enclosed.
- q. **Continuous "B" class ceilings or linings**, in association with the relevant decks or bulkheads, may be accepted as contributing wholly or in part, to the required insulation and integrity of a division.
- r. **Construction and arrangement of saunas**
  - r.1. The perimeter of the sauna shall be of "A" class boundaries and may include changing rooms, showers and toilets. The sauna shall be insulated to A-60 standard against other spaces except those inside of the perimeter and spaces of categories (5), (9) and (10).
  - r.2. Bathrooms with direct access to saunas may be considered as part of them. In such cases, the door between sauna and the bathroom need not comply with fire safety requirements.
  - r.3. The traditional wooden lining on the bulkheads and ceiling are permitted in the sauna. The ceiling above the oven shall be lined with a non-combustible plate with an air gap of at least 30 mm. The distance from the hot surfaces to combustible materials shall be at least 500 mm or the combustible materials shall be protected (e.g. non-combustible plate with an air gap of at least 30 mm).
  - r.4. The traditional wooden benches are permitted to be used in the sauna.
  - r.5. The sauna door shall open outwards by pushing.
  - r.6. Electrically heated ovens shall be provided with a timer.

#### Guidance

#### **Continuous ceiling [IACS UISC107]**

*If an air gap between cabins results in an opening in the continuous class B-15 ceiling, the bulkheads on both sides of the air gap are to be of class B-15.*

#### End of guidance

304. Fire integrity of bulkheads and decks in ships carrying not more than 36 passengers

305. In addition to complying with the specific provisions for fire integrity of bulkheads and decks of passenger ships, the minimum fire integrity of bulkheads and decks shall be as prescribed in tables T.E9.304.1 and T.E9.304.2.

306. The following requirements govern application of the tables:

- a. Tables T.E9.304.1 and T.E9.304.2 shall apply respectively to the bulkheads and decks separating adjacent spaces;
- b. For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories (1) to (11) below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30 % communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms shall be as prescribed in tables T.E9.304.1 and T.E9.304.2. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row in the tables.
- c. **Control stations Spaces containing emergency sources of power and lighting.**
  - c.1. Wheelhouse and chartroom. Spaces containing the ship's radio equipment. Fire control stations. Control room for propulsion machinery when located outside the machinery space. Spaces containing centralized fire alarm equipment.

#### d. **Corridors**

- d1. Passenger and crew corridors and lobbies.

#### e. **Accommodation spaces**

- e.1. Spaces as defined in Chapter E3 excluding corridors.

#### f. **Stairways**

- f.1. Interior stairways, lifts, totally enclosed emergency escape trunks, and escalators



|   |   |
|---|---|
| (other than those wholly contained within the machinery spaces) and enclosures thereto.   |   |
| f.2. In this connection, a stairway which is enclosed only at one level shall be regarded as part of the space from which it is not separated by a fire door.   |   |
| g. <b>Service spaces (low risk)</b>   |   |
| g.1. Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m <sup>2</sup> and drying rooms and laundries.   |   |
| h. <b>Machinery spaces of category A</b>  |   |
| h.1. Spaces as defined in regulation E3.131.  | o. In determining the applicable fire integrity standard of a boundary between two spaces within a main vertical zone or horizontal zone which is protected by an automatic sprinkler system complying with the provisions of the Fire Safety Systems Code or between such zones both of which are so protected, the lesser of the two values given in the tables shall apply. Where a zone with sprinklers and a zone without sprinklers meet within accommodation and service spaces, the higher of the two values given in the tables shall apply to the division between the zones. |
| i. <b>Other machinery spaces</b>  |   |
| i.1. Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces). Spaces as defined in regulation E3.130 excluding machinery spaces of category A.   | p. Continuous "B" class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.   |
| j. <b>Cargo spaces</b>  |   |
| j.1. All spaces used for cargo (including cargo oil tanks) and trunkways and hatchways to such spaces, other than special category spaces.  | q. External boundaries which are required to be of steel or other equivalent material may be pierced for the fitting of windows and sidescuttles provided that there is no requirement for such boundaries of passenger ships to have "A" class integrity. Similarly, in such boundaries which are not required to have "A" class integrity, doors may be constructed of materials which are to the satisfaction of the RBNA.   |
| k. <b>Service spaces (high risk)</b>  |   |
| k.1. Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and store-rooms having areas of 4 m <sup>2</sup> or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces.  | r. Saunas shall comply with paragraph E9.303.d.   |
| l. <b>Open decks</b>  |   |
| l.1. Open deck spaces and enclosed promenades having little or no fire risk. Enclosed promenades shall have no significant fire risk, meaning that furnishing shall be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings. Air spaces (the space outside superstructures and deckhouses). |   |
| m. <b>Special category and ro-ro spaces</b>   |   |
| m.1. Spaces as defined in regulation E3.141 and E3.146;   |   |
| n. In determining the applicable fire integrity standard of a boundary between two spaces within a main   |   |

**TABLE T.E9.304.1 - FIRE INTEGRITY OF BULKHEADS SEPARATING ADJACENT SPACES IN PASSENGER SHIPS CARRYING NOT MORE THAN 36 PASSENGERS**

| SPACES                                 | (1)     | (2)   | (3)     | (4)                | (5)                | (6)  | (7)     | (8)  | (9)             | (10) | (11)            |
|--|---------|-------|---------|--------------------|--------------------|------|---------|------|-----------------|------|-----------------|
| Control stations (1)                   | A-0 [c] | A-0   | A-60    | A-0                | A-15               | A-60 | A-15    | A-60 | A-60            | *    | A-60            |
| Corridors (2)                          |         | C [e] | B-0 [e] | A-0 [a]<br>B-0 [e] | B-0 [e]            | A-60 | A-0     | A-0  | A-15<br>A-0 [d] | *    | A-15            |
| Accommodation spaces (3)               |         |       | C [e]   | A-0 [a]<br>B-0 [e] | B-0 [e]            | A-60 | A-0     | A-0  | A-15<br>A-0 [d] | *    | A-30<br>A-0 [d] |
| Stairways (4)                          |         |       |         | A-0 [a]<br>B-0 [e] | A-0 [a]<br>B-0 [e] | A-60 | A-0     | A-0  | A-15<br>A-0 [d] | *    | A-15            |
| Service spaces (low risk) (5)          |         |       |         |                    | C [e]              | A-60 | A-0     | A-0  | A-0             | *    | A-0             |
| Machinery spaces of category A (6)     |         |       |         |                    |                    | *    | A-0     | A-0  | A-60            | *    | A-60            |
| Other machinery spaces (7)             |         |       |         |                    |                    |      | A-0 [b] | A-0  | A-0             | *    | A-0             |
| Cargo spaces (8)                       |         |       |         |                    |                    |      |         | *    | A-0             | *    | A-0             |
| Service spaces (high risk) (9)         |         |       |         |                    |                    |      |         |      | A-0 [b]         | *    | A-30            |
| Open decks (10)                        |         |       |         |                    |                    |      |         |      |                 | –    | A-0             |
| Special category and ro-ro spaces (11) |         |       |         |                    |                    |      |         |      |                 |      | A-0             |

**Note 1:** (to be applied to Tab 3 and Tab 4, as appropriate)

[a] : For clarification as to which applies, see [1.3.2] and [1.3.5].

[b] : Where spaces are of the same numerical category and letter “b” appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose, e.g. in category (9). A galley next to a galley does not require a bulkhead, but a galley next to a paint room requires an A-0 bulkhead.

[c] : Bulkheads separating the wheelhouse and chartroom from each other may have a B-0 rating. No fire rating is required for those partitions separating the navigation bridge and the safety centre when the latter is within the navigation bridge.

[d] : See items b) 3) and b) 4) of [1.3.4].

[e] : For the application of item b) of [1.3.1], B-0 and C, where appearing in Tab 3, are to be read as A-0.

[f] : Fire insulation need not be fitted if the machinery space in category (7), in the opinion of the Society, has little or no fire risk.

\* : Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material, but is not required to be of A class standard. However, where a deck, except in a category (10) space, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-extinguishing system is fitted.

For the application of item b) of [1.3.1], an asterisk, where appearing in Tab 4, except for categories (8) and (10), is to be read as A-0.

**TABLE T.E9.304.2 - FIRE INTEGRITY OF DECKS SEPARATING ADJACENT SPACES IN PASSENGER SHIPS CARRYING NOT MORE THAN 36 PASSENGERS**

| SPACE below                            | SPACE above |                 |                 |                 |      |      |          |      |      |      |                 |
|--|-------------|-----------------|-----------------|-----------------|------|------|----------|------|------|------|-----------------|
|  | (1)         | (2)             | (3)             | (4)             | (5)  | (6)  | (7)      | (8)  | (9)  | (10) | (11)            |
| Control stations (1)                   | A-0         | A-0             | A-0             | A-0             | A-0  | A-60 | A-0      | A-0  | A-0  | *    | A-30            |
| Corridors (2)                          | A-0         | *               | *               | A-0             | *    | A-60 | A-0      | A-0  | A-0  | *    | A-0             |
| Accommodation spaces (3)               | A-60        | A-0             | *               | A-0             | *    | A-60 | A-0      | A-0  | A-0  | *    | A-30<br>A-0 [d] |
| Stairways (4)                          | A-0         | A-0             | A-0             | *               | A-0  | A-60 | A-0      | A-0  | A-0  | *    | A-0             |
| Service spaces (low risk) (5)          | A-15        | A-0             | A-0             | A-0             | *    | A-60 | A-0      | A-0  | A-0  | *    | A-0             |
| Machinery spaces of category A (6)     | A-60        | A-60            | A-60            | A-60            | A-60 | *    | A-60 [f] | A-30 | A-60 | *    | A-60            |
| Other machinery spaces (7)             | A-15        | A-0             | A-0             | A-0             | A-0  | A-0  | *        | A-0  | A-0  | *    | A-0             |
| Cargo spaces (8)                       | A-60        | A-0             | A-0             | A-0             | A-0  | A-0  | A-0      | *    | A-0  | *    | A-0             |
| Service spaces (high risk) (9)         | A-60        | A-30<br>A-0 [d] | A-30<br>A-0 [d] | A-30<br>A-0 [d] | A-0  | A-60 | A-0      | A-0  | A-0  | *    | A-30            |
| Open decks (10)                        | *           | *               | *               | *               | *    | *    | *        | *    | *    | –    | A-0             |
| Special category and ro-ro spaces (11) | A-60        | A-15            | A-30<br>A-0 [d] | A-15            | A-0  | A-30 | A-0      | A-0  | A-30 | A-0  | A-0             |

**Note 1:** The notes to Tab 3 apply to this table as appropriate.

*Notes:* To be applied to both tables T.E90.304.1 and T.E9.304.2 as appropriate.

- a. For clarification as to which applies, see paragraphs E9.302 and E9.305.
- b. Where spaces are of the same numerical category and superscript b appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose, (e.g. in category (9)). A galley next to a galley does not require a bulkhead but a galley next to a paint room requires an "A-0" bulkhead.
- c. Bulkhead separating the wheelhouse and chartroom from each other may have a "B-0" rating. No fire rating is required for those partitions separating the navigation bridge and the safety centre when the latter is within the navigation bridge.
- d. For the application of paragraph E9.301.b1.2, "B-0" and "C", where appearing in table T.E9.304.1, shall be read as "A-0".
- e. Fire insulation need not be fitted if the machinery space in category (7), in the opinion of the RBNA, has little or no fire risk.
- f. Ships constructed before 1 July 2014 shall comply, as a minimum, with the previous requirements applicable at the time the ship was constructed, as specified in Chapter E1.

Note 1: Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material, but is not required to be of "A" class standard. However, where a deck, except in a category (10) space, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations shall be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-fighting system is fitted.

Note 2: For the application of paragraph E9.301.b, an asterisk, where appearing in table T.E9.304.2, except for categories (8) and (10), shall be read as "A-0".

#### 307. Protection of stairways and lifts in accommodation area

- a. Stairways shall be within enclosures formed of "A" class divisions, with positive means of closure at all openings, except that:
  - a.1. a stairway connecting only two decks need not be enclosed, provided the integrity of the deck is maintained by proper bulkheads or self-closing doors in one 'tween-deck space. When a stairway is closed in one 'tween-deck space, the stairway enclosure shall be

protected in accordance with the tables for decks in paragraphs E9.303 or E9.304.4; and

- a.2. stairways may be fitted in the open in a public space, provided they lie wholly within the public space.
- b. Lift trunks shall be so fitted as to prevent the passage of smoke and flame from one 'tween-deck to another and shall be provided with means of closing so as to permit the control of draught and smoke. Machinery for lifts located within stairway enclosures shall be arranged in a separate room, surrounded by steel boundaries, except that small passages for lift cables are permitted. Lifts which open into spaces other than corridors, public spaces, special category spaces, stairways and external areas shall not open into stairways included in the means of escape.

308. **Arrangement of cabin balconies:** on passenger ships constructed on or after 1 July 2008, non-load bearing partial bulkheads which separate adjacent cabin balconies shall be capable of being opened by the crew from each side for the purpose of fighting fires.

#### 309. Protection of atriums

- a. Atriums shall be within enclosures formed of "A" class divisions having a fire rating determined in accordance with tables T.E9.303.2 and T.E9.304.2, as applicable.
- b. Decks separating spaces within atriums shall have a fire rating determined in accordance with tables T.E9.303.2 and T.E9.304.2, as applicable.

#### 400. Cargo ships except tankers: methods of

401. One of the following methods of protection shall be adopted in accommodation and service spaces and control stations:

- a. **Method IC:** The construction of internal divisional bulkheads of non-combustible "B" or "C" class divisions generally without the installation of an automatic sprinkler, fire detection and fire alarm system in the accommodation and service spaces, except as required by regulation E7.305.b; or
- b. **Method IIC:** The fitting of an automatic sprinkler, fire detection and fire alarm system as required by regulation E7.305.c for the detection and extinction of fire in all spaces in which fire might be expected to originate, generally with no restriction on the type of internal divisional bulkheads; or
- c. **Method IIIC:** The fitting of a fixed fire detection and fire alarm system as required by regulation E7.305.d, in spaces in which a fire might be expected to originate, generally with no restriction

on the type of internal divisional bulkheads, except that in no case must the area of any accommodation space or spaces bounded by an "A" or "B" class division exceed 50 m<sup>2</sup>. Consideration may be given by the RBNA to increasing this area for public spaces.

- d. The requirements for the use of non-combustible materials in the construction and insulation of boundary bulkheads of machinery spaces, control stations, service spaces, etc., and the protection of the above stairway enclosures and corridors will be common to all three methods outlined in paragraph E9.401.a.

**402. Bulkheads within accommodation area:** bulkheads required to be "B" class divisions shall extend from deck to deck and to the shell or other boundaries. However, where a continuous "B" class ceiling or lining is fitted on both sides of the bulkhead, the bulkhead may terminate at the continuous ceiling or lining.

- a. **Method IC:** Bulkheads not required by this or other regulations for cargo ships to be "A" or "B" class divisions, shall be of at least "C" class construction.
- b. **Method IIC:** There shall be no restriction on the construction of bulkheads not required by this or other regulations for cargo ships to be "A" or "B" class divisions except in individual cases where "C" class bulkheads are required in accordance with table T.E9.403.1
- c. **Method IIIC:** There shall be no restriction on the construction of bulkheads not required for cargo ships to be "A" or "B" class divisions except that the area of any accommodation space or spaces bounded by a continuous "A" or "B" class division must in no case exceed 50 m<sup>2</sup>, except in individual cases where "C" class bulkheads are required in accordance with table T.E9.403.2. Consideration may be given by the RBNA to increasing this area for public spaces.

**403. Fire integrity of bulkheads and decks**

- a. In addition to complying with the specific provisions for fire integrity of bulkheads and decks of cargo ships, the minimum fire integrity of bulkheads and decks shall be as prescribed in tables T.E9.403.1 and T.E9.403.2.
- b. The following requirements shall govern application of the tables:
- b.1. . Tables T.E9.403.1 and T.E9.403.2 shall apply respectively to the bulkheads and decks separating adjacent spaces;
- b.2. . For determining the appropriate fire

integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories (1) to (11) below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this regulation, or where it is possible to assign two or more classifications to a space, it shall be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30 % communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms shall be as prescribed in tables T.E9.403.1 and T.E9.403.2. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row in the tables;

i. **(1) Control stations**

- i.1. Spaces containing emergency sources of power and lighting.
- i.2. Wheelhouse and chartroom.
- i.3. Spaces containing the ship's radio equipment.
- i.4. Fire control stations.
- i.5. Control room for propulsion machinery when located outside the machinery space.
- i.6. Spaces containing centralized fire alarm equipment.

ii. **(2) Corridors**

- i.1. corridors and lobbies.

iii. **(3) Accommodation spaces**

- i.1. Spaces as defined in Chapter E excluding corridors.

iv. **(4) Stairways**

- i.1. Interior stairway, lifts, totally enclosed emergency escape trunks, and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto. In this connection, a stairway which

is enclosed only at one level shall be regarded as part of the space from which it is not separated by a fire door.

spaces (the space outside superstructures and deckhouses).

v. **(5) Service spaces (low risk)**

- i.1. Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m<sup>2</sup> and drying rooms and laundries.

vi. **(6) Machinery spaces of category A**

- i.1. Spaces as defined in regulation E3.131.

vii. **(7) Other machinery spaces**

- i.1. Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces). Spaces as defined in regulation E3.130 excluding machinery spaces of category A.

viii. **(8) Cargo spaces**

- i.1. All spaces used for cargo (including cargo oil tanks) and trunkways and hatchways to such spaces.

ix. **(9) Service spaces (high risk)**

- i.1. Galleys, pantries containing cooking appliances, saunas, paint lockers and store-rooms having areas of 4 m<sup>2</sup> or more, spaces for the storage of flammable liquids, and workshops other than those forming part of the machinery spaces.

x. **(10) Open decks**

- i.1. Open deck spaces and enclosed promenades having little or no fire risk. To be considered in this category, enclosed promenades shall have no significant fire risk, meaning that furnishings shall be restricted to deck furniture. In addition, such spaces shall be naturally ventilated by permanent openings. Air

xi. **(11) Ro-ro and vehicle spaces**

- i.1. Ro-ro spaces as defined in regulation E3.141. Vehicle spaces as defined in regulation E3.149.

*Guidance [IACS UI SC45]*

***Fire integrity of bulkheads and decks:***

*The following spaces are considered to belong to the categories of spaces dealt with by E9.400 and E9.500, for the purpose of this regulation, as follows :*

*- Navigation equipment room (radar transmitter) and battery rooms (1): Control Stations*

*Note 1: Provision chambers are to be treated as store rooms*

*Note 2: Refrigerated provision chambers are to be Category 9 service spaces if thermally insulated with combustible materials, or Category 5 service spaces if thermally insulated with non-combustible materials.*

*End of guidance*



**TABLE T.E9.403.1: FIRE INTEGRITY OF BULKHEADS SEPARATING ADJACENT SPACES IN CARGO SHIPS**

| SPACES                             | (1)     | (2) | (3)     | (4)            | (5)            | (6)  | (7)     | (8)     | (9)     | (10) | (11)     |
|------------------------------------|---------|-----|---------|----------------|----------------|------|---------|---------|---------|------|----------|
| Control stations (1)               | A-0 [e] | A-0 | A-60    | A-0            | A-15           | A-60 | A-15    | A-60    | A-60    | *    | A-60     |
| Corridors (2)                      |         | C   | B-0     | A-0 [c]<br>B-0 | B-0            | A-60 | A-0     | A-0     | A-0     | *    | A-30     |
| Accommodation spaces (3)           |         |     | C [a,b] | A-0 [c]<br>B-0 | B-0            | A-60 | A-0     | A-0     | A-0     | *    | A-30     |
| Stairways (4)                      |         |     |         | A-0 [c]<br>B-0 | A-0 [c]<br>B-0 | A-60 | A-0     | A-0     | A-0     | *    | A-30     |
| Service spaces (low risk) (5)      |         |     |         |                | C              | A-60 | A-0     | A-0     | A-0     | *    | A-0      |
| Machinery spaces of category A (6) |         |     |         |                |                | *    | A-0     | A-0 [g] | A-60    | *    | A-60 [f] |
| Other machinery spaces (7)         |         |     |         |                |                |      | A-0 [d] | A-0     | A-0     | *    | A-0      |
| Cargo spaces (8)                   |         |     |         |                |                |      |         | *       | A-0     | *    | A-0      |
| Service spaces (high risk) (9)     |         |     |         |                |                |      |         |         | A-0 [d] | *    | A-30     |
| Open decks (10)                    |         |     |         |                |                |      |         |         |         | –    | A-0      |
| Ro-ro and vehicle spaces (11)      |         |     |         |                |                |      |         |         |         |      | * [h]    |

**Note 1:** (to be applied to Tab 5 and Tab 6, as appropriate)

[a] : No special requirements are imposed upon bulkheads in methods IIC and IIIC fire protection.

[b] : In case of method IIIC, B class bulkheads of B-0 rating are to be provided between spaces or groups of spaces of 50m<sup>2</sup> and over in area.

[c] : For clarification as to which applies, see [1.4.2] and [1.4.4].

[d] : Where spaces are of the same numerical category and letter “d” appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose, e.g. in category (9). A galley next to a galley does not require a bulkhead, but a galley next to a paint room requires an A-0 bulkhead.

[e] : Bulkheads separating the wheelhouse, chartroom and radio room from each other may have a B-0 rating.

[f] : An A-0 rating may be used if no dangerous goods are intended to be carried or if such goods are stowed not less than 3 m horizontally from such a bulkhead.

[g] : For cargo spaces in which dangerous goods are intended to be carried, Ch 4, Sec 11, [2.9] applies.

[h] : Bulkheads and decks separating ro-ro spaces are to be capable of being closed reasonably gastight and such divisions are to have A class integrity in so far as reasonable and practicable, if in the opinion of the Society it has little or no fire risk.

[i] : Fire insulation need not be fitted in the machinery space in category (7) if, in the opinion of the Society, it has little or no fire risk.

\*

: Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of A class standard. However where a deck, except an open deck, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-extinguishing system is fitted.

**TABLE T.E9403.2: FIRE INTEGRITY OF DECKS SEPARATING ADJACENT SPACES IN CARGO SHIPS**

| SPACE below                        | SPACE above |      |      |      |      |      |          |      |         |      |       |
|------------------------------------|-------------|------|------|------|------|------|----------|------|---------|------|-------|
|                                    | (1)         | (2)  | (3)  | (4)  | (5)  | (6)  | (7)      | (8)  | (9)     | (10) | (11)  |
| Control stations (1)               | A-0         | A-0  | A-0  | A-0  | A-0  | A-60 | A-0      | A-0  | A-0     | *    | A-60  |
| Corridors (2)                      | A-0         | *    | *    | A-0  | *    | A-60 | A-0      | A-0  | A-0     | *    | A-30  |
| Accommodation spaces (3)           | A-60        | A-0  | *    | A-0  | *    | A-60 | A-0      | A-0  | A-0     | *    | A-30  |
| Stairways (4)                      | A-0         | A-0  | A-0  | *    | A-0  | A-60 | A-0      | A-0  | A-0     | *    | A-30  |
| Service spaces (low risk) (5)      | A-15        | A-0  | A-0  | A-0  | *    | A-60 | A-0      | A-0  | A-0     | *    | A-0   |
| Machinery spaces of category A (6) | A-60        | A-60 | A-60 | A-60 | A-60 | *    | A-60 [i] | A-30 | A-60    | *    | A-60  |
| Other machinery spaces (7)         | A-15        | A-0  | A-0  | A-0  | A-0  | A-0  | *        | A-0  | A-0     | *    | A-0   |
| Cargo spaces (8)                   | A-60        | A-0  | A-0  | A-0  | A-0  | A-0  | A-0      | *    | A-0     | *    | A-0   |
| Service spaces (high risk) (9)     | A-60        | A-0  | A-0  | A-0  | A-0  | A-60 | A-0      | A-0  | A-0 [d] | *    | A-30  |
| Open decks (10)                    | *           | *    | *    | *    | *    | *    | *        | *    | *       | –    | *     |
| Ro-ro and vehicle spaces (11)      | A-60        | A-30 | A-30 | A-30 | A-0  | A-60 | A-0      | A-0  | A-30    | *    | * [h] |

**Note 1:** The notes to Tab 5 apply to this Table as appropriate.



- c. continuous "B" class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.
- d. external boundaries which are required to be of steel or other equivalent material may be pierced for the fitting of windows and sidescuttles provided that there is no requirement for such boundaries of cargo ships to have "A" class integrity. Similarly, in such boundaries which are not required to have "A" class integrity, doors may be constructed of materials which are to the satisfaction of the RBNA.
- e. saunas shall comply with paragraph E9.303.d.

**404. Protection of stairways and lift trunks in accommodation spaces, service spaces and control stations**

- a. Stairways which penetrate only a single deck shall be protected, at a minimum, at one level by at least "B-0" class divisions and self-closing doors. Lifts which penetrate only a single deck shall be surrounded by "A-0" class divisions with steel doors at both levels. Stairways and lift trunks which penetrate more than a single deck shall be surrounded by at least "A-0" class divisions and be protected by self-closing doors at all levels.
- b. On ships having accommodation for 12 persons or less, where stairways penetrate more than a single deck and where there are at least two escape routes direct to the open deck at every accommodation level, the "A-0" requirements of paragraph E9.404.1 may be reduced to "B-0".

*Guidance [IACS MSC/Circ.1120]*

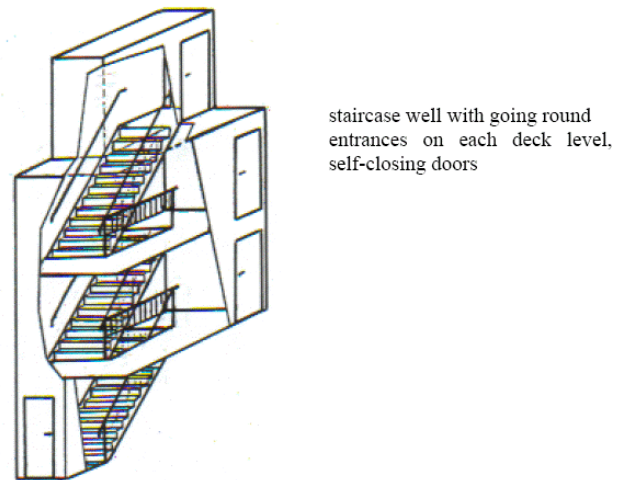
**403. Construction of protected stairways**

405. The required protection of stairways penetrating more than a single deck can be achieved by:

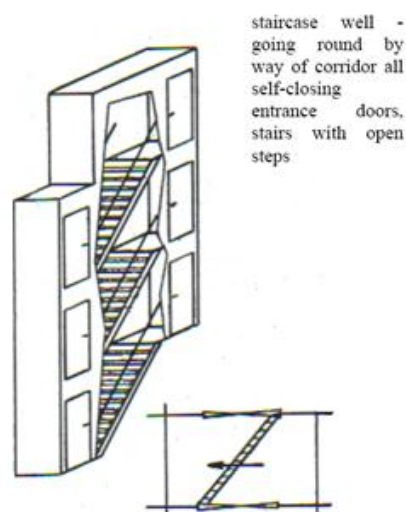
- a. a stairway enclosure allowing access from one stair to a superimposed stair within such enclosure, the entrances to which shall consist self-closing "A" class fire doors at each deck level (see figure F.E9.403.1); or
- b. stairway enclosure enclosing the stairs only, in combination with self-closing "A" class fire doors at each deck-level and at each end of a stair.
- c. No requirements apply to the stairs except that they shall be of steel frame structure or be made of equivalent material (see figure F.E9.403.2); or
- d. stairways that penetrate only one single deck shall be protected, at a minimum, at one level by at least "B-0" class division and self-closing doors (see

figure F.E9.403.3).

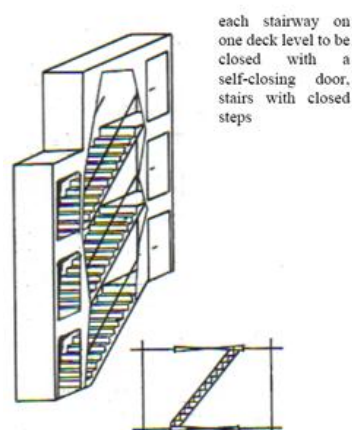
**FIGURE F.E9.403.1 - CONSTRUCTION OF PROTECTED STAIRWAYS OF CARGO SHIPS**



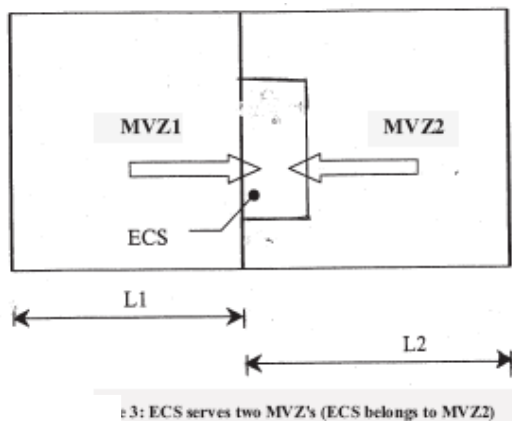
**FIGURE F.E9.403.2 - CONSTRUCTION OF PROTECTED STAIRWAYS OF CARGO SHIPS**



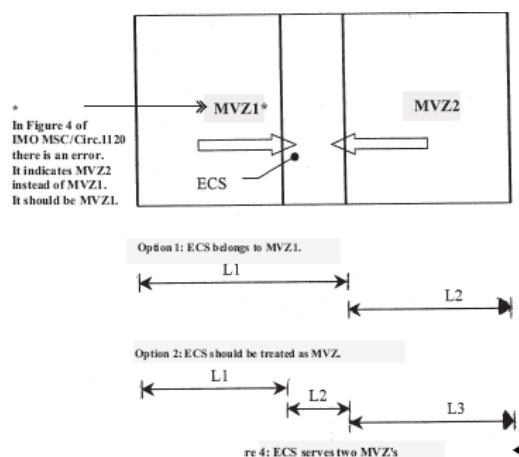
**FIGURE F.E9.403.3 - CONSTRUCTION OF PROTECTED STAIRWAYS OF CARGO SHIPS**



**FIGURE F.E9.403.4 - CONSTRUCTION OF PROTECTED STAIRWAYS OF CARGO SHIPS**



**FIGURE F.E9.403.5 - CONSTRUCTION OF PROTECTED STAIRWAYS OF CARGO SHIPS**



## 500. Tankers

See Part II, Title 32, Section 3, Chapter E, Subchapter E9, paragraph E.100.

## 600. Penetrations in fire-resisting divisions and prevention of heat transmission

601. Where "A" class divisions are penetrated, such penetrations shall be tested in accordance with the Fire Test Procedures Code, subject to the provisions of paragraph 4.1.1.5. In the case of ventilation ducts, paragraphs E9.901.b and E9.903.d apply. However, where a pipe penetration is made of steel or equivalent material having a thickness of 3mm or greater and a length of not less than 900 mm on each side of the Division, and there are no openings, testing is not required. Such penetrations shall be suitably insulated by extension of the insulation at the same level of the division.

### Guidance

#### *Penetrations in fire-resistive divisions and prevention of heat transmission:*

*This regulation shall be applied to all penetrations at the exterior boundaries of superstructures and deckhouses which are required to be "A-60" class insulated*

### End of guidance

602. Where "B" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements shall be made to ensure that the fire resistance is not impaired, subject to the provisions of E9.302. Pipes other than steel or copper that penetrate "B" class divisions shall be protected by either:

- a fire-tested penetration device suitable for the fire resistance of the division pierced and the type of pipe used; or
- a steel sleeve, having a thickness of not less than 1.8 mm and a length of not less than 900 mm for pipe diameters of 150 mm or more and not less than 600 mm for pipe diameters of less than 150 mm (preferably equally divided to each side of the division). The pipe shall be connected to the ends of the sleeve by flanges or couplings; or the clearance between the sleeve and the pipe shall not exceed 2.5 mm; or any clearance between pipe and sleeve shall be made tight by means of non-combustible or other suitable material.

603. Uninsulated metallic pipes penetrating "A" or "B" class divisions shall be of materials having a melting temperature which exceeds 950°C for "A-0" and 850°C for "B-0" class divisions.

604. In approving structural fire protection details, the RBNA shall have regard to the risk of heat transmission at intersections and terminal points of required thermal barriers. The insulation of a deck or bulkhead shall be carried past the penetration, intersection or terminal point for a distance of at least 450 mm in the case of steel and aluminium structures. If a space is divided with a deck or a bulkhead of "A" class standard having insulation of different values, the insulation with the higher value shall continue on the deck or bulkhead with the insulation of the lesser value for a distance of at least 450 mm.

### Guidance [IACS MSC/Circ.1120]

#### *Prevention of heat transmission by insulation and structural details for drainage*

*Details of measures to be adopted for avoiding heat transmission at intersections and terminal points of insulation of decks or bulkheads are given in figures F.E9.604.1 and F.E9.604.2 below.*

Alternative details may be accepted provided that the effectiveness of such design is verified by an appropriate test in the same manner as those specified in the FTP Code.

In the case where the lower part of insulation has to be cut for drainage, the construction shall be in accordance with the structural details as given in figure F.E9.604.3 below.

Prevention of heat transmission by insulation and structural details for drainage\*:

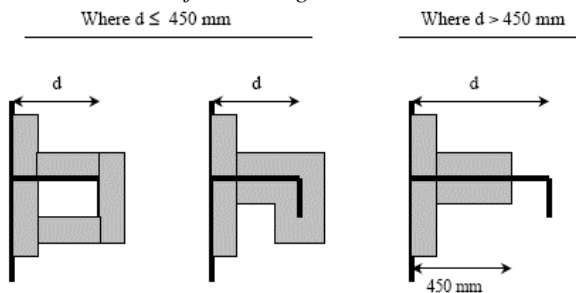


FIGURE F.E9.604.1

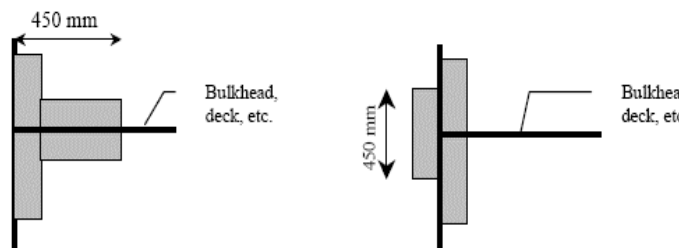
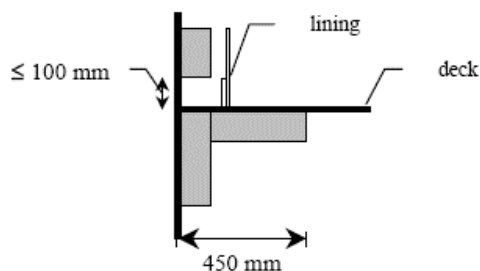


FIGURE F.E9.604.2



\*Note:  
d = Depth of stiffener on girder.

FIGURE F.E9.604.3

End of guidance

## 700. Protection of openings in fire-resisting divisions

### 701. Openings in "A" class divisions

- a. Except for hatches between cargo, special category, store, and baggage spaces, and between such spaces and the weather decks, openings shall be provided with permanently attached means of closing which

shall be at least as effective for resisting fires as the divisions in which they are fitted.

- b. The construction of doors and door frames in "A" class divisions, with the means of securing them when closed, shall provide resistance to fire as well as to the passage of smoke and flame equivalent to that of the bulkheads in which the doors are situated, this being determined in accordance with the Fire Test Procedures Code. Such doors and door frames shall be constructed of steel or other equivalent material. Watertight doors need not be insulated.

Guidance [IACS MSC/Circ.541]

### Fire testing of watertight doors

Watertight doors constructed in accordance with regulation SOLAS II-1/15 and fitted below the bulkhead deck that are required to be watertight need not be tested to the Fire Test Procedures (FTP) Code provided that the doors meet the requirements for water tightness in regulation SOLAS II-1/18.

### Doors in divisions of a higher standard and fire testing of watertight doors

Where required divisions are replaced by divisions of a higher standard, the door need only conform to the required division.

Watertight doors constructed in accordance with regulation SOLAS II-1/15 and fitted below the bulkhead deck that are required to be watertight need not be tested to the FTP Code, provided that the doors meet the requirements for water tightness in regulation SOLAS II-1/18.

Doors fitted above the bulkhead deck which are required to meet both the fire protection and watertight requirements (see MSC/Circ.541) shall be tested to the FTP Code.

End of guidance

- c. It shall be possible for each door to be opened and closed from each side of the bulkhead by one person only.
- d. Fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures other than power-operated watertight doors and those which are normally locked shall satisfy the following requirements:
  - d.1. the doors shall be self closing and be capable of closing with an angle of inclination of up to 3.5° opposing closure;

- d.2. the approximate time of closure for hinged fire doors shall be no more than 40 s and no less than 10 s from the beginning of their movement with the ship in upright position. The approximate uniform rate of closure for sliding doors shall be of no more than 0.2 m/s and no less than 0.1 m/s with the ship in upright position;
- d.3. the doors, except those for emergency escape trunks, shall be capable of remote release from the continuously manned central control station, either simultaneously or in groups, and shall be capable of release also individually from a position at both sides of the door. Release switches shall have an on-off function to prevent automatic resetting of the system;
- d.4. hold-back hooks not subject to central control station release are prohibited;
- d.5. a door closed remotely from the central control station shall be capable of being re-opened from both sides of the door by local control. After such local opening, the door shall automatically close again;
- d.6. indication shall be provided at the fire door indicator panel in the continuously manned central control station whether each door is closed;

**Guidance [IACS MSC/Circ.541]**

***Lift door indicators located in continuously manned central control station***

*Lift door indication signals shall meet the following:*

*.1 the signal showing that “A” class lift doors are in the closed position shall be activated only when the order to close the main fire doors has been given by the continuously manned central control station;*

*.2 when there are several lifts giving access to the same stairway, the lift door indicators located in the continuously manned central control station shall be capable of indicating that all the lift doors giving access to the same landing are properly closed. This indication shall be shown on the panel; and*

*.3 when an order to close the main fire doors is given, the same order shall also stop the lifts from operating by sending them to a pre-specified deck, to be determined on a case-by-case basis according to the ship’s design. In addition, those inside the lift shall be able to order the lift doors open while those outside the lift shall not be able to do so.*

*End of guidance*

- d.7. the release mechanism shall be so designed that the door will automatically close in the event of disruption of the control system or central power supply;
- d.8. local power accumulators for power operated doors shall be provided in the immediate vicinity of the doors to enable the doors to be operated at least ten times (fully opened and closed) after disruption of the control system or central power supply using the local controls;
- d.9. disruption of the control system or central power supply at one door shall not impair the safe functioning of the other doors;
- d.10. 4.1.1.4.10 remote released sliding or power operated doors shall be equipped with an alarm that sounds at least 5 s but no more than 10 s, after the door is released from the central control station and before the door begins to move and continues sounding until the door is completely closed;
- d.11. a door designed to re-open upon contacting an object in its path shall re-open not more than 1 m from the point of contact;
- d.12. double leaf doors equipped with a latch necessary for their fire integrity shall have a latch that is automatically activated by the operation of the doors when released by the system;
- d.13. doors giving direct access to special category spaces which are power operated and automatically closed need not be equipped with the alarms and remote release mechanisms required in paragraphs E9.701.a as relevant;
- d.14. the components of the local control system shall be accessible for maintenance and adjusting;
- d.15. power operated doors shall be provided with a control system of an approved type which shall be able to operate in case of fire and be in accordance with the Fire Test Procedures Code. This system shall satisfy the following requirements:
  - i. the control system shall be able to operate the door at the temperature of at least 200°C for at least 60 min, served by the power supply;
  - ii. the power supply for all other doors not subject to fire shall not be impaired; and



- iii. at temperatures exceeding 200°C the control system shall be automatically isolated from the power supply and shall be capable of keeping the door closed up to at least 945°C.
- e. In ships carrying not more than 36 passengers, where a space is protected by an automatic sprinkler fire detection and fire alarm system complying with the provisions of the Fire Safety Systems Code or fitted with a continuous "B" class ceiling, openings in decks not forming steps in main vertical zones nor bounding horizontal zones shall be closed reasonably tight and such decks shall meet the "A" class integrity requirements in so far as is reasonable and practicable in the opinion of the RBNA.
- f. The requirements for "A" class integrity of the outer boundaries of a ship shall not apply to glass partitions, windows and sidescuttles, provided that there is no requirement for such boundaries to have "A" class integrity in paragraph E9.701.c. The requirements for "A" class integrity of the outer boundaries of the ship shall not apply to exterior doors, except for those in superstructures and deckhouses facing life-saving appliances, embarkation and external assembly station areas, external stairs and open decks used for escape routes. Stairway enclosure doors need not meet this requirement.
- g. Except for watertight doors, weathertight doors (semi-watertight doors), doors leading to the open deck and doors which need to be reasonably gastight, all "A" class doors located in stairways, public spaces and main vertical zone bulkheads in escape routes shall be equipped with a self-closing hose port. The material, construction and fire resistance of the hose port shall be equivalent to the door into which it is fitted, and shall be a 150 mm square clear opening with the door closed and shall be inset into the lower edge of the door, opposite the door hinges or, in the case of sliding doors, nearest the opening.
- h. Where it is necessary that a ventilation duct passes through a main vertical zone division, a fail-safe automatic closing fire damper shall be fitted adjacent to the division. The damper shall also be capable of being manually closed from each side of the division. The operating position shall be readily accessible and be marked in red light-reflecting colour. The duct between the division and the damper shall be of steel or other equivalent material and, if necessary, insulated to comply with the requirements of E9.601. The damper shall be fitted on at least one side of the division with a visible indicator showing whether the damper is in the open position.

## 702. Openings in "B" class divisions

- a. Doors and door frames in "B" class divisions and means of securing them shall provide a method of closure which shall have resistance to fire equivalent to that of the divisions, this being determined in accordance with the Fire Test Procedures Code except that ventilation openings may be permitted in the lower portion of such doors. Where such opening is in or under a door, the total net area of any such opening or openings shall not exceed 0.05 m<sup>2</sup>. Alternatively, a non combustible air balance duct routed between the cabin and the corridor, and located below the sanitary unit, is permitted where the cross sectional area of the duct does not exceed 0.05 m<sup>2</sup>. All ventilation openings shall be fitted with a grill made of non-combustible material. Doors shall be non combustible.
- b. Cabin doors in "B" class divisions shall be of a self closing type. Hold back hooks are not permitted.
- c. The requirements for "B" class integrity of the outer boundaries of a ship shall not apply to glass partitions, windows and sidescuttles. Similarly, the requirements for "B" class integrity shall not apply to exterior doors in superstructures and deckhouses. For ships carrying not more than 36 passengers, the RBNA may permit the use of combustible materials in doors separating cabins from the individual interior sanitary spaces such as showers.
- d. In ships carrying not more than 36 passengers, where an automatic sprinkler system complying with the provisions of the Fire Safety Systems Code is fitted:
  - d.1. openings in decks not forming steps in main vertical zones nor bounding horizontal zones shall be closed reasonably tight and such decks shall meet the "B" class integrity requirements in so far as is reasonable and practicable in the opinion of the RBNA; and openings in corridor bulkheads of "B" class materials shall be protected in accordance with the provisions of paragraph 2.2.2.

## 703. Windows and sidescuttles

- a. Windows and sidescuttles in bulkheads within accommodation and service spaces and control stations other than those to which the provisions of paragraphs E9.701.a and E9.701.b apply shall be so constructed as to preserve the integrity requirements of the type of bulkheads in which they are fitted, this being determined in accordance with the Fire Test Procedures Code.

- b. Notwithstanding the requirements of tables T.E9.303.1, T.E9.303.2, T.E9.304.1 and T.E9.304.2, windows and sidescuttles in bulkheads separating accommodation and service spaces and control stations from weather shall be constructed with frames of steel or other suitable material. The glass shall be retained by a metal glazing bead or angle.
- c. Windows facing life saving appliances, embarkation and assembly stations, external stairs and open decks used for escape routes, and windows situated below liferaft and escape slide embarkation areas shall have fire integrity as required in table T.E1.303.1. Where automatic dedicated sprinkler heads are provided for windows, "A-0" windows may be accepted as equivalent. To be considered under this paragraph, the sprinkler heads shall either be:
  - d. dedicated heads located above the windows, and installed in addition to the conventional ceiling sprinklers; or
  - e. 4conventional ceiling sprinkler heads arranged such that the window is protected by an average application rate of at least 5 l/min per square metre and the additional window area is included
- f. in the calculation of the area of coverage.
- g. Windows located in the ship's side below the lifeboat embarkation area shall have fire integrity at least equal to "A-0" class.

#### 704. Doors in fire-resisting divisions in cargo ships

- a. The fire resistance of doors shall be equivalent to that of the division in which they are fitted, this being determined in accordance with the Fire Test Procedures Code. Doors and door frames in "A" class divisions shall be constructed of steel. Doors in "B" class divisions shall be non combustible. Doors fitted in boundary bulkheads of machinery spaces of category A shall be reasonably gastight and self-closing. In ships constructed according to method IC, the RBNA may permit the use of combustible materials in doors separating cabins from individual interior sanitary accommodation such as showers.

#### Guidance

##### **Doors in divisions of a higher standard**

*Where required divisions are replaced by divisions of a higher standard, the door need only conform to the required division.*

##### **Doors in fire-resisting divisions of cargo ships**

*Steel or equivalent material is acceptable for the construction of doors and door frames in "A" class divisions.*

#### End of guidance

705. Doors required to be self closing shall not be fitted with hold-back hooks. However, hold-back arrangements fitted with remote release devices of the fail safe type may be utilized.

706. In corridor bulkheads, ventilation openings may be permitted in and under the doors of cabins and public spaces. Ventilation openings are also permitted in "B" class doors leading to lavatories, offices, pantries, lockers and store-rooms. Except as permitted below, the openings shall be provided only in the lower half of a door. Where such an opening is in or under a door, the total net area of any such opening or openings shall not exceed 0.05 m<sup>2</sup>. Alternatively, a non combustible air balance duct routed between the cabin and the corridor, and located below the sanitary unit, is permitted where the cross sectional area of the duct does not exceed 0.05 m<sup>2</sup>. Ventilation openings, except those under the door, shall be fitted with a grill made of non combustible material.

707. Watertight doors need not be insulated.

#### **800. Protection of openings in machinery spaces boundaries and cargo space boundaries**

801. Application:

The provision of this paragraph shall apply to machinery spaces of category A and, where the RBNA considers it desirable, to other machinery spaces.

#### **802. Protection of openings in machinery space boundaries**

- a. The number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces shall be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the ship.
- b. Skylights shall be of steel and shall not contain glass panels.
- c. Means of control shall be provided for closing power-operated doors or actuating release mechanisms on doors other than power-operated watertight doors. The controls shall be located outside the space concerned, where they will not be cut off in the event of fire in the space it serves.
- d. In passenger ships, the means of control required in paragraph E9.601.d shall be situated at one control position or grouped in as few positions as possible, to the satisfaction of the RBNA. Such positions



shall have safe access from the open deck.

e. In passenger ships, doors, other than power-operated watertight doors, shall be so arranged that positive closure is assured in case of fire in the space by power-operated closing arrangements or by the provision of self-closing doors capable of closing against an inclination of 3.5° opposing closure, and having a fail-safe hold-back arrangement, provided with a remotely operated release device. Doors for emergency escape trunks need not be fitted with a fail-safe hold-back facility and a remotely operated release device.

f. Windows shall not be fitted in machinery space boundaries. However, this does not preclude the use of glass in control rooms within the machinery spaces.

### 803. Protection of cargo space boundaries

a. In passenger ships carrying more than 36 passengers, the boundary bulkheads and decks of special category and ro-ro spaces shall be insulated to "A-60" class standard. However, where a category (5), (9) or (10) space, as defined in E9.303, is on one side of the division, the standard may be reduced to "A-0". Where fuel oil tanks are below a special category space, the integrity of the deck between such spaces may be reduced to "A-0" standard.

b. In passenger ships carrying not more than 36 passengers, the boundary bulkheads of special category spaces shall be insulated as required for category (11) spaces in table T.E9.302.3 and the horizontal boundaries as required for category (11) spaces in table T.E9.302.3.

c. In passenger ships carrying not more than 36 passengers, the boundary bulkheads and decks of closed and open ro-ro spaces shall have a fire integrity as required for category (8) spaces in table T.E9.304.1 and the horizontal boundaries as required for category (8) spaces in table T.E9.304.2.

d. In passenger ships, indicators shall be provided on the navigation bridge which shall indicate when any fire door leading to or from the special category spaces is closed.

e. In tankers, for the protection of cargo tanks carrying crude oil and petroleum products having a flashpoint not exceeding 60°C, materials readily rendered ineffective by heat shall not be used for valves, fittings, tank opening covers, cargo vent piping, and cargo piping so as to prevent the spread of fire to the cargo.

## 900. Ventilation systems

### 901. Duct and dampers

a. Ventilation ducts shall be of non combustible material. However, short ducts, not generally exceeding 2 m in length and with a free cross sectional area not exceeding 0.02 m<sup>2</sup>, need not be non combustible subject to the following conditions:

a.1. the ducts are made of a material which has low flame spread characteristics;

a.2. the ducts are only used at the end of the ventilation device; and

a.3. the ducts are not situated less than 600 mm, measured along the duct, from an opening in an "A" or "B" class division, including continuous "B" class ceiling.

b. The following arrangements shall be tested in accordance with the Fire Test Procedures Code:

b.1. fire dampers, including their relevant means of operation; and

b.2. duct penetrations through "A" class divisions. However, the test is not required where steel sleeves are directly joined to ventilation ducts by means of riveted or screwed flanges or by welding.

#### Guidance

#### [IACS UI SC175]

##### *Ventilation systems:*

*Combustible gaskets in flanged ventilation duct connections are not permitted within 600 mm of an opening in an "A" or "B" class divisions and in ducts required to be of "A" class construction.*

#### [IACS UI SC99]

##### *Flexible bellows of combustible materials:*

*Flexible bellows of combustible material may be used for connecting fans to the ducting in air conditioning room.*

#### End of guidance

### 902. Arrangement of ducts

a. The ventilation systems for machinery spaces of category A, vehicle spaces, ro-ro spaces, galleys, special category spaces and cargo spaces shall, in general, be separated from each other and from the ventilation systems serving other spaces, except that the galley ventilation systems on cargo ships of less than 4,000 gross tonnage and in passenger ships carrying not more than 36 passengers need not be completely separated, but may be served by

separate ducts from a ventilation unit serving other spaces. In any case, an automatic fire damper shall be fitted in the galley ventilation duct near the ventilation unit. Ducts provided for the ventilation of machinery spaces of category A, galleys, vehicle spaces, ro-ro spaces or special category spaces shall not pass through accommodation spaces, service spaces or control stations unless they comply with the conditions specified in paragraphs E9.902.a or E9.902.b below:

- a.1. the ducts are constructed of steel having a thickness of at least 3 mm and 5 mm for ducts the widths or diameters of which are up to and including 300 mm and 760 mm and over respectively and, in the case of such ducts, the widths or diameters of which are between 300 mm and 760 mm having a thickness obtained by interpolation;
- a.2. the ducts are suitably supported and stiffened;
- a.3. the ducts are fitted with automatic fire dampers close to the boundaries penetrated; and
- a.4. the ducts are insulated to "A-60" class standard from the machinery spaces, galleys, vehicle spaces, ro-ro spaces or special category spaces to a point at least 5 m beyond each fire damper;
- a.5. or
- a.6. the ducts are constructed of steel in accordance with paragraphs E9.902.a.1 and E9.902.a.2; and
- a.7. the ducts are insulated to "A-60" class standard throughout the accommodation spaces, service spaces or control stations, except that penetrations of main zone divisions shall also comply with the requirements of paragraph E9.701.a.

b. Ducts provided for ventilation to accommodation spaces, service spaces or control stations shall not pass through machinery spaces of category A, galleys, vehicle spaces, ro-ro spaces or special category spaces unless they comply with the conditions specified in paragraphs E9.902.b.1 to E9.902.b.3 or E9.902.b.a and E9.902.b.2 below:

- b.1. the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro space or special category space are constructed of steel in accordance with paragraphs E9.902.b.1 and E9.902.b.2 ;
- b.2. automatic fire dampers are fitted close to the boundaries penetrated; and

- b.3. the integrity of the machinery space, galley, vehicle space, ro-ro space or special category space boundaries is maintained at the penetrations; or
- b.4. the ducts, where they pass through a machinery space of category A, galley, vehicle space, ro-ro space or special category space, are constructed of steel in accordance with paragraphs E9.902.b.1 and E9.902.b.2 ; and
- b.5. the ducts are insulated to "A-60" standard within the machinery space, galley, vehicle space, ro-ro space or special category space;
- b.6. except that penetrations of main zone divisions shall also comply with the requirements of paragraph E9.701.d.15.g.

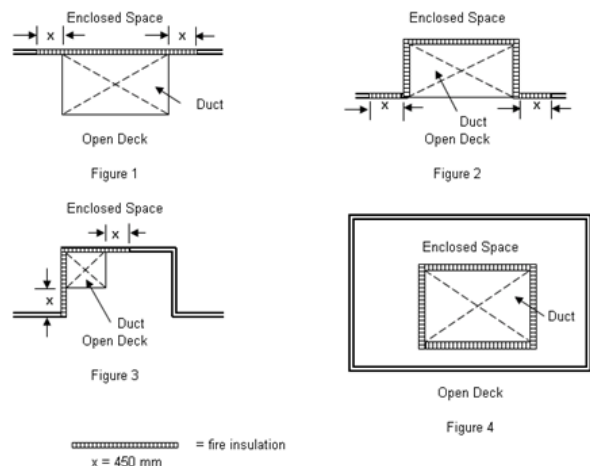
#### Guidance

#### Separation of galley exhausts ducts from spaces [IACS UI SC221]

*With respect to the application of E9.902.a E9.702.b and E9.902.b for determining fire insulation for trunks and ducts which pass through an enclosed space, the term "pass through" pertains to the part of the trunk/duct contiguous to the enclosed space.*

*The following sketches are given as examples:*

#### Examples of galley ducts contiguous to enclosed space



#### [IACS UI SC192]

#### Arrangement of galley ducts SOLAS:

*The expression "in any case" means, in this context, "for any duct section" and this sentence actually applies to arrangements where a ventilation unit serves some spaces and a galley by a separate duct, as permitted for cargo ships of less than 4,000 gross tonnage and for passenger ships carrying not more than 36 passengers.*

*End of guidance*

**903. Details of duct penetrations**

- a. Where a thin plated duct with a free cross-sectional area equal to, or less than, 0.02 m<sup>2</sup> passes through "A" class bulkheads or decks, the opening shall be lined with a steel sheet sleeve having a thickness of at least 3 mm and a length of at least 200 mm, divided preferably into 100 mm on each side of the bulkhead or, in the case of the deck, wholly laid on the lower side of the decks pierced. Where ventilation ducts with a free cross-sectional area exceeding 0.02 m<sup>2</sup> pass through "A" class bulkheads or decks, the opening shall be lined with a steel sheet sleeve. However, where such ducts are of steel construction and pass through a deck or bulkhead, the ducts and sleeves shall comply with the following:
  - a.1. The sleeves shall have a thickness of at least 3 mm and a length of at least 900 mm. When passing through bulkheads, this length shall be divided preferably into 450 mm on each side of the bulkhead. These ducts, or sleeves lining such ducts, shall be provided with fire insulation. The insulation shall have at least the same fire integrity as the bulkhead or deck through which the duct passes; and
  - a.2. Ducts with a free cross sectional area exceeding 0.075 m<sup>2</sup> shall be fitted with fire dampers in addition to the requirements of paragraph E9.903.c first paragraph above. The fire damper shall operate automatically, but shall also be capable of being closed manually from both sides of the bulkhead or deck. The damper shall be provided with an indicator which shows whether the damper is open or closed. Fire dampers are not required, however, where ducts pass through spaces surrounded by "A" class divisions, without serving those spaces, provided those ducts have the same fire integrity as the divisions which they pierce. Fire dampers shall be easily accessible. Where they are placed behind ceilings or linings, these ceilings or linings shall be provided with an inspection door on which a plate reporting the identification number of the fire damper is provided. The fire damper identification number shall also be placed on any remote controls required.
- b. Ventilation ducts with a free cross-sectional area exceeding 0.02m<sup>2</sup> passing through "B" class bulkheads shall be lined with steel sheet sleeves of 900 mm in length, divided preferably into 450 mm on each side of the bulkheads unless the duct is of steel for this length.

*Guidance*

***Fire dampers in ventilation ducts: [IACS UI SC64]***

*Ducts or pipes with free sectional area of 0,075m<sup>2</sup> or less need not be fitted with fire damper at their passage through Class "A" divisions provided that the requirements of E9.702.a, E9.702.b, E9.701, E9.603 and E9.904.c are complied with.*

***[MSC/Circ.1120]***

***Type of means of closing***

*Manual closing may be achieved by mechanical means of release or by remote operation of the fire damper by means of a fail-safe electrical switch or pneumatic release (spring-loaded, etc.) on both sides of the division.*

*End of guidance*

**904. Ventilation systems for passenger ships carrying more than 36 passengers**

- a. The ventilation system of a passenger ship carrying more than 36 passengers shall be in compliance with the following additional requirements.
- b. In general, the ventilation fans shall be so disposed that the ducts reaching the various spaces remain within the main vertical zone.
- c. Where ventilation systems penetrate decks, precautions shall be taken, in addition to those relating to the fire integrity of the deck required by paragraphs E9.601 and E4.100f, to reduce the likelihood of smoke and hot gases passing from one 'tween deck space to another through the system. In addition to insulation requirements contained in E7.400 vertical ducts shall, if necessary, be insulated as required by the appropriate tables T.E9.303.1 and T.E9.303.2.

*Guidance*

***Ventilation system penetrating decks [MSC/Circ.1120]***

*A duct, irrespective of its cross section, serving more than one 'tween deck shall be fitted, near the penetration of each deck served, with a fire or smoke damper.*

*Such dampers shall close automatically by means of a fusible link or other suitable device, and manually from the deck in which the passage of smoke, due to a fire in the deck immediately below which is served by the same duct, will be avoided.*

*Where, within a main vertical zone, a fan serves more than one 'tween deck through separate ducts, each of these dedicated to a single 'tween deck, each duct shall be provided with a manually operated smoke damper fitted close to the fan.*

*End of guidance*

- d. Except in cargo spaces, ventilation ducts shall be constructed of the following materials:
- d.1. ducts not less than 0.075 m<sup>2</sup> in free cross-sectional area and all vertical ducts serving more than a single 'tween-deck space shall be constructed of steel or other equivalent material;
  - d.2. ducts less than 0.075 m<sup>2</sup> in free cross-sectional area other than the vertical ducts referred to in paragraph E6.400, shall be constructed of non combustible materials. Where such ducts penetrate "A" or "B" class divisions, due regard shall be given to ensuring the fire integrity of the division; and
  - d.3. short lengths of duct, not in general exceeding 0.02m<sup>2</sup> in free cross-sectional area nor 2 m in length, need not be non combustible provided that all of the following conditions are met:
  - d.4. the duct is constructed of a material which has low flame spread characteristics;
  - d.5. the duct is used only at the terminal end of the ventilation system; and
  - d.6. the duct is not located closer than 600mm measured along its length to a penetration of an "A" or "B" class division, including continuous "B" class ceilings.
- e. Stairway enclosures shall be ventilated and served by an independent fan and duct system which shall not serve any other spaces in the ventilation systems.
- f. Exhaust ducts shall be provided with hatches for inspection and cleaning. The hatches shall be located near the fire dampers.

**905. Exhaust ducts from galley ranges: Requirements for passenger ships carrying more than 36 passengers**

- a. Exhaust ducts from galley ranges shall meet the requirements of paragraphs E9.100 and E9.200 and shall be fitted with:
- b. a grease trap readily removable for cleaning unless an alternative approved grease removal system is fitted;
- c. a fire damper located in the lower end of the duct which is automatically and remotely operated, and, in addition, a remotely operated fire damper located in the upper end of the duct;

- d. a fixed means for extinguishing a fire within the duct;
- e. remote-control arrangements for shutting off the exhaust fans and supply fans, for operating the fire dampers mentioned in paragraph E6.500 and for operating the fire-extinguishing system, which shall be placed in a position close to the entrance to the galley. Where a multi-branch system is installed, a remote means located with the above controls shall be provided to close all branches exhausting through the same main duct before an extinguishing medium is released into the system; and
- f. suitably located hatches for inspection and cleaning.

*Guidance*

***Location of hatches for inspection and cleaning in galley range ducts***

*One hatch shall be provided close to the exhaust fan.*

*In the galley exhaust duct, the grease will accumulate more in the lower end. Therefore, hatches shall be fitted also in this part of the duct.*

***Galley exhaust duct: [IACS UISC108]***

*The requirements to exhaust ducts from galley ranges in which grease or fat is likely to accumulate will apply to all exhaust ducts from galley ranges.*

***Exhaust duct from galley ranges: [IACS UI SC118]***

*Fire dampers required by Reg. II-2/9.7.5.1 and 9.7.5.2.1 do not need to pass the fire test in Res. A.754(18), but shall be of steel and capable of stopping the draught. The requirements to A class applies only to the part of the duct outside of the galley.*

*End of guidance*

**g. Requirements for cargo ships and passenger ships carrying not more than 36 passenger**

- g.1. Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges shall be constructed of "A" class divisions. Each exhaust duct shall be fitted with:
- g.2. a grease trap readily removable for cleaning;
- g.3. a fire damper located in the lower end of the duct;
- g.4. arrangements, operable from within the galley, for shutting off the exhaust fans; and

- g.5. fixed means for extinguishing a fire within the duct.

*Guidance*

**Galley exhaust duct:** [IACS UI SC106]

*Grease trap, fire damper, fan shut-off and fixed fire extinguishing are only required when a galley exhaust duct passes through accommodation spaces or spaces containing combustible materials. The term spaces containing combustible materials will normally apply to all spaces in accommodation.*

*End of guidance*

**E10. FIRE FIGHTING**

**100. Purpose**

101. The purpose of this regulation is to suppress and swiftly extinguish a fire in the space of origin. For this purpose, the following functional requirements shall be met:

- a. fixed fire-extinguishing systems shall be installed, having due regard to the fire growth potential of the protected spaces; and
- b. fire-extinguishing appliances shall be readily available.

**200. Water supply systems**

201. Ships shall be provided with fire pumps, fire mains, hydrants and hoses complying with the applicable requirements of this regulation.

**202. Fire mains and hydrants: general**

Materials readily rendered ineffective by heat shall not be used for fire mains and hydrants unless adequately protected. The pipes and hydrants shall be so placed that the fire hoses may be easily coupled to them. The arrangement of pipes and hydrants shall be such as to avoid the possibility of freezing. Suitable drainage provisions shall be provided for fire main piping. Isolation valves shall be installed for all open deck fire main branches used for purposes other than fire fighting. In ships where deck cargo may be carried, the positions of the hydrants shall be such that they are always readily accessible and the pipes shall be arranged as far as practicable to avoid risk of damage by such cargo.

**203. Ready availability of water supply**

The arrangements for the ready availability of water supply shall be:

a. **in passenger ships:**

- a.1. of 1,000 gross tonnage and upwards such that at least one effective jet of water is immediately available from any hydrant in an interior location and so as to ensure the continuation of the output of water by the automatic starting of one required fire pump;
- a.2. of less than 1,000 gross tonnage by automatic start of at least one fire pump or by remote starting from the navigation bridge of at least one fire pump. If the pump starts automatically or if the bottom valve cannot be opened from where the pump is remotely started, the bottom valve shall always be kept open; and
- a.3. if fitted with periodically unattended machinery spaces the RBNA shall determine provisions for fixed water fire-extinguishing arrangement for such spaces equivalent to those required for normally attended machinery spaces;

b. **in cargo ships:**

- b.1. to the satisfaction of the RBNA; and
- b.2. with a periodically unattended machinery space or when only one person is required on watch, there shall be immediate water delivery from the fire main system at a suitable pressure, either by remote starting of one of the main fire pumps with remote starting from the navigation bridge and fire control station, if any, or permanent pressurization of the fire main system by one of the main fire pumps, except that the RBNA may waive this requirement for cargo ships of less than 1,600 gross tonnage if the fire pump starting arrangement in the machinery space is in an easily accessible position.

**204. Diameter of fire mains**

- a. The diameter of the fire main and water service pipes shall be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously, except that in the case of cargo ships the diameter need only be sufficient for the discharge of 140 m<sup>3</sup>/h.

**205. Isolating valves and relief valves**

- a. Isolating valves to separate the section of the fire main within the machinery space containing the main fire pump or pumps from the rest of the fire



main shall be fitted in an easily accessible and tenable position outside the machinery spaces. The fire main shall be so arranged that when the isolating valves are shut all the hydrants on the ship, except those in the machinery space referred to above, can be supplied with water by another fire pump or an emergency fire pump. The emergency fire pump, its seawater inlet, and suction and delivery pipes and isolating valves shall be located outside the machinery space. If this arrangement cannot be made, the sea-chest may be fitted in the machinery space if the valve is remotely controlled from a position in the same compartment as the emergency fire pump and the suction pipe is as short as practicable. Short lengths of suction or discharge piping may penetrate the machinery space, provided they are enclosed in a substantial steel casing or are insulated to "A-60" class standards. The pipes shall have substantial wall thickness, but in no case less than 11 mm, and shall be welded except for the flanged connection to the sea inlet valve.

#### Guidance

#### [IACS UI SC121]

#### Fire Pump Isolation Requirements

Any part of the fire main routed through a category A machinery space must be fitted with isolating valves outside of the space. The arrangements of the fire mains must allow for fire water from the fire pumps or emergency fire pump to reach all hydrants outside of the isolated space. Isolation requirements of SOLAS Reg. II-2/10.2.1.4.1 are not applicable to the piping from fire pumps located in other spaces other than category A machinery spaces.

#### [IACS UI SC245]

Suction and discharge piping of emergency fire pumps, which are run through the machinery space (SOLAS II-2/10.2.1.4.1)

.1 "the valve" in second sentence means "sea inlet valve";

.2 in cases where suction or discharge piping penetrating machinery spaces are enclosed in a substantial steel casing, or are insulated to "A-60" class standards, it is not necessary to enclose or insulate "distance pieces", "sea inlet valves" and "sea-chests" to "A-60" class standards; For this purpose, the discharge piping means piping between the emergency fire pump and the isolating valve;

.3 the method for insulating pipes to "A-60" class standards is that they are to be covered/protected in a practical manner by insulation material which is approved

as a part of "A-60" class divisions in accordance with the FTP Code; and

.4 where the sea inlet valve is in the machinery space, the valve shall not be a fail-close type. Where the sea inlet valve is in the machinery space and is not a fail-open type, measures shall be taken so that the valve can be opened in the event of fire, e.g. control piping, actuating devices and/or electric cables with fire resistant protection equivalent to "A-60" class standards.

.5 In cases where main fire pumps are provided in compartments outside machinery spaces and where the emergency fire pump suction or discharge piping penetrates such compartments, the above interpretation is to be applied to the piping.

#### End of guidance

- b. A valve shall be fitted to serve each fire hydrant so that any fire hose may be removed while the fire pumps are in operation.
- c. Relief valves shall be provided in conjunction with fire pumps if the pumps are capable of developing a pressure exceeding the design pressure of the water service pipes, hydrants and hoses. These valves shall be so placed and adjusted as to prevent excessive pressure in any part of the fire main system.
- d. In tankers, isolation valves shall be fitted in the fire main at the poop front in a protected position and on the tank deck at intervals of not more than 40 m to preserve the integrity of the fire main system in case of fire or explosion.

#### 206. Number and position of hydrants

- a. The number and position of hydrants shall be such that at least two jets of water not emanating from the same hydrant, one of which shall be from a single length of hose, may reach any part of the ship normally accessible to the passengers or crew while the ship is being navigated and any part of any cargo space when empty, any ro-ro space or any vehicle space in which latter case the two jets shall reach any part of the space, each from a single length of hose. Furthermore, such hydrants shall be positioned near the accesses to the protected spaces.

#### Guidance

#### Location of hydrant in machinery spaces

At least one hydrant with hose, nozzle and coupling wrench shall be provided in machinery spaces of category A.

#### End of guidance

- b. In addition to the requirements in paragraph E10.206.a. passenger ships shall comply with the



following:

- c. in the accommodation, service and machinery spaces, the number and position of hydrants shall be such that the requirements of paragraph E10.206.a. may be complied with when all watertight doors and all doors in main vertical zone bulkheads are closed; and
- d. where access is provided to a machinery space of category A at a low level from an adjacent shaft tunnel, two hydrants shall be provided external to, but near the entrance to, that machinery space. Where such access is provided from other spaces, in one of those spaces two hydrants shall be provided near the entrance to the machinery space of category A. Such provision need not be made where the tunnel or adjacent spaces are not part of the escape route.

#### 207. Pressure at hydrants

With the two pumps simultaneously delivering water through the nozzles specified in paragraph E3.100, with the quantity of water as specified in paragraph E2.300, through any adjacent hydrants, the following minimum pressures shall be maintained at all hydrants:

##### a. for passenger ships:

- a.1. 4.000 gross tonnage and upwards 0,40 N/mm<sup>2</sup>
- a.2. less than 4.000 gross tonnage 0,30 N/mm<sup>2</sup>

##### b. for cargo ships:

- b.1. 6,000 gross tonnage and upwards 0,27 N/mm<sup>2</sup>
- b.2. less than 6,000 gross tonnage 0,25 N/mm<sup>2</sup>

- c. the maximum pressure at any hydrant shall not exceed that at which the effective control of a fire hose can be demonstrated.

#### 208. International shore connection

- a. Ships of 500 gross tonnage and upwards shall be provided with at least one international shore connection complying with the Fire Safety Systems Code.
- b. Facilities shall be available enabling such a connection to be used on either side of the ship.

#### 209. Fire pumps

##### 210. Pumps accepted as fire pumps

Sanitary, ballast, bilge or general service pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil and that if they are subject

to occasional duty for the transfer or pumping of oil fuel, suitable change-over arrangements are fitted.

##### 211. Number of fire pumps

Ships shall be provided with independently driven fire pumps as follows:

##### a. in passenger ships of:

- a.1. 4.000 gross tonnage and upwards at least three
- a.2. less than 4.000 gross tonnage at least two

##### b. in cargo ships of:

- b.1. 1.000 gross tonnage and upwards at least two
- b.2. less than 1.000 gross tonnage at least two power-driven pumps, one of which shall be independently driven.

##### 213. Arrangement of fire pumps and fire mains

- a. **Fire pumps:** The arrangement of sea connections, fire pumps and their sources of power shall be as to ensure that:

- a.1. in passenger ships of 1,000 gross tonnage and upwards, in the event of a fire in any one compartment, all the fire pumps will not be put out of action; and
- a.2. in passenger ships of less than 1,000 gross tonnage and in cargo ships, if a fire in any one compartment could put all the pumps out of action, there shall be an alternative means consisting of an emergency fire pump complying with the provisions of the Fire Safety Systems Code with its source of power and sea connection located outside the space where the main fire pumps or their sources of power are located.

##### Guidance

##### [IACS UI SC163]

##### *Emergency fire pumps in cargo ships - sea suction and sea valve (Interpretation):*

*The emergency fire pump shall as a minimum comply with paragraph 2.2.1.1 of FSS Code, Ch.12.*

*Where a fixed water-based fire extinguishing system installed for the protection of the machinery space in accordance with SOLAS regulation II-2/Reg.10.4.1.1, is supplied by the emergency fire pump, the emergency fire pump capacity shall be adequate to supply the fixed fire extinguishing system at the required pressure plus two jets of water.*

*The capacity of the two jets shall in any case be calculated by that emanating from the biggest nozzle size available*

onboard from the following table (\*note), but shall not be less than 25 m<sup>3</sup>/h.

**TABLE T.E10.213.1**

| <i>Capacity of single jet</i> |                      |                        |
|-------------------------------|----------------------|------------------------|
| <i>Pressure at Hydrant</i>    | <i>Nozzle size</i>   |                        |
|                               | 16 mm                | 19 mm                  |
| 0.27 N/mm <sup>2</sup>        | 16 m <sup>3</sup> /h | 23.5 m <sup>3</sup> /h |

\*note: When selecting the biggest nozzle size available onboard, the nozzles located in the space where the main fire pumps are located can be excluded.

**[IACS UI SC162]**

**Fire Pump Isolation Requirements:**

*Unless the two main fire pumps, their sea suction and the fuel supply or source of power for each pump are situated within compartments separated at least by A-O divisions, so that a fire in any one compartment will not render both fire pumps inoperable, an emergency fire pump shall be fitted.*

*An arrangement in which one main fire pump is located in a compartment having more than one bulkhead or deck adjacent to the compartment containing the other main fire pump shall also require an emergency fire pump.*

**[IACS UI SC165]**

**Electrical cables for the emergency fire pump:**

*So far as is reasonably practicable the electrical cables to the emergency fire pump are not to pass through the machinery spaces containing the main fire pumps and their source(s) of power and/or prime mover(s). Where the ship arrangements are such that the cables have to pass through these spaces the cables are to be of a fire resistant type and specially protected against mechanical damage, e.g. run in heavy gauge pipe.*

*They are to be of a fire resistant type, where they pass through other high fire risk areas.*

*End of guidance*

**b. Requirements for the space containing the emergency fire pump**

- b.1. Location of the space** The space containing the fire pump shall not be contiguous to the boundaries of machinery spaces of category A or those spaces containing main fire pumps. Where this is not practicable, the common bulkhead between the two spaces shall be insulated to a standard of structural fire protection equivalent to that required for a control station.

*Guidance*

**[IACS UI SC114]**

**Emergency Fire Pump Access**

**Interpretation:**

*When a single access to the emergency fire pump room is through another space adjoining a machinery space of category A or the spaces containing the main fire pumps, class A-60 boundary is required between that other space and the machinery space of category A or the spaces containing the main fire pumps.*

*End of guidance*

- b.2. Access to the emergency fire pump** No direct access shall be permitted between the machinery space and the space containing the emergency fire pump and its source of power. When this is impracticable, the RBNA may accept an arrangement where the access is by means of an airlock with the door of the machinery space being of "A-60" class standard and the other door being at least steel, both reasonably gastight, self-closing and without any hold-back arrangements. Alternatively, the access may be through a watertight door capable of being operated from a space remote from the machinery space and the space containing the emergency fire pump and unlikely to be cut off in the event of fire in those spaces. In such cases, a second means of access to the space containing the emergency fire pump and its source of power shall be provided.
- b.3. Ventilation of the emergency fire pump space** Ventilation arrangements to the space containing the independent source of power for the emergency fire pump shall be such as to preclude, as far as practicable, the possibility of smoke from a machinery space fire entering or being drawn into that space.

- c. Additional pumps for cargo ships** In addition, in cargo ships where other pumps, such as general service, bilge and ballast, etc., are fitted in a machinery space, arrangements shall be made to ensure that at least one of these pumps, having the capacity and pressure required by paragraphs E10.207.d. and E10.214.c, is capable of providing water to the fire main.

**Connection of a pump to fire main**

This does not force designers to choose pumps with capacity and pressure characteristics other than that being optimal for the service intended, just to make their connection to the fire main possible, provided the required number and capacity of fire pumps are already fitted.

## 214. Capacity of fire pumps

- a. **Total capacity of required fire pumps** The required fire pumps shall be capable of delivering for fire-fighting purposes a quantity of water, at the pressure specified in paragraph E10.207, as follows:
- b. **pumps in passenger ships:** the quantity of water is not less than two thirds of the quantity required to be dealt with by the bilge pumps when employed for bilge pumping; and
- c. **pumps in cargo ships, other than any emergency pump:** the quantity of water is not less than four thirds of the quantity required under regulation II-1/21 to be dealt with by each of the independent bilge pumps in a passenger ship of the same dimension when employed in bilge pumping, provided that in no cargo ship need the total required capacity of the fire pumps exceed 180 m<sup>3</sup>/h.
- d. **Capacity of each fire pump** Each of the required fire pumps (other than any emergency pump required in paragraph E10.213.a for cargo ships) shall have a capacity not less than 80% of the total required capacity divided by the minimum number of required fire pumps but in any case not less than 25 m<sup>3</sup>/h, and each such pump shall in any event be capable of delivering at least the two required jets of water. These fire pumps shall be capable of supplying the fire main system under the required conditions. Where more pumps than the minimum of required pumps are installed, such additional pumps shall have a capacity of at least 25 m<sup>3</sup>/h and shall be capable of delivering at least the two jets of water required in paragraph E10.206.a.

## 215. Fire hoses and nozzles

### 216. General specifications

- a. Fire hoses shall be of non-perishable material approved by the RBNA and shall be sufficient in length to project a jet of water to any of the spaces in which they may be required to be used. Each hose shall be provided with a nozzle and the necessary couplings. Hoses specified in this chapter as "fire hoses" shall, together with any necessary fittings and tools, be kept ready for use in conspicuous positions near the water service hydrants or connections. Additionally, in interior locations in passenger ships carrying more than 36 passengers, fire hoses shall be connected to the hydrants at all times. Fire hoses shall have a length of at least 10 m, but not more than:
  - e. 15 m in machinery spaces;
  - f. 20 m in other spaces and open decks; and
  - g. 25 m for open decks on ships with a maximum

breadth in excess of 30 m.

- h. Unless one hose and nozzle is provided for each hydrant in the ship, there shall be complete interchangeability of hose couplings and nozzles.

### 217. Number and diameter of fire hoses

- a. Ships shall be provided with fire hoses, the number and diameter of which shall be to the satisfaction of the RBNA.
- b. In passenger ships, there shall be at least one fire hose for each of the hydrants required by paragraph E10.206 and these hoses shall be used only for the purposes of extinguishing fires or testing the fire-extinguishing apparatus at fire drills and surveys.

#### c. In cargo ships:

- c.1. **of 1,000 gross tonnage and upwards,** the number of fire hoses to be provided shall be one for each 30 m length of the ship and one spare, but in no case less than five in all. This number does not include any hoses required in any engine-room or boiler room. The RBNA may increase the number of hoses required so as to ensure that hoses in sufficient number are available and accessible at all times, having regard to the type of ship and the nature of trade in which the ship is employed. Ships carrying dangerous goods in accordance with regulation 19 shall be provided with three hoses and nozzles, in addition to those required above; and
- c.2. **of less than 1,000 gross tonnage,** the number of fire hoses to be provided shall be calculated in accordance with the provisions of paragraph above. However, the number of hoses shall in no case be less than three.

### 218. Size and types of nozzles

- a. For the purposes of this chapter, standard nozzle sizes shall be 12 mm, 16 mm and 19 mm or as near thereto as possible. Larger diameter nozzles may be permitted at the discretion of the RBNA.
- b. For accommodation and service spaces, a nozzle size greater than 12 mm need not be used.
- c. For machinery spaces and exterior locations, the nozzle size shall be such as to obtain the maximum discharge possible from two jets at the pressure mentioned in paragraph E10.207 from the smallest pump, provided that a nozzle size greater than 19 mm need not be used.
- d. 4 Nozzles shall be of an approved dual-purpose type (i.e. spray/jet type) incorporating a shutoff.

### 300. Portable fire extinguishers

301. **Type and design:** Portable fire extinguishers shall comply with the requirements of the Fire Safety Systems Code.

### 302. Arrangement of fire extinguishers

- a. Accommodation spaces, service spaces and control stations shall be provided with portable fire extinguishers of appropriate types and in sufficient number to the satisfaction of the RBNA. Ships of 1,000 gross tonnage and upwards shall carry at least five portable fire extinguishers.
- b. One of the portable fire extinguishers intended for use in any space shall be stowed near the entrance to that space.
- c. Carbon dioxide fire extinguishers shall not be placed in accommodation spaces. In control stations and other spaces containing electrical or electronic equipment or appliances necessary for the safety of the ship, fire extinguishers shall be provided whose extinguishing media are neither electrically conductive nor harmful to the equipment and appliances.
- d. Fire extinguishers shall be situated ready for use at easily visible places, which can be reached quickly and easily at any time in the event of a fire, and in such a way that their serviceability is not impaired by the weather, vibration or other external factors. Portable fire extinguishers shall be provided with devices which indicate whether they have been used.

### 303. Spare charges

- a. Spare charges shall be provided for 100% of the first ten extinguishers and 50% of the remaining fire extinguishers capable of being recharged on board. Not more than sixty total spare charges are required. Instructions for recharging shall be carried on board.
- b. 3.3.2 For fire extinguishers which cannot be recharged on board, additional portable fire extinguishers of the same quantity, type, capacity and number as determined in paragraph E10.303.a above shall be provided in lieu of spare charges.

### 400. Fixed fire-extinguishing systems

#### 401. Types of fixed fire-extinguishing systems

- a. A fixed fire-extinguishing system required by paragraph E10.500 below may be any of the following systems:
  - a.1. a fixed gas fire-extinguishing system complying with the provisions of the Fire Safety Systems Code;

- a.2. a fixed high-expansion foam fire-extinguishing system complying with the provisions of the Fire Safety Systems Code; and
- a.3. a fixed pressure water-spraying fire-extinguishing system complying with the provisions of the Fire Safety Systems Code.
- a.4. Where a fixed fire-extinguishing system not required by this chapter is installed, it shall meet the requirements of the relevant regulations of this chapter and the Fire Safety Systems Code.
- a.5. Fire-extinguishing systems using Halon 1211, 1301, and 2402 and perfluorocarbons shall be prohibited.
- a.6. In general, the RBNA shall not permit the use of steam as a fire-extinguishing medium in fixed fire-extinguishing systems. Where the use of steam is permitted by the RBNA, it shall be used only in restricted areas as an addition to the required fire-extinguishing system and shall comply with the requirements of the Fire Safety System Code.

#### 402. Closing appliances for fixed gas fire-extinguishing systems

Where a fixed gas fire-extinguishing system is used, openings which may admit air to, or allow gas to escape from, a protected space shall be capable of being closed from outside the protected space.

#### 403. Storage rooms of fire-extinguishing medium

When the fire-extinguishing medium is stored outside a protected space, it shall be stored in a room which is located behind the forward collision bulkhead, and is used for no other purposes. Any entrance to such a storage room shall preferably be from the open deck and shall be independent of the protected space. If the storage space is located below deck, it shall be located no more than one deck below the open deck and shall be directly accessible by a stairway or ladder from the open deck. Spaces which are located below deck or spaces where access from the open deck is not provided shall be fitted with a mechanical ventilation system designed to take exhaust air from the bottom of the space and shall be sized to provide at least 6 air changes per hour. Access doors shall open outwards, and bulkheads and decks, including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjacent enclosed spaces shall be gastight. For the purpose of the application of tables E9.303.1 and E9.303.2, E9.304.1 to E9.304.2, E9.403.1 to E9.403.2, E9.502.1 to E9.502.2, such storage rooms shall be treated as fire control stations



**Guidance [IACS MSC.1/Circ.1239]**

**Storage of fire-extinguishing media forward the cargo holds**

*1 Fire-extinguishing media protecting the cargo holds may be stored in a room located forward of the cargo holds, but aft of the collision bulkhead or aft its imaginary vertical line, provided that both the local manual release mechanism and remote control(s) for the release of the media are fitted, and that the latter is of robust construction or so protected as to remain operable in case of fire in the protected spaces. The remote controls shall be placed in the accommodation area in order to facilitate their ready accessibility by the crew. The capability to release different quantities of fire-extinguishing media into different cargo holds so protected shall be included in the remote release arrangement.*

**[IACS MSC/Circ.1120]**

**Storage rooms for fire-extinguishing media**

*The following requirements are applicable only for the storage rooms for fire-extinguishing media of fixed gas fire-extinguishing systems:*

- .1 the storage room shall be used for no other purpose (last part of the first sentence);*
- .2 if the storage space is located below deck, it shall be located no more than one deck below the open deck and shall be directly accessible by a stairway or ladder from the open deck (third sentence);*
- .3 spaces which are located below deck or spaces where access from the open deck is not provided, shall be fitted with a mechanical ventilation system designed to take exhaust air from the bottom of the space and shall be sized to provide at least six air changes per hour (fourth sentence); and*
- .4 access doors shall open outwards, and bulkheads and decks including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjacent enclosed spaces shall be gas tight (fifth sentence).*

**[IACS UI SC204]**

**Storage of fire-extinguishing media forward the cargo holds**

*Fire-extinguishing media protecting the cargo holds may be stored in a room located forward the cargo holds, but aft of the collision bulkhead, provided that both the local manual release mechanism and remote control(s) for the release of the media are fitted, and the latter is of robust construction or so protected as to remain operable in case of fire in the protected spaces. The remote controls shall be placed in the accommodation area in order to facilitate their ready accessibility by the crew. The capability to*

*release different quantities of fire-extinguishing media into different cargo holds so protected shall be included in the remote release arrangement.*

*End of guidance*

**404. Water pumps for other fire-extinguishing systems**

Pumps, other than those serving the fire main, required for the provision of water for fire-extinguishing systems required by this chapter, their sources of power and their controls shall be installed outside the space or spaces protected by such systems and shall be so arranged that a fire in the space or spaces protected will not put any such system out of action.

**500. Fire-extinguishing arrangements in machinery spaces**

**501.** Machinery spaces containing oil-fired boilers or oil fuel units

a. Machinery spaces of category A containing oil-fired boilers or oil fuel units shall be provided with any one of the fixed fire-extinguishing systems in paragraph E4.401 In each case, if the engine-room and boiler room are not entirely separate, or if fuel oil can drain from the boiler room into the engine-room, the combined engine and boiler rooms shall be considered as one compartment.

**b. Additional fire-extinguishing arrangements**

- b.1. There shall be in each boiler room or at an entrance outside of the boiler room at least one portable foam applicator unit complying with the provisions of the Fire Safety Systems Code.
- b.2. There shall be at least two portable foam extinguishers or equivalent in each firing space in each boiler room and in each space in which a part of the oil fuel installation is situated. There shall be not less than one approved foam type extinguisher of at least 135 l capacity or equivalent in each boiler room. These extinguishers shall be provided with hoses on reels suitable for reaching any part of the boiler room. In the case of domestic boilers of less than 175 kW an approved foam type extinguisher of at least 135 l capacity is not required.
- b.3. In each firing space there shall be a receptacle containing at least 0.1 m<sup>3</sup> sand, sawdust impregnated with soda, or other approved dry material, along with a suitable shovel for spreading the material. An approved portable extinguisher may be substituted as an alternative.

## 502. Machinery spaces containing internal combustion machinery

- a. Fixed fire-extinguishing systems
- b. Machinery spaces of category A containing internal combustion machinery shall be provided with one of the fixed fire-extinguishing systems in paragraph E4.401.
- c. Additional fire-extinguishing arrangements
  - c.1. There shall be at least one portable foam applicator unit complying with the provisions of the Fire Safety Systems Code.
  - c.2. There shall be in each such space approved foam-type fire extinguishers, each of at least 45 l capacity or equivalent, sufficient in number to enable foam or its equivalent to be directed on to any part of the fuel and lubricating oil pressure systems, gearing and other fire hazards. In addition, there shall be provided a sufficient number of portable foam extinguishers or equivalent which shall be so located that no point in the space is more than 10 m walking distance from an extinguisher and that there are at least two such extinguishers in each such space. For smaller spaces of cargo ships the RBNA may consider relaxing this requirement.

### Guidance

#### **Relaxation of fire-extinguishing equipment for cargo ships**

*A relaxation for cargo ships shall be accepted as follows: The 45 l foam type extinguisher or its equivalent may be arranged outside of the space concerned.*

### End of guidance

## 503. Machinery spaces containing steam turbines or enclosed steam engines

- a. Fixed fire-extinguishing systems  
In spaces containing steam turbines or enclosed steam engines used for main propulsion or other purposes having in the aggregate a total output of not less than 375 kW, one of the fire-extinguishing systems specified in paragraph 4.1 shall be provided if such spaces are periodically unattended.
- b. Additional fire-extinguishing arrangements
  - b.1. There shall be approved foam fire extinguishers, each of at least 45 l capacity or equivalent, sufficient in number to enable foam or its equivalent to be directed on to any part of the pressure lubrication system, on to any part of the casings enclosing pressure-lubricated parts of the turbines, engines or associated gearing, and any other

fire hazards. However, such extinguishers shall not be required if protection, at least equivalent to that required by this subparagraph, is provided in such spaces by a fixed fire-extinguishing system fitted in compliance with paragraph E4.100.

- b.2. There shall be a sufficient number of portable foam extinguishers or equivalent which shall be so located that no point in the space is more than 10 m walking distance from an extinguisher and that there are at least two such extinguishers in each such space, except that such extinguishers shall not be required in addition to any provided in compliance with paragraph E10.501.b above

**504. Other machinery spaces:** Where, in the opinion of the RBNA, a fire hazard exists in any machinery space for which no specific provisions for fire-extinguishing appliances are prescribed in paragraphs E5.100, E5.200 and E5.300, there shall be provided in, or adjacent to, that space such a number of approved portable fire extinguishers or other means of fire extinction as the RBNA may deem sufficient.

## 505. Additional requirements for passenger ships

- a. In passenger ships carrying more than 36 passengers, each machinery space of category A shall be provided with at least two suitable water fog applicators.
- b. A water fog applicator might consist of a metal L-shaped pipe, the long limb being about 2 m in length, capable of being fitted to a fire hose, and the short limb being about 250 mm in length, fitted with a fixed water fog nozzle or capable of being fitted with a water spray nozzle.

## 506. Fixed local application fire-fighting systems

- a. Paragraph E10.506 shall apply to passenger ships of 500 gross tonnage and above and cargo ships of 2,000 gross tonnage and above.
- b. Machinery spaces of category A above 500 m<sup>3</sup> in volume shall, in addition to the fixed fire-extinguishing system required in paragraph E5.101, be protected by an approved type of fixed water based or equivalent local application fire-fighting system, based on the guidelines developed by the RBNA. In the case of periodically unattended machinery spaces, the fire-extinguishing system shall have both automatic and manual release capabilities. In the case of continuously manned machinery spaces, the fire-extinguishing system is only required to have a manual release capability.
  - b.1. Refer to the Guidelines for the approval of fixed water-based local application fire-fighting systems for use in category A



machinery spaces (MSC/Circ.913).

- b.2. 5.6.3 Fixed local application fire-extinguishing systems are to protect areas such as the following without the necessity of engine shutdown, personnel evacuation, or sealing of the spaces:
- b.3. the fire hazard portions of internal combustion machinery used for the ship's main propulsion and power generation;
- b.4. boiler fronts;
- b.5. the fire hazard portions of incinerators; and
- b.6. purifiers for heated fuel oil.

- c. 5.6.4 Activation of any local application system shall give a visual and distinct audible alarm in the protected space and at continuously manned stations. The alarm shall indicate the specific system activated. The system alarm requirements described within this paragraph are in addition to, and not a substitute for, the detection and fire alarm system required elsewhere in this chapter.

#### Guidance

#### [IACS UI SC176]

##### **Fixed Local Application Fire Extinguishing System**

*Any installation of nozzles on board shall reflect the arrangement successfully tested in accordance with MSC/Circ.913. If a specific arrangement of the nozzles is foreseen on board, deviating from the one tested as per MSC/circ. 913, it can be accepted provided such arrangement additionally passes fire tests based on the scenarios of this circular.*

*The automatic release shall be activated by a detection system capable of reliably identifying the local zones. Consideration shall be given to prevent accidental release.*

*Oil fired equipment, such as inert gas generators and thermal oil heaters shall also be protected by this system, if located in machinery spaces above 500m3.*

*Boiler fronts shall be interpreted as the boiler burner location irrespective of the boiler design.*

*Grouped visual and audible alarms, as well as indication of the activated zone, shall be provided in each protected space, in the engine control room and in the wheelhouse. Audible alarms may use a single tone.*

#### [IACS UI SC198]

##### **Sections in local application fire extinguishing systems**

*"In multi-engine installations, at least two sections shall be arranged."*

#### [IACS MSC/Circ.1120]

##### **Definition of areas to be protected by local application systems (internal combustion machinery)**

*Hot surfaces such as exhaust pipes without insulation or with insulation likely to be removed frequently for maintenance and high-pressure fuel oil systems installed nearby the hot surfaces shall be protected.*

*The term "insulation likely to be removed frequently" means insulation fitted in accordance with the requirements of Part II, Title 11, Section 6, Subchapter G1, but which might not be secured firmly because it may be removed frequently for periodic maintenance, such as pipes between cylinders and the exhaust manifold.*

*For typical diesel engines, the area on top of the engine, fuel oil injection pumps and turbo chargers shall be protected. Where the fuel oil injection pumps are located in a sheltered position such as under the steel platform, the pump need not be protected by the system.*

##### **Definition of areas to be protected by local application systems (boiler fronts)**

*The area around the burner(s) without insulation or with insulation likely to be removed frequently for maintenance shall be protected. The term "insulation likely to be removed frequently" means insulation fitted in accordance with the requirements of Part II, Title 11, Section 6, Subchapter G1, but which might not be secured firmly because it may be removed frequently for periodic maintenance.*

*Oil-fired inert gas generators shall be also protected in the same manner.*

##### **Definition of areas to be protected by local application systems (incinerators)**

*The area around the burner(s) without insulation or with insulation likely to be removed frequently for maintenance shall be protected. The term "insulation likely to be removed frequently" means insulation fitted in accordance with the requirements of Part II, Title 11, Section 6, Subchapter G1, but which might not be secured firmly because it may be removed frequently for periodic maintenance.*

#### End of guidance

##### **600. Fire-extinguishing arrangements in control stations, accommodation and service spaces**

##### **601. Sprinkler systems in passenger ships**

- a. Passenger ships carrying more than 36 passengers shall be equipped with an automatic sprinkler, fire detection and fire alarm system of an approved type complying with the requirements of the Fire Safety Systems Code in all control stations, accommodation and service spaces, including corridors and stairways. Alternatively, control

stations, where water may cause damage to essential equipment, may be fitted with an approved fixed fire-extinguishing system of another type. Spaces having little or no fire risk such as voids, public toilets, carbon dioxide rooms and similar spaces need not be fitted with an automatic sprinkler system.

- b. In passenger ships carrying not more than 36 passengers, when a fixed smoke detection and fire alarm system complying with the provisions of the Fire Safety Systems Code is provided only in corridors, stairways and escape routes within accommodation spaces, an automatic sprinkler system shall be installed in accordance with regulation E6.503.b.

#### 602. Sprinkler systems for cargo ships

In cargo ships in which method IIC specified in regulation E9.401.a2 is adopted, an automatic sprinkler, fire detection and fire alarm system shall be fitted in accordance with the requirements in E6.502

#### 603. Spaces containing flammable liquid

##### Paint lockers shall be protected by:

- a carbon dioxide system, designed to give a minimum volume of free gas equal to 40% of the gross volume of the protected space;
- a dry powder system, designed for at least 0.5 kg powder/m<sup>3</sup>
- a water spraying or sprinkler system, designed for 5 l/m<sup>2</sup> min. Water spraying systems may be connected to the fire main of the ship; or
- a system providing equivalent protection, as determined by the RBNA.
- In all cases, the system shall be operable from outside the protected space.

604. **Flammable liquid lockers** shall be protected by an appropriate fire-extinguishing arrangement approved by the RBNA.

605. **For lockers of a deck area of less than 4 m<sup>2</sup>**, which do not give access to accommodation spaces, a portable carbon dioxide fire extinguisher sized to provide a minimum volume of free gas equal to 40% of the gross volume of the space may be accepted in lieu of a fixed system. A discharge port shall be arranged in the locker to allow the discharge of the extinguisher without having to enter into the protected space. The required portable fire extinguisher shall be stowed adjacent to the port. Alternatively, a port or hose connection may be provided to facilitate the use of fire main water.

#### 606 Deep-fat cooking equipment

- Deep-fat cooking equipment shall be fitted with the following:
- an automatic or manual fire-extinguishing system tested to an international standard acceptable to the RBNA;\*
- Refer to the recommendations by the International RBNA for Standardization, in particular publication ISO 15371:2000, Fire-extinguishing systems for protection of galley deep fat cooking equipment.
- a primary and backup thermostat with an alarm to alert the operator in the event of failure of either thermostat;
- arrangements for automatically shutting off the electrical power upon activation of the fire-extinguishing system;
- an alarm for indicating operation of the fire-extinguishing system in the galley where the equipment is installed; and
- controls for manual operation of the fire-extinguishing system which are clearly labelled for ready use by the crew

##### Guidance

##### Automatic sprinkler systems

*Paragraph 2.3.3.2 of Chapter 8 of the FSS Code - the nominal area is defined as being the gross, horizontal projection of the area to be covered.*

*Instructions for carrying out of periodic tests shall be exhibited prominently at the control station.*

##### Deep fat fryer standards

*Deep fat fryers are included in the Marine Equipment Directive and on UK ships shall be so approved and wheel marked*

##### End of guidance

#### 700. Fire-extinguishing arrangements in cargo spaces

701. Fixed gas fire-extinguishing systems for general cargo

- Except as provided for in paragraph E6.200, the cargo spaces of passenger ships of 1.000 gross tonnage and upwards shall be protected by a fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of the Fire Safety Systems Code or by a fixed high-expansion foam fire-extinguishing system which gives equivalent protection.
- Where it is shown to the satisfaction of the RBNA that a passenger ship is engaged on voyages of such

short duration that it would be unreasonable to apply the requirements of paragraph E6.101 and also in ships of less than 1.000 gross tonnage, the arrangements in cargo spaces shall be to the satisfaction of the RBNA, provided that the ship is fitted with steel hatch covers and effective means of closing all ventilators and other openings leading to the cargo spaces.

- c. Except for ro-ro and vehicle spaces, cargo spaces on cargo ships of 2.000 gross tonnage and upwards shall be protected by a fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of the Fire Safety Systems Code, or by a fire-extinguishing system which gives equivalent protection.

*Guidance*

**[IACS UI SC48]**

*Fire protection arrangements in cargo spaces:*

*Interpretation:*

*Ships of less than 2.000 tons gross tonnage carrying petroleum products having a flash point exceeding 60C (c.c. test) are not required to be fitted with a fixed fire extinguishing system.*

*End of guidance*

- d. The RBNA may exempt from the requirements of paragraphs E6.104 and E6.200, cargo spaces of any cargo ship if constructed, and solely intended for, the carriage of ore, coal, grain, unseasoned timber, non-combustible cargoes or cargoes which, in the opinion of the RBNA, constitute a low fire risk. Such exemptions may be granted only if the ship is fitted with steel hatch covers and effective means of closing all ventilators and other openings leading to the cargo spaces. When such exemptions are granted, the RBNA shall issue an Exemption Certificate, irrespective of the date of construction of the ship concerned, in accordance with regulation I/12(a)(vi), and shall ensure that the list of cargoes the ship is permitted to carry is attached to the Exemption Certificate.

*Guidance*

#### **Fixed gas fire-extinguishing systems for general cargo**

1 Non-combustible cargoes, such as materials listed in paragraph 1 of Annex 2 to the FTP Code, need not be mentioned on exemption certificates issued under regulation II-2/10.7.1.4.

2 The document of compliance with regulation II-2/19 may not permit more cargoes than indicated in the list of cargoes attached to the exemption certificate issued under regulation II-2/10.7.1.4.

**[IACS UI SC197]**

**Non-combustible cargoes:**

*Fixed gas fire-extinguishing systems for dangerous goods*

*A ship engaged in the carriage of dangerous goods in any cargo spaces shall be provided with a fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of the Fire Safety Systems Code or with a fire-extinguishing system which, in the opinion of the RBNA, gives equivalent protection for the cargoes carried.*

*End of guidance*

*Guidance*

**[IMO Resolution A.951(23)]**

#### **IMPROVED GUIDELINES FOR MARINE PORTABLE FIRE EXTINGUISHERS**

##### **Classification**

*Extinguishers are classified according to the type of extinguishing medium they contain. At present the types of extinguishers and the uses for which they are recommended are as follows:*

##### **Fire classifications**

*Fire classifications are generally indicated as A, B, C, D and F (or K). There are currently two standards, defining classes of fires according to the nature of the material undergoing combustion, as follows*

**[MSC.1/Circ.1275]**

***Unified interpretation on the number and arrangement of portable fire extinguishers in the various types of spaces on board ships***

**2.1** *The table below shall be applied for the number and arrangement of portable fire extinguishers in accom*

*modation spaces, service spaces, control stations, machinery spaces of category A, other machinery spaces, cargo spaces, weather deck and other spaces on board ships.*

**2.2** *SOLAS regulation II-2/10.3.2.2 requires that “one of the portable fire extinguishers intended for use in any space shall be stowed near the entrance to that space. It is recommended that the remaining portable fire extinguishers in the public spaces and workshops be located at or near the main entrances and exits.*

**2.3** *If a space is locked when unmanned, portable fire extinguishers required for that space may be kept inside or outside the space.*

**2.4** *Unless expressly provided by the Unified interpretations of SOLAS chapter II-2, the FSS Code, the FTP Code and related fire test procedures (MSC/Circ.1120) or SOLAS regulation II-2/10.5, the*

following table shall be applied to the number and arrangement of portable fire extinguishers in machinery spaces of category A.

accordance with the Guidelines for marine portable fire extinguishers, (see table below) as adopted by resolution A.951(23). The classes of portable fire extinguishers in the table are only for reference.

### 3 The selection of portable fire extinguishers

The selection of portable fire extinguishers shall be appropriate to the fire hazard(s) in the space in

**TABLE T.E10.701.1 – USE OF FIRE EXTINGUISHING MEDIM**

| <i>Extinguishingmedium</i>   | <i>Recommended for use on fires involving</i>                                      |
|--|--|
| Water<br>Waterwithadditives  | wood, paper, textiles and similar materials  |
| Foam   | wood, paper, textiles and flammable liquids  |
| Dry powder/chemical<br>(standard/ classes B, C )                     | flammable liquids, electrical equipment and flammable gases                        |
| Dry powder/chemical (multiple or general<br>purpose/classes A, B, C) | wood, paper, textiles, flammable liquids, electrical equipment and flammable gases |
| Drypowder/chemical (metal)   | combustiblemetals  |
| Carbondioxide  | flammable liquids and electrical equipment   |
| Wet chemical for class F or K  | cooking grease, fats or oil fires  |
| Clean agents*  |  |

**TABLE T.E10.710.2 – COMPARATIVE TABLE FOR THE CLASSIFICATION OF FIRES**

| <b><i>International RBNA for Standardization (ISO standard 3941)*</i></b>   | <b><i>National Fire Protection Association (NFPA 10)</i></b>  |
|---|---|
| <b><i>Class A:</i></b> Fires involving solid materials, usually of anorganic nature, in which combustion normally takes place with the formation of glowing embers. | <b><i>Class A:</i></b> Fires in ordinary combustible materials such as wood, cloth, paper, rubber and many plastics.  |
| <b><i>Class B:</i></b> Fires involving liquids or liquefiable solids.   | <b><i>Class B:</i></b> Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers and flammable gases.  |
| <b><i>Class C:</i></b> Fires involving gases  | <b><i>Class C:</i></b> Fires, which involve energized electrical equipment where the electrical non- conductivity of the extinguishing medium is of importance. (When electrical equipment is de-energized, extinguishers for class A or B fires may be used safely.) |
| <b><i>Class D:</i></b> Fires involving metals   | <b><i>Class D:</i></b> Fires in combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium.   |
| <b><i>Class F:</i></b> Fires involving cooking oils   | <b><i>Class K:</i></b> Fires involving cooking grease, fats and oils  |



**TABLE T.E1.701.3 – MINIMUM NUMBERS AND DISTRIBUTION OF PORTABLE FIRE EXTINGUISHERS IN THE VARIOUS TYPES OF SPACES ON BOARD SHIPS**

| <i>Type of spaces</i>                 |   | <i>Minimum number of extinguishers</i>   | <i>Class(es) of extinguisher(s)</i> |
|---------------------------------------|---|--|-------------------------------------|
| <i>Accommodation spaces</i>           | <i>Public spaces</i>  | <i>1 per 250 m<sup>2</sup> of deck area or fraction thereof</i>  | <i>A</i>                            |
|                                       | <i>Corridors</i>  | <i>Travel distance to extinguishers shall not exceed 25 m within each deck and main vertical zone</i>                                | <i>A</i>                            |
|                                       | <i>Stairway</i>   | <i>0</i>   |                                     |
|                                       | <i>Lavatories, cabins, offices, pantries containing no cooking appliances</i>   | <i>0</i>   |                                     |
|                                       | <i>Hospital</i>   | <i>1</i>   | <i>A</i>                            |
| <i>Service spaces</i>                 | <i>Laundry drying rooms, pantries containing cooking appliances</i>   | <i>1<sup>2</sup></i>   | <i>A or B</i>                       |
|                                       | <i>Lockers and store rooms (having a deck area of 4 m<sup>2</sup> or more ), mail and baggage rooms, specie rooms, workshops (not part of machinery spaces, galleys)</i>  | <i>1<sup>2</sup></i>   | <i>B</i>                            |
|                                       | <i>Galleys</i>  | <i>1 class B and 1 additional class F or K for galleys with deep fat fryers</i>  | <i>B , F or K</i>                   |
|                                       | <i>Lockers and store rooms (deck area is less than 4 m<sup>2</sup>)</i>   | <i>0</i>   |                                     |
|                                       | <i>Other spaces in which flammable liquids are stowed</i>   | <i>In accordance with SOLAS regulation II-2/10.6.3</i>   |                                     |
| <i>Control stations</i>               | <i>Control stations (other than wheelhouse)</i>   | <i>1</i>   | <i>A or C</i>                       |
|                                       | <i>Wheelhouse</i>   | <i>2, if the wheelhouse is less than 50 m<sup>2</sup> only 1 extinguisher is required<sup>3</sup></i>                                | <i>A or C</i>                       |
| <i>Machinery spaces of category A</i> | <i>Central control station for propulsion machinery</i>   | <i>1, and 1 additional extinguisher suitable for electrical fires when main switchboards are arranged in central control station</i> | <i>A and/or C</i>                   |
|                                       | <i>Vicinity of the main switchboards</i>  | <i>2</i>   | <i>C</i>                            |
|                                       | <i>Workshops</i>  | <i>1</i>   | <i>A or B</i>                       |
|                                       | <i>Enclosed space with oil-fired inert gas generators, incinerators and waste disposal units</i>  | <i>2</i>   | <i>B</i>                            |
|                                       | <i>Separately enclosed room with fuel oil purifiers</i>   | <i>0</i>   |                                     |
|                                       | <i>Periodically unattended Machinery spaces of category A</i>   | <i>1 at each entrance<sup>1</sup></i>  | <i>B</i>                            |
| <i>Other spaces</i>                   | <i>Workshops forming part of machinery spaces and other machinery spaces (auxiliary spaces, electrical equipment spaces, auto – telephone exchange rooms, air conditioning spaces and other similar spaces)</i> | <i>1</i>   | <i>B or C</i>                       |

| <i>Type of spaces</i> |  | <i>Minimum number of extinguishers</i>   | <i>Class(es) of extinguisher(s)</i> |
|-----------------------|--|--|-------------------------------------|
|                       | <i>Weather deck</i>                    | <i>0<sup>4</sup></i>   | <i>B</i>                            |
|                       | <i>Ro-ro spaces and vehicle spaces</i> | <i>No point if space is more than 20 m walking distance from an extinguisher at each deck level<sup>4, 5</sup></i> | <i>B</i>                            |
|                       | <i>Cargo spaces</i>                    | <i>0<sup>4</sup></i>   | <i>B</i>                            |
|                       | <i>Cargo pump-room</i>                 | <i>2</i>   | <i>B</i>                            |
|                       | <i>Helidecks</i>                       | <i>In accordance with SOLAS regulation II-2/18.5.1</i>   | <i>B</i>                            |

**NOTES:**

<sup>1</sup> A portable fire extinguisher required for a small space may be located outside and near the entrance to that space.

<sup>2</sup> For service spaces, a portable fire extinguisher required for that small space placed outside or near the entrance to that space may also be considered as part of the requirement for the space in which it is located.

<sup>3</sup> If the wheelhouse is adjacent with the chartroom and has a door giving direct access to chartroom, no additional fire extinguisher is required in the chart room. The same applies to safety centres if they are within the boundaries of the wheelhouse in passenger ships.

<sup>4</sup> Two portable fire extinguishers, each having a capacity of not less than 6 kg of dry powder or equivalent, shall be provided when dangerous goods are carried on the weather deck, in open ro-ro spaces and vehicle spaces, and in cargo spaces as appropriate. Two portable fire extinguishers, each having a suitable capacity, shall be provided on weather deck for tankers.

<sup>5</sup> No portable fire extinguisher needs to be provided in cargo holds of containerships if motor vehicles with fuel in their tank for their own propulsion are carried in open or closed containers.

*End of guidance*

## **800. Cargo tank protection and Protection of cargo pump-rooms in tankers**

### **801. Fixed deck foam fire-extinguishing systems**

- a. For tankers of 20,000 tonnes deadweight and upwards, a fixed deck foam fire-extinguishing system shall be provided complying with the provisions of the Fire Safety Systems Code, except that, in lieu of the above, the RBNA, after having given consideration to the ship's arrangement and equipment, may accept other fixed installations if they afford protection equivalent to the above, in accordance with regulation I/5. The requirements for alternative fixed installations shall comply with the requirements in paragraph E8.200 .
- b. In accordance with paragraph E8.100, where the RBNA accepts an equivalent fixed installation in lieu of the fixed deck foam fire-extinguishing system, the installation shall:
- c. be capable of extinguishing spill fires and also preclude ignition of spilled oil not yet ignited; and
- d. be capable of combating fires in ruptured tanks.
- e. Tankers of less than 20,000 tonnes deadweight shall be provided with a deck foam fire-extinguishing system complying with the requirements of the Fire Safety Systems Code.

### **802. Fixed fire-extinguishing systems**

Each cargo pump-room shall be provided with one of the following fixed fire-extinguishing systems operated from a readily accessible position outside the pump-room. Cargo pump-rooms shall be provided with a system suitable for machinery spaces of category A.

- a. A carbon dioxide fire-extinguishing system complying with the provisions the Fire Safety Systems Code and with the following:
  - a.1. the alarms giving audible warning of the release of fire-extinguishing medium shall be safe for use in a flammable cargo vapour/air mixture; and
  - a.2. a notice shall be exhibited at the controls stating that, due to the electrostatic ignition hazard, the system is to be used only for fire extinguishing and not for inerting purposes.
- b. A high-expansion foam fire-extinguishing system complying with the provisions of the Fire Safety Systems Code, provided that the foam concentrate supply is suitable for extinguishing fires involving the cargoes carried.
- c. A fixed pressure water-spraying fire-extinguishing system complying with the provisions of the Fire Safety Systems Code.

## **802. Quantity of fire-extinguishing medium**

Where the fire-extinguishing medium used in the cargo pump-room system is also used in systems serving other spaces, the quantity of medium provided or its delivery rate need not be more than the maximum required for the largest compartment.

## **900. Fire-fighter's outfits**

### **901. Types of fire-fighter's outfits**

Fire-fighter's outfits shall comply with the Fire Safety Systems Code.

### **902. Number of fire-fighter's outfits**

- a. Ships shall carry at least two fire-fighter's outfits.
- b. In addition, in passenger ships there shall be provided:
  - b.1. for every 80 m, or part thereof, of the aggregate of the lengths of all passenger spaces and service spaces on the deck which carries such spaces or, if there is more than one such deck, on the deck which has the largest aggregate of such lengths, two fire-fighter's outfits and, in addition, two sets of personal equipment, each set comprising the items stipulated in the Fire Safety Systems Code. In passenger ships carrying more than 36 passengers, two additional fire-fighter's outfits shall be provided for each main vertical zone. However, for stairway enclosures which constitute individual main vertical zones and for the main vertical zones in the fore or aft end of a ship which do not contain spaces of categories (6), (7), (8) or (12) defined in regulation E9.303, no additional fire-fighter's outfits are required; and
  - b.2. on ships carrying more than 36 passengers, for each pair of breathing apparatus, one water fog applicator which shall be stored adjacent to such apparatus.
- a. In addition, in tankers, two fire-fighter's outfits shall be provided.
- b. The RBNA may require additional sets of personal equipment and breathing apparatus, having due regard to the size and type of the ship.
- c. Two spare charges shall be provided for each required breathing apparatus. Passenger ships carrying not more than 36 passengers and cargo ships that are equipped with suitably located means for fully recharging the air cylinders free from contamination need carry only one spare charge for each required apparatus. In passenger ships carrying more than 36 passengers, at least two spare charges for each breathing apparatus shall be

provided.

### 903. Storage of fire-fighter's outfits

- a. The fire-fighter's outfits or sets of personal equipment shall be kept ready for use in an easily accessible location that is permanently and clearly marked and, where more than one fire-fighter's outfit or more than one set of personal equipment is carried, they shall be stored in widely separated positions.
- b. In passenger ships, at least two fire-fighter's outfits and, in addition, one set of personal equipment shall be available at any one position. At least two fire-fighter's outfits shall be stored in each main vertical zone.

## E11. STRUCTURAL INTEGRITY

### 100. Purpose:

101. 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.

### 200. Material of hull, superstructures, structural bulkheads, decks and deckhouses

201. 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 E3.43, the "applicable fire exposure" shall be according to the integrity and insulation standards given in tables T.E9.303.1 to T.E9.303.2. 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.

### 300. 3 Structure of aluminium alloy

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

302. The insulation of aluminium alloy components of "A" or "B" class divisions, except structure which, in the opinion of the RBNA, 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

#### Guidance

*Insulation of aluminium decks and interpretation of "load-bearing divisions"* [IACS MSC/Circ.1120]

*If an aluminium deck is tested with insulation installed below the deck, then the result will apply to decks which are bare on the top. Aluminium decks may not be provided with deck coverings or insulation on the top unless tested with the deck covering or insulation included, to verify that the 200°C temperature of the aluminium is not exceeded. However, when needed, any approved primary deck covering (not specifically the one used during the standard fire test of the deck) may be used for meeting this requirement.*

*When spaces of categories (1) to (10) in E9.303 or of categories (1) to (5) and (10) in E9.304 are located on top of aluminium decks, the deck does not need to be insulated from the upper side, provided the deck is protected by an approved deck covering.*

*"Load-bearing division" is a deck or bulkhead including stiffeners, pillars, stanchions and other structural members which, if eliminated, would adversely affect the designated structural strength of the ship.*

#### End of guidance

303. special attention shall be given to the insulation of aluminium alloy components of embarkation areas, and "A" and "B" class divisions to ensure:

- a. that for such members supporting lifeboat and liferaft areas and "A" class divisions, the temperature rise limitation specified in paragraph E11.302 shall apply at the end of one hour; and
- b. 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.

### 400. Machinery spaces of category A

401. Crowns and casings of machinery spaces of category A shall be of steel construction and shall be insulated as required by tables T. E9.403.1 and T.E9.502.1, as appropriate.

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

### 500. Materials of overboard fittings

501. 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.

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

601. **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:

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

#### 602. Openings for small flow by thermal variations

Openings for pressure release required by paragraph E6.100 shall:

- a. 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
- b. 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.

*Guidance [IACS MSC/Circ.1120]*

#### *Area classification and selection of electrical equipment*

*Areas on open deck, or semi-enclosed spaces on open deck, within 3 m of cargo tank ventilation outlets which permit the flow of small volumes of vapour, air or inert gas mixtures caused by thermal variation are defined as Zone 1.*

*Permitted electrical equipment:*

- *Certified safe type equipment for Zone 1.*
- *Areas within 2 m beyond the zone specified in 1 above are defined as Zone 2. Permitted electrical equipment:*
- *Certified safe type equipment for Zone 1;*
- *Equipment of a type, which ensures the absence of sparks, "hot spots" during its normal operation;*
- *Equipment having an enclosure filled with a liquid dielectric, the application, or encapsulated;*
- *Pressurized equipment;*
- *Equipment specifically designed for Zone 2 (for example type "n" protection in accordance with IEC Publication 60079-15).*

**Note :** *Zones 1 and 2 are those defined in IEC Publication IEC 60092 Electrical installations in ships - Part 502: Tankers - Special features.*

#### ***Electrical equipment in areas next to cargo tank ventilation outlets which permit flow of small volumes of vapour***

*Permitted electrical equipment:*

- a. *Areas on open deck within 3 m of cargo tank ventilation outlets which permit the flow of small volumes of vapour caused by thermal variation: certified safe type equipment.*
- b. *Areas 2 m beyond the zone specified in 1 above:*
  - *certified safe type equipment; or*
  - *equipment of a type which ensures absence of sparks or arcs and absence of ignition capable surface during normal operation; or*
  - *equipment specifically designed for Zone 2 as defined in IEC Publication 60092 Electrical installations in ships - Part 502: Tankers - Special features.*

*End of guidance*

#### 603. Safety measures in cargo tanks

- a. Preventive measures against liquid rising in the venting system
- b. 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.

#### 604. Secondary means for pressure/vacuum relief

- a. 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 E6.200. Alternatively, pressure sensors may be fitted in each tank protected by the arrangement required in paragraph E6.200, 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.



*Guidance*

**[IACS UI SC140]**

**Secondary Means of Venting Cargo Tanks**

- a. *A P/V breaker fitted on the IG main may be utilised as the required secondary means of venting where the cargo is homogenous or for multiple cargoes where the vapours are compatible and do not require isolation.*
- b. *The height requirements of Reg. II-2/4.5.3.4.1 and 11.6.2 and the requirements for devices to prevent the passage of flame of Reg. II-2/4.5.3.3 are not applicable to the P/V breaker provided the settings are above those of the venting arrangements required by Reg. II-2/11.6.1.*
- c. *Where the venting arrangements are of the free flow type and the masthead isolation valve is closed for the unloading condition, the IG systems will serve as the primary underpressure protection with the P/V breaker serving as the secondary means.*
- d. *Inadvertent closure or mechanical failure of the isolation valves required by SOLAS Reg. II-2/4.5.3.2.2 and the FSS Code, Ch. 15, 2.3.2.2 need not be considered in establishing the secondary means where the cargo is homogenous or for multiple cargoes where the vapours are compatible and do not require isolation since:*
  - *The valves are operated under the control of the responsible ships officer and a clear visual indication of the operational status of the valves is required by SOLAS Reg. II-2/4.5.3.2.2, as amended, and*
  - *The possibility of mechanical failure of the valves is remote due to their simplicity.*

*-For ships that apply pressure sensors in each tank as an alternative secondary means of venting as per SOLAS Reg. II-2/11.6.3.2, the setting of the over-pressure alarm shall be above the pressure setting of the P/V-valve and the setting of the under-pressure alarm shall be below the vacuum setting of the P/V-valve. The alarm settings are to be within the design pressures of the cargo tanks. The settings are to be fixed and not arranged for blocking or adjustment in operation\*.*

*-An exception is permitted for ships that carry different types of cargo and use P/Vvalves with different settings, one setting for each type of cargo. The settings may be adjusted to account for the different types of cargo.*

*End of guidance*

- b. Bypasses in vent mains

- c. Pressure/vacuum valves required by paragraph E6.100 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.

**604. Pressure/vacuum-breaking devices**

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

- a. 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
- b. 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.
- c. Such devices shall be installed on the inert gas main unless they are installed in the venting system required by Part II, Title 32, Section 1, E2 or on individual cargo tanks. The location and design of the devices shall be in accordance with Part II, Title 32, Section 1, E2 and E6.

**605. 6.4 Size of vent outlets**

Vent outlets for cargo loading, discharging and ballasting required by paragraph E6.200 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.

**E12. MEANS OF ESCAPE**

**100. Purpose: swiftly escape to the lifeboat and liferaft embarkation deck. For this purpose, the following functional requirements shall be met:**

101. safe escape routes shall be provided;
102. escape routes shall be maintained in a safe condition, clear of obstacles; and
103. additional aids for escape shall be provided as necessary to ensure accessibility, clear marking, and adequate design for emergency situations.

*Guidance*

**[IACS UI SC247]**

**Emergency exit hatches to open deck**

*To facilitate a swift and safe means of escape to the lifeboat and liferaft embarkation deck, the following provisions apply to overhead hatches fitted along the escape routes addressed by Chapter E12:*

- *the securing devices shall be of a type which can be opened from both sides;*
- *the maximum force needed to open the hatch cover shall not exceed 150 N; and*
- *the use of a spring equalizing, counterbalance or other suitable device on the hinge side to reduce the force needed for opening is acceptable.*

*End of guidance*

## 200. General requirements

201. Unless expressly provided otherwise in this regulation, at least two widely separated and ready means of escape shall be provided from all spaces or groups of spaces.

202. Lifts shall not be considered as forming one of the means of escape as required by this regulation.

## 300. Means of escape from control stations, accommodation spaces and service spaces

301. Stairways and ladders shall be so arranged as to provide ready means of escape to the lifeboat and liferaft embarkation deck from passenger and crew accommodation spaces and from spaces in which the crew is normally employed, other than machinery spaces.

302. Unless expressly provided otherwise in this regulation, a corridor, lobby, or part of a corridor from which there is only one route of escape shall be prohibited. Dead-end corridors used in service areas which are necessary for the practical utility of the ship, such as fuel oil stations and athwartship supply corridors, shall be permitted, provided such dead-end corridors are separated from crew accommodation areas and are inaccessible from passenger accommodation areas. Also, a part of a corridor that has a depth not exceeding its width is considered a recess or local extension and is permitted.

303. All stairways in accommodation and service spaces and control stations shall be of steel frame construction except where the RBNA sanctions the use of other equivalent material.

304. If a radiotelegraph station has no direct access to the open deck, two means of escape from, or access to, the station shall be provided, one of which may be a porthole or window of sufficient size or other means to the satisfaction of the RBNA.

305. Doors in escape routes shall, in general, open in way of the direction of escape, except that:

- a. individual cabin doors may open into the cabins in order to avoid injury to persons in the corridor when the door is opened; and
- b. doors in vertical emergency escape trunks may open out of the trunk in order to permit the trunk to be used both for escape and for access.

## 306. Means of escape in passenger ships:

### a. Escape from spaces below the bulkhead deck

a.1. Below the bulkhead deck, two means of escape, at least one of which shall be independent of watertight doors, shall be provided from each watertight compartment or similarly restricted space or group of spaces. Exceptionally, the RBNA may dispense with one of the means of escape for crew spaces that are entered only occasionally, if the required escape route is independent of watertight doors.

a.2. Where the RBNA has granted dispensation under the provisions of paragraph E12.306.a above, this sole means of escape shall provide safe escape. However, stairways shall not be less than 800 mm in clear width with handrails on both sides.

b. **Escape from spaces above the bulkhead deck:** above the bulkhead deck there shall be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces, at least one of which shall give access to a stairway forming a vertical escape.

c. **Direct access to stairway enclosures:** stairway enclosures in accommodation and service spaces shall have direct access from the corridors and be of a sufficient area to prevent congestion, having in view the number of persons likely to use them in an emergency. Within the perimeter of such stairway enclosures, only public toilets, lockers of non-combustible material providing storage for non-hazardous safety equipment and open information counters are permitted. Only public spaces, corridors, lifts, public toilets, special category spaces and open ro-ro spaces to which any passengers carried can have access, other escape stairways required by paragraph E12.306.d below and external areas are permitted to have direct access to these stairway enclosures. Small corridors or "lobbies" used to separate an enclosed stairway from galleys or main laundries may have direct access to the stairway provided they have a minimum deck area of 4.5 m<sup>2</sup>, a width of no less than 900 mm and contain a fire hose station.

*Guidance* [IACS MSC/Circ.1120]**Direct access to stairway enclosures**

Direct access to escape stairway enclosures is only intended for those areas of an accommodation space as defined in E3.139 for public spaces. Portions of an accommodation space that serve a purpose different to that of a public space, such as theatre backstage areas, shall not have direct access to escape stairway enclosures.

*End of guidance*

- d. **Details of means of escape:** At least one of the means of escape required by paragraphs E12.306.a shall consist of a readily accessible enclosed stairway, which shall provide continuous fire shelter from the level of its origin to the appropriate lifeboat and liferaft embarkation decks, or to the uppermost weather deck if the embarkation deck does not extend to the main vertical zone being considered. In the latter case, direct access to the embarkation deck by way of external open stairways and passageways shall be provided and shall have emergency lighting and slip free surfaces underfoot. Boundaries facing external open stairways and passageways forming part of an escape route and boundaries in such a position that their failure during a fire would impede escape to the embarkation deck shall have fire integrity, including insulation values, in accordance with tables T.E9.303.1 to T.E9.303.4, as appropriate.

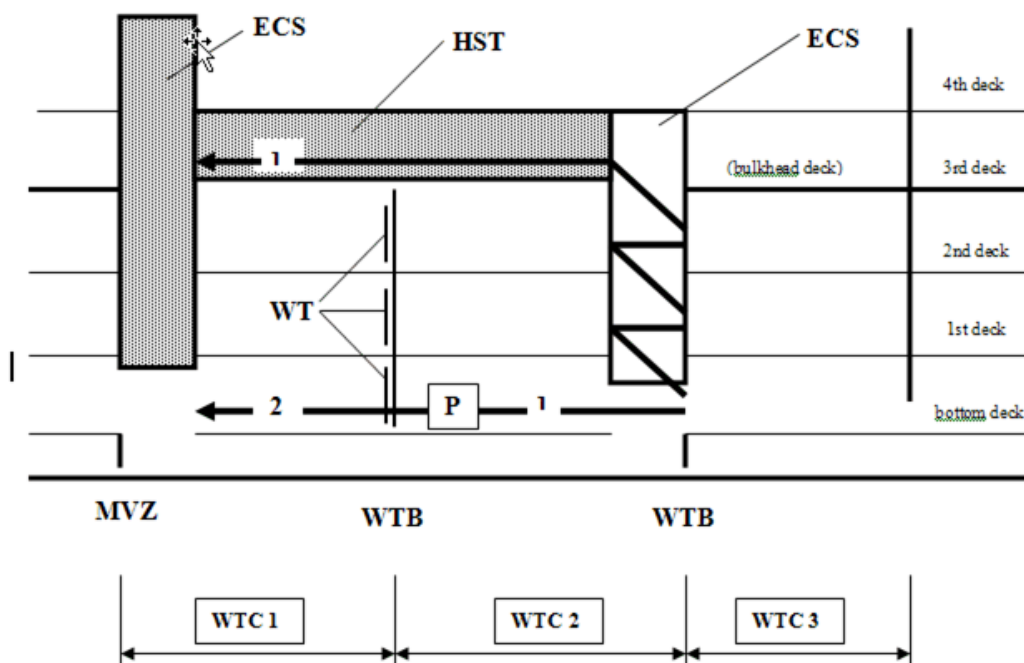
*Guidance***Means of escape**[IACS MSC/Circ.1120]

The stairway arrangement required by the present item E2.306.d. for below bulkhead deck compartments of one main vertical zone can be arranged by:

- one enclosed stairway which provides a continuous fire shelter from the level of its origin to the embarkation deck in one watertight compartment;
- each of the other compartments have an enclosed stairway which provides a continuous fire shelter from the level of its origin to the bulkhead deck; and
- the continuous fire shelter is also provided on the bulkhead deck through a route protected as a category 2 space (horizontal stairway).

In applying this interpretation, the content of E12.306.a. shall also be taken into account.

**FIGURE F.E12.306.1 - CONTINUOUS FIRE SHELTER OF MEANS OF ESCAPE:**



## NOTES ON FIGURE F.E12.306.1:

ECS: stairway enclosed in a continuous fire shelter  
HST: “horizontal stairway”; route protected as a category 2 space  
MVZ: main vertical zone  
WTB: watertight bulkhead  
WTC: watertight compartment  
WTD: watertight door  
P: group of persons

- d.1. Protection of access from the stairway enclosures to the lifeboat and liferaft embarkation areas shall be provided either directly or through protected internal routes which have fire integrity and insulation values for stairway enclosures as determined by tables T.E9.303.1 1 to T.E9.303.4, as appropriate.
- d.2. Stairways serving only a space and a balcony in that space shall not be considered as forming one of the required means of escape.
- d.3. Each level within an atrium shall have two means of escape, one of which shall give direct access to an enclosed vertical means of escape meeting the requirements of paragraph E12.306.d first item.

### Guidance [IACS MSC/Circ.1120]

#### *Size of enclosed means of escape in atriums*

*Such enclosed means of escape shall be sized taking into account the total number of persons at each level of the atrium considered.*

#### *End of guidance*

- d.4. The widths, number and continuity of escapes shall be in accordance with the requirements in the Fire Safety Systems Code.
- e. **Marking of escape routes:** In addition, the means of escape, including stairways and exits, shall be marked by lighting or photoluminescent strip indicators placed not more than 300 mm above the deck at all points of the escape route, including angles and intersections. The marking must enable passengers to identify the routes of escape and readily identify the escape exits. If electric illumination is used, it shall be supplied by the emergency source of power and it shall be so arranged that the failure of any single light or cut in a lighting strip will not result in the marking being ineffective. Additionally, escape route signs and fire equipment location markings shall be of photoluminescent material or marked by lighting. The RBNA shall ensure that such lighting or photoluminescent equipment has been evaluated,

tested and applied in accordance with the Fire Safety Systems Code.

- e.1. In passenger ships carrying more than 36 passengers, the requirements of the paragraph above shall also apply to the crew accommodation areas.

#### f. **Normally locked doors that form part of an escape route**

- f.1. Cabin and stateroom doors shall not require keys to unlock them from inside the room. Neither shall there be any doors along any designated escape route which require keys to unlock them when moving in the direction of escape.
- f.2. Escape doors from public spaces that are normally latched shall be fitted with a means of quick release. Such means shall consist of a door-latching mechanism incorporating a device that releases the latch upon the application of a force in the direction of escape flow. Quick release mechanisms shall be designed and installed to the satisfaction of the RBNA and, in particular:
  - f.3. consist of bars or panels, the actuating portion of which extends across at least one half of the width of the door leaf, at least 760 mm and not more than 1,120 mm above the deck;
  - f.4. cause the latch to release when a force not exceeding 67 N is applied; and
  - f.5. not be equipped with any locking device, set screw or other arrangement that prevents the release of the latch when pressure is applied to the releasing device.

### 307. **Means of escape in cargo ships**

- a. General: at all levels of accommodation there shall be provided at least two widely separated means of escape from each restricted space or group of spaces.
- b. **Escape from spaces below the lowest open deck:** below the lowest open deck the main means of escape shall be a stairway and the second escape may be a trunk or a stairway.

c. **Escape from spaces above the lowest open deck:** above the lowest open deck the means of escape shall be stairways or doors to an open deck or a combination thereof.

d. **Dead-end corridors:** no dead-end corridors having a length of more than 7 m shall be accepted.

e. **Width and continuity of escape routes:** the width, number and continuity of escape routes shall be in accordance with the requirements in the Fire Safety Systems Code.

f. **Dispensation from two means of escape:** exceptionally, the RBNA may dispense with one of the means of escape, for crew spaces that are entered only occasionally, if the required escape route is independent of watertight doors.

#### 308. **Emergency escape breathing devices\***

a. Refer to the Guidelines for the performance, location, use and care of emergency escape breathing devices (MSC/Circ.849).

b. Emergency escape breathing devices shall comply with the Fire Safety Systems Code. Spare emergency escape breathing devices shall be kept onboard.

c. All ships shall carry at least two emergency escape breathing devices within accommodation spaces.

d. In all passenger ships, at least two emergency escape breathing devices shall be carried in each main vertical zone.

e. In all passenger ships carrying more than 36 passengers, two emergency escape breathing devices, in addition to those required in paragraph 3.4.3 above, shall be carried in each main vertical zone.

f. However, paragraphs E12.308.d and E12.308.e do not apply to stairway enclosures which constitute individual main vertical zones and to the main vertical zones in the fore or aft end of a ship which do not contain spaces of categories (6), (7), (8) or (12) as defined in E9..

#### 400. **Means of escape from machinery spaces**

401. **Means of escape on passenger ships:** means of escape from each machinery space in passenger ships shall comply with the following provisions.

a. **Escape from spaces below the bulkhead deck.** Where the space is below the bulkhead deck, the two means of escape shall consist of either:

a.1. two sets of steel ladders, as widely separated as possible, leading to doors in the upper part of the space, similarly separated and

from which access is provided to the appropriate lifeboat and liferaft embarkation decks. One of these ladders shall be located within a protected enclosure that satisfies E9. 303, category (2), or E9.304, category (4), as appropriate, from the lower part of the space it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards shall be fitted in the enclosure. The ladder shall be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The protected enclosure shall have minimum internal dimensions of at least 800 mm x 800 mm, and shall have emergency lighting provisions; or

a.2. one steel ladder leading to a door in the upper part of the space from which access is provided to the embarkation deck and additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the embarkation deck.

#### *Guidance [IACS MSC/Circ.1120]*

*Arrangement of means of escape (passenger ships)(cargo ships)*

*Ladders having strings of flexible steel wire ropes are not acceptable in such escape routes.*

#### *End of guidance*

b. **Escape from spaces above the bulkhead deck:** where the space is above the bulkhead deck, the two means of escape shall be as widely separated as possible and the doors leading from such means of escape shall be in a position from which access is provided to the appropriate lifeboat and liferaft embarkation decks. Where such means of escape require the use of ladders, these shall be of steel.

c. **Dispensation from two means of escape:** in a ship of less than 1,000 gross tonnage, the RBNA may dispense with one of the means of escape, due regard being paid to the width and disposition of the upper part of the space. In a ship of 1,000 gross tonnage and above, the RBNA may dispense with one means of escape from any such space, including a normally unattended auxiliary machinery space, so long as either a door or a steel ladder provides a safe escape route to the embarkation deck, due regard being paid to the nature and location of the space and whether persons are normally employed in that space. In the steering gear space, a second means of escape shall be provided when the emergency steering position



is located in that space unless there is direct access to the open deck.

*Guidance [IACS UI SC41]*

**Means of escape:**

*The above requirement applies only to auxiliary machinery spaces where persons are not normally employed.*

*End of guidance*

- d. 4.1.4 Escape from machinery control rooms  
Two means of escape shall be provided from a machinery control room located within a machinery space, at least one of which will provide continuous fire shelter to a safe position outside the machinery space.

402. **Means of escape on cargo ships:** means of escape from each machinery space in cargo ships shall comply with the following provisions.

- a. **Escape from machinery spaces of category A:** except as provided in paragraph E12.402.b, two means of escape shall be provided from each machinery space of category A. In particular, one of the following provisions shall be complied with:

- a.1. two sets of steel ladders, as widely separated as possible, leading to doors in the upper part of the space, similarly separated and from which access is provided to the open deck. One of these ladders shall be located within a protected enclosure that satisfies regulation E9.403, category (4), from the lower part of the space it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards shall be fitted in the enclosure. The ladder shall be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The enclosure shall have minimum internal dimensions of at least 800 mm x 800 mm, and shall have emergency lighting provisions; or
- a.2. one steel ladder leading to a door in the upper part of the space from which access is provided to the open deck and, additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the open deck.

- b. **Dispensation from two means of escape:** escape required under paragraph E12.402.a, due regard being paid to the dimension and disposition of the upper part of the space. In addition, the means of escape from machinery spaces of category A need

not comply with the requirement for an enclosed fire shelter listed in paragraph E12.402.a. first item. In the steering gear space, a second means of escape shall be provided when the emergency steering position is located in that space unless there is direct access to the open deck. From machinery spaces other than those of category A, two escape routes shall be provided except that a single escape route may be accepted for spaces that are entered only occasionally, and for spaces where the maximum travel distance to the door is 5 m or less.

403. **Emergency escape breathing devices**

- a. On all ships, within the machinery spaces, emergency escape breathing devices shall be situated ready for use at easily visible places, which can be reached quickly and easily at any time in the event of fire. The location of emergency escape breathing devices shall take into account the layout of the machinery space and the number of persons normally working in the spaces.
- b. Refer to the Guidelines for the performance, location, use and care of emergency escape breathing devices (MSC/Circ.849).
- c. The number and location of these devices shall be indicated in the fire control plan.
- d. Emergency escape breathing devices shall comply with the Fire Safety Systems Code.

500. **Means of escape on passenger ships from special category and open ro-ro spaces to which any passengers carried can have access**

501. In special category and open ro-ro spaces to which any passengers carried can have access, the number and locations of the means of escape both below and above the bulkhead deck shall be to the satisfaction of the RBNA and, in general, the safety of access to the embarkation deck shall be at least equivalent to that provided for under paragraphs E12.306.a.1, E12.401.b, E12.306.c. Such spaces shall be provided with designated walkways to the means of escape with a breadth of at least 600 mm. The parking arrangements for the vehicles shall maintain the walkways clear at all times.

502. One of the escape routes from the machinery spaces where the crew is normally employed shall avoid direct access to any special category space.

600. **Means of escape from ro-ro spaces**

601. At least two means of escape shall be provided in ro-ro spaces where the crew are normally employed. The escape routes shall provide a safe escape to the lifeboat and liferaft embarkation decks and shall be located at the fore and aft ends of the space.

*Guidance [IACS MSC/Circ.1020]*

**Arrangement of escape routes in ro-ro cargo spaces**

*The escape (and access) routes shall be so arranged to ensure safe escape also during loading and unloading such as indication of escape lane on deck with minimum clearance of 600 mm in width.*

*End of guidance*

**700. Additional requirements for ro-ro passenger ships**

**701. General**

- a. Escape routes shall be provided from every normally occupied space on the ship to an assembly station. These escape routes shall be arranged so as to provide the most direct route possible to the assembly station,\* and shall be marked with symbols based on the guidelines developed by the RBNA.†
- b. The escape route from cabins to stairway enclosures shall be as direct as possible, with a minimum number of changes in direction. It shall not be necessary to cross from one side of the ship to the other to reach an escape route. It shall not be necessary to climb more than two decks up or down in order to reach an assembly station or open deck from any passenger space.
- c. Refer to the Indication of the assembly stations in passenger ships (MSC/Circ.777)
- d. Refer to Symbols related to life-saving appliances and arrangements adopted by the RBNA by resolution A.760(18).
- e. External routes shall be provided from open decks, as referred to in paragraph E6.103, to the survival craft embarkation stations.
- f. Where enclosed spaces adjoin an open deck, openings from the enclosed space to the open deck shall, where practicable, be capable of being used as an emergency exit.
- g. Escape routes shall not be obstructed by furniture and other obstructions. With the exception of tables and chairs which may be cleared to provide open space, cabinets and other heavy furnishings in public spaces and along escape routes shall be secured in place to prevent shifting if the ship rolls or lists. Floor coverings shall also be secured in place. When the ship is under way, escape routes shall be kept clear of obstructions such as cleaning carts, bedding, luggage and boxes of goods.

**702. Instruction for safe escape**

- a. Decks shall be sequentially numbered, starting with "1" at the tank top or lowest deck. The numbers shall be prominently displayed at stair landings and lift lobbies. Decks may also be named, but the deck number shall always be displayed with the name.

- b. Simple "mimic" plans showing the "you are here" position and escape routes marked by arrows shall be prominently displayed on the inside of each cabin door and in public spaces. The plan shall show the directions of escape and shall be properly oriented in relation to its position on the ship.

**703. Strength of handrails and corridors**

- a. Handrails or other handholds shall be provided in corridors along the entire escape route so that a firm handhold is available at every step of the way, where possible, to the assembly stations and embarkation stations. Such handrails shall be provided on both sides of longitudinal corridors more than 1.8 m in width and transverse corridors more than 1 m in width. Particular attention shall be paid to the need to be able to cross lobbies, atriums and other large open spaces along escape routes. Handrails and other handholds shall be of such strength as to withstand a distributed horizontal load of 750 N/m applied in the direction of the centre of the corridor or space, and a distributed vertical load of 750 N/m applied in the downward direction. The two loads need not be applied simultaneously.
- b. The lowest 0.5 m of bulkheads and other partitions forming vertical divisions along escape routes shall be able to sustain a load of 750 N/m to allow them to be used as walking surfaces from the side of the escape route with the ship at large angles of heel.

**704. Evacuation analysis**

- a. Escape routes shall be evaluated by an evacuation analysis early in the design process. The analysis shall be used to identify and eliminate, as far as practicable, congestion which may develop during an abandonment, due to normal movement of passengers and crew along escape routes, including the possibility that crew may need to move along these routes in a direction opposite to the movement of passengers. In addition, the analysis shall be used to demonstrate that escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty.
- b. Refer to interim guidelines for Evacuation Analysis for New and Existing Passenger Ships (MSC/CIRC 1033)

**800. Doors in watertight bulkheads of cargo ships and passenger ships [IACS UI SC156]**

801. This item E12.800 pertains to doors located in way of the internal watertight subdivision boundaries and the external watertight boundaries necessary to ensure compliance with the relevant subdivision and damage stability regulations.

- a. Doors in watertight bulkheads of small cargo ships, not subject to any statutory subdivision and damage stability requirements, may be hinged quick acting doors arranged to open out of the major space protected. They shall be constructed in accordance with the requirements of the classing society and have notices affixed to each side stating, "To be kept closed at sea".
- b. This item E12.800 shall not apply to HSCs.
- c. This item E12.800 does not apply to doors located in external boundaries above equilibrium or intermediate waterplanes.
- d. The design and testing requirements for watertight doors vary according to their location relative to the equilibrium waterplane or intermediate waterplane at any stage of assumed flooding.
- e. The scope of the present item in this context shall not be limited to watertight doors covered by SOLAS. Watertight doors required by other statutory damage stability requirements, e.g. MARPOL, the IBC and IGC Codes are covered as well. Small cargo vessels not subject to damage stability requirements are not required to comply with the full scheme.

#### 802. Definitions

- a. **"Watertight"**: Capable of preventing the passage of water in any direction under a design head. The design head for any part of a structure shall be determined by reference to its location relative to the bulkhead deck or freeboard deck, as applicable, or to the most unfavourable equilibrium/intermediate waterplane, in accordance with the applicable subdivision and damage stability regulations, whichever is the greater. A watertight door is thus one that will maintain the watertight integrity of the subdivision bulkhead in which it is located.
- b. **"Equilibrium Waterplane"**: the waterplane in still water when, taking account of flooding due to an assumed damage, the weight and buoyancy forces acting on a vessel are in balance. This relates to the final condition when no further flooding takes place or after cross flooding is completed.
- c. **"Intermediate Waterplane"**: the waterplane in still water, which represents the instantaneous floating position of a vessel at some intermediate stage between commencement and completion of flooding when, taking account of the assumed

instantaneous state of flooding, the weight and buoyancy forces acting on a vessel are in balance.

- d. **"Sliding Door or Rolling Door"**: a door having a horizontal or vertical motion generally parallel to the plane of the door.
- e. **"Hinged Door"**: a door having a pivoting motion about one vertical or horizontal edge.

803. **Structural Design**: doors shall be of approved design and substantial construction in accordance with the requirements of the classing society and shall be of a strength equivalent to that of the subdivision bulkheads in which they are fitted.

#### 804. Operation Mode, Location and Outfitting

- a. Doors shall be fitted in accordance with all requirements regarding their operation mode, location and outfitting, i.e. provision of controls, means of indication, etc., as shown in Table T.E12.804.1 below. This table is to be read in conjunction with the following general notes:
- b. For passenger ships the watertight doors and their controls are to be located in compliance with Part II Title 21 Section 3.

#### c. Frequency of Use whilst at sea

- c.1. **Normally Closed**: Kept closed at sea but may be used if authorised. To be closed again after use.
- c.2. **Permanently Closed**: The time of opening such doors in port and of closing them before the ship leaves port shall be entered in the log-book. Shall such doors be accessible during the voyage, they shall be fitted with a device to prevent unauthorised opening.
- c.3. **Normally Open**: May be left open provided it is always ready to be immediately closed.
- c.4. **Used**: In regular use, may be left open provided it is ready to be immediately closed.

#### d. Type

|  |     |
|--|-----|
| Power operated, sliding or rolling <sup>*2</sup> | POS |
| Power operated, hinged                           | POH |
| Sliding or Rolling                               | S   |
| Hinged   | H   |

<sup>\*2</sup> Rolling doors are technically identical to sliding doors.

#### e. Control

e.1. **Local :**

- i. All doors, except those which are to be permanently closed at sea, are to be capable of being opened and closed by hand, (and by power, where applicable locally, from both sides of the doors, with the ship listed to either side.
- ii. For passenger ships, the angle of list at which operation by hand is to be possible is 15 degrees or 20 degrees if the ship is allowed to heel up to 20 degrees during intermediate stages of flooding.
- iii. For cargo ships, the angle of list at which operation by hand is to be possible is 30 degrees.

e.2. **Remote**

- i. Where indicated in Table T.E12.804.1, doors are to be capable of being remotely closed by power from the bridge. Where it is necessary to start the power unit for operation of the watertight door, means to start the power unit is also to be provided at remote control stations. The operation of such remote control is to be in accordance with Part II Title 21 Section 3.

e.3. **Indication**

- i. Where shown in Table T.E12.804.1, position indicators are to be provided at all remote operating positions as well as locally, on both sides of the doors, to show whether the doors are open or closed and, if applicable, with all dogs/cleats fully and properly engaged.
- ii. Indication at all remote control positions: the door position indicating system is to be of self-monitoring type and the means for testing of the indicating system are to be provided at the position where the indicators are fitted. An indication (i.e. red light) shall be placed locally showing that the door is in remote control mode ("doors closed mode"). Special care shall be taken in order to avoid potential danger when passing through the door. Signboard/instructions shall be placed in way of the door advising how to act when the door is in "doors closed" mode.

f. **Alarms**

- f.1. Doors which are to be capable of being remotely closed are to be provided with an audible alarm, distinct from any other alarm in the area, which will sound whenever such a door is remotely closed. For passenger ships the alarm shall sound for at least 5 s but not more than 10 s before the door begins to move and shall continue sounding until the door is completely closed. In the case of remote closure by hand operation, an alarm is required to sound only while the door is actually moving.
- f.2. In passenger areas and areas of high ambient noise, the audible alarms are to be supplemented by visual signals at both sides of the doors.

g. **Notices**

- g.1. As shown in Table T.E12.804.1, doors which are normally closed at sea but not provided with means of remote closure, are to have notices fixed to both sides of the doors stating, "To be kept closed at sea". Doors which are to be permanently closed at sea are to have notices fixed to both sides stating, "Not to be opened at sea".

805. **Fire Doors**

- a. Watertight doors may also serve as fire doors but need not be fire-tested when intended for use below the bulkhead deck. Where such doors are used at locations above the bulkhead deck they shall, in addition to complying with the provisions applicable to fire doors at the same locations, also comply with means of escape provisions of SOLAS II-2/13 (2000 Amendments, Res. MSC.99(73).
- b. Where a watertight door is located adjacent to a fire door, both doors shall be capable of independent operation, remotely if required by SOLAS II-1/15.8.1 to 15.8.3 and from both sides of the each door.

806. **Testing**

- a. Doors which become immersed by an equilibrium or intermediate waterplane, are to be subjected to a hydrostatic pressure test.
- b. For large doors intended for use in the watertight subdivision boundaries of cargo spaces, structural analysis may be accepted in lieu of pressure testing. Where such doors utilise gasket seals, a prototype pressure test to confirm that the compression of the gasket material is capable of accommodating any deflection, revealed by the structural analysis, is to be carried out.

- c. Doors which are not immersed by an equilibrium or intermediate waterplane but become intermittently immersed at angles of heel in the required range of positive stability beyond the equilibrium position are to be hose tested. Additionally, such doors may need to be pressure tested to a head as specified by a National standard or regional agreement

#### Guidance

*For clarification purposes it shall be noted that even though these doors are covered by the text in this item E12.800, in accordance with the practice of LL, SOLAS and MARPOL Conventions such hose testing usually is related to weathertight doors rather than to watertight doors.*

#### End of guidance

#### d. Pressure Testing

- d.1. The head of water used for the pressure test shall correspond at least to the head measured from the lower edge of the door opening, at the location in which the door is to be fitted in the vessel, to the bulkhead deck or freeboard deck, as applicable, or to the most unfavourable damage waterplane, if that be greater. Testing may be carried out at the factory or other shore based testing facility prior to installation in the ship.

- d.2. **Leakage Criteria:** The following acceptable leakage criteria shall apply to:

**TABLE T.E12.806.1 – LEAKAGE CRITERIA**

|                             |                         |
|-----------------------------|-------------------------|
| Doors with gaskets          | No leakage              |
| Doors with metallic sealing | Max leakage 1 litre/min |

- d.3. Limited leakage may be accepted for pressure tests on large doors located in cargo spaces employing gasket seals or guillotine doors located in conveyor tunnels, in accordance with the following

$$\text{Leakage rate (litre/min)} = (1/6568) \times (P + 4.572) \times h^3$$

where:

P = perimeter of door opening (metres)

h = test head of water (metres)

- d.4. However, in the case of doors where the water head taken for the determination of the scantling does not exceed 6.10 m, the leakage rate may be taken equal to 0.375 litre/min if this value is greater than that calculated by the above-mentioned formula.

- e. For doors on passenger ships which are normally open and used at sea or which become submerged by the equilibrium or intermediate waterplane, a prototype test shall be conducted, on each side of the door, to check the satisfactory closing of the door against a force equivalent to a water height of at least 1m above the sill on the centre line of the door. Arrangements for passenger ships shall be in accordance with Part II Title 21 Section 3.

- f. **Hose Testing:** All watertight doors shall be subject to a hose test after installation in a ship. Hose testing is to be carried out from each side of a door unless, for a specific application, exposure to floodwater is anticipated only from one side. Where a hose test is not practicable because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by means such as an ultrasonic leak test or an equivalent test.



**TABLE T.E12.804.1 - INTERNAL DOORS IN WATERTIGHT BULKHEADS IN CARGO SHIPS AND PASSENGER SHIPS**

| <i>Position relative to equilibrium or intermediate waterplane</i>   | <i>1. Frequency of Use whilst at sea</i> | <i>2. Type</i> | <i>3. Remote Control<sup>6</sup></i> | <i>4. Indication locally and on Bridge<sup>6</sup></i> | <i>5. Audible Alarm<sup>6</sup></i> | <i>6. Notice</i> | <i>7. Comments</i>                                    | <i>8. Regulation</i>                                  |
|--|--|----------------|--------------------------------------|--|-------------------------------------|------------------|---|---|
| <b>Passenger Ships</b>   |  |                |                                      |  |                                     |                  |   |   |
| A. At or below   | Norm. Closed                             | POS            | Yes                                  | Yes  | Yes                                 | No               | Certain doors may be left open, see SOLAS II-1/15.9.3 | SOLAS II-1/ 15.9.1,2 & 3                              |
|  | Perm. Closed                             | S, H           | No                                   | No   | No                                  | Yes              | see Notes 1 + 4                                       | SOLAS II-1/ 15.10.1 & 2                               |
| B. Above   | Norm. open                               | POS, POH       | Yes                                  | Yes  | Yes                                 | No               |   | SOLAS II-1/ 15.9.3<br>SOLAS II-1/20.1<br>MSC/Circ.541 |
|  | Norm. Closed                             | S, H           | No                                   | Yes  | No                                  | Yes              | see Note 2  |   |
| <b>Cargo Ships</b>   |  |                |                                      |  |                                     |                  |   |   |
| A. At or below   | Used                                     | POS            | Yes                                  | Yes  | Yes                                 | No               |   | SOLAS II-1/ 25-9.2                                    |
|  | Norm. Closed                             | S, H           | No                                   | Yes  | No                                  | Yes              | see Notes 2 + 3 + 5                                   | SOLAS II-1/ 25-9.3                                    |
|  | Perm. Closed                             | S, H           | No                                   | No   | No                                  | Yes              | see Notes 1 + 4                                       | SOLAS II-1/ 25-9.4; SOLAS II-1/ 25-10                 |
| B. Above   | Used                                     | POS            | Yes                                  | Yes  | Yes                                 | No               |   | SOLAS II-1/ 25-9.2                                    |
|  | Norm. closed                             | S, H           | No                                   | Yes  | No                                  | Yes              | See Notes 2 + 5                                       | SOLAS II-1/ 25-9.3                                    |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>Doors in watertight bulkheads subdividing cargo spaces.</li> <li>If hinged, this door shall be of quick acting or single action type</li> <li>"ICLL66+A.320" or "1988 Protocol to ICLL66", MARPOL, IGC and IBC- Codes require remotely operated watertight doors to be sliding doors.</li> <li>The time of opening such doors in port and closing them before the ship leaves port shall be entered in the logbook.</li> <li>The use of such doors shall be authorised by the officer of the watch.</li> <li>Cables for control and power systems to power operated watertight doors and their status indication shall comply with the requirements of UR E15.</li> </ol> |  |                |                                      |  |                                     |                  |   |   |

## **E13. ALTERNATIVE AND ARRANGEMENTS**

### **DESIGN**

#### **100. 1 Purpose**

101. The purpose of this regulation is to provide a methodology for alternative design and arrangements for fire safety.

#### **200. General**

201. Fire safety design and arrangements may deviate from the prescriptive requirements set out in Chapters E1 to E17, provided that the design and arrangements meet the fire safety objectives and the functional requirements.

202. When fire safety design or arrangements deviate from the prescriptive requirements of this chapter, engineering analysis, evaluation and approval of the alternative design and arrangements shall be carried out in accordance with this regulation.

#### **300. Engineering analysis**

301. The engineering analysis shall be prepared and submitted to the RBNA, based on the guidelines developed by the RBNA (refer to MSC/CIRC 1002) and shall include, as a minimum, the following elements:

- a. determination of the ship type and space(s) concerned;
- b. identification of prescriptive requirement(s) with which the ship or the space(s) will not comply;
- c. identification of the fire and explosion hazards of the ship or the space(s) concerned, including:
  - c.1. identification of the possible ignition sources;
  - c.2. identification of the fire growth potential of each space concerned;
  - c.3. identification of the smoke and toxic effluent generation potential for each space concerned;
  - c.4. identification of the potential for the spread of fire, smoke or of toxic effluents from the space(s) concerned to other spaces;
- d. determination of the required fire safety performance criteria for the ships or the space(s) concerned addressed by the prescriptive requirement(s), in particular:
  - d.1. performance criteria shall be based on the fire safety objectives and on the functional requirements of this chapter;

d.2. performance criteria shall provide a degree of safety not less than that achieved by using the prescriptive requirements; and

d.3. performance criteria shall be quantifiable and measurable;

- e. detailed description of the alternative design and arrangements, including a list of the assumptions used in the design and any proposed operational restrictions or conditions; and
- f. technical justification demonstrating that the alternative design and arrangements meet the required fire safety performance criteria.

#### **400. Evaluation of the alternative design and arrangements**

401. The engineering analysis required in paragraph E5.300 shall be evaluated and approved by the RBNA, taking into account the guidelines developed by the RBNA (refer to the guidelines to be developed by the RBNA).

402. A copy of the documentation, as approved by the RBNA, indicating that the alternative design and arrangements comply with this regulation shall be carried onboard the ship.

#### **500. Exchange of information**

501. The RBNA shall communicate to the RBNA pertinent information concerning alternative design and arrangements approved by them for circulation to all Contracting Governments.

#### **600. Re-evaluation due to change of conditions**

601. If the assumptions and operational restrictions that were stipulated in the alternative design and arrangements are changed, the engineering analysis shall be carried out under the changed condition and shall be approved by the RBNA.

## **E14. PROTECTION OF VEHICLE, SPECIAL CATEGORY AND RO-RO SPACES**

#### **100. Purpose**

101. The purpose of this regulation is to provide additional safety measures in order to address the fire safety objectives of this chapter for ships fitted with vehicle, special category and ro-ro spaces. For this purpose, the following functional requirements shall be met:

- a. fire protection systems shall be provided to adequately protect the ship from the fire hazards associated with vehicle, special category and ro-ro spaces;

- b. ignition sources shall be separated from vehicle, special category and ro-ro spaces; and
- c. vehicle, special category and ro-ro spaces shall be adequately ventilated.

## 200. General requirements

201. **Application:** In addition to complying with the requirements of regulations in:

E4 through E6;  
E7 through E11;  
E12,

as appropriate, vehicle, special category and ro-ro spaces shall comply with the requirements of this regulation.

## 202. Basic principles for passenger ships

- a. The basic principle underlying the provisions of this regulation is that the main vertical zoning required by regulation E9.200 may not be practicable in vehicle spaces of passenger ships and, therefore, equivalent protection must be obtained in such spaces on the basis of a horizontal zone concept and by the provision of an efficient fixed fire-extinguishing system. Based on this concept, a horizontal zone for the purpose of this regulation may include special category spaces on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m.
- b. The basic principle underlying the provisions of paragraph E14.202.ais also applicable to ro-ro spaces.
- c. The requirements of ventilation systems, openings in "A" class divisions and penetrations in "A" class divisions for maintaining the integrity of vertical zones in this chapter shall be applied equally to decks and bulkheads forming the boundaries separating horizontal zones from each other and from the remainder of the ship.

## 300. Precaution against ignition of flammable vapours in closed vehicle spaces, closed ro-ro spaces and special category spaces

### 301. Capacity of ventilation systems

There shall be provided an effective power ventilation system sufficient to give at least the following air changes:

**TABLE T.E14.301.1 – CAPACITY OF THE VENTILATION SYSTEMS**

|           |   |                         |
|-----------|---|-------------------------|
| <b>.1</b> | <b><i>Passenger ships</i></b>   |                         |
|           | Special category spaces   | 10 air changes per hour |
|           | Closed ro-ro and vehicle spaces other than special category spaces for ships carrying more than 36 passengers     | 10 air changes per hour |
|           | Closed ro-ro and vehicle spaces other than special category spaces for ships carrying not more than 36 passengers | 6 air changes per hour  |
| <b>.2</b> | <b><i>Cargo ships</i></b>   | 6 air changes per hour  |

The RBNA may require an increased number of air changes when vehicles are being loaded and unloaded.

## 302. Performance of ventilation systems

- a. In passenger ships, the power ventilation system required in paragraph E9.303 shall be separate from other ventilation systems and shall be in operation at all times when vehicles are in such spaces. Ventilation ducts serving such cargo spaces capable of being effectively sealed shall be separated for each such space. The system shall be capable of being controlled from a position outside such spaces.
- b. In cargo ships, ventilation fans shall normally be run continuously whenever vehicles are on board. Where this is impracticable, they shall be operated for a limited period daily as weather permits and in any case for a reasonable period prior to discharge, after which period the ro-ro or vehicle space shall be proved gas-free. One or more portable combustible gas detecting instruments shall be carried for this purpose. The system shall be entirely separate from other ventilating systems. Ventilation ducts serving ro-ro or vehicle spaces shall be capable of being effectively sealed for each cargo space. The system shall be capable of being controlled from a position outside such spaces.
- c. The ventilation system shall be such as to prevent air stratification and the formation of air pockets.

## 303. Indication of ventilation systems

Means shall be provided on the navigation bridge to indicate any loss of the required ventilating capacity.

### 304. Closing appliances and ducts

- a. Arrangements shall be provided to permit a rapid shutdown and effective closure of the ventilation system from outside of the space in case of fire, taking into account the weather and sea conditions.
- b. Ventilation ducts, including dampers, within a common horizontal zone shall be made of steel. In passenger ships, ventilation ducts that pass through other horizontal zones or machinery spaces shall be "A-60" class steel ducts constructed in accordance with regulations E9.702.a and E9.702.b.

### 305. Permanent openings

Permanent openings in the side plating, the ends or deckhead of the space shall be so situated that a fire in the cargo space does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the cargo spaces.

### 306. Electrical equipment and wiring

- a. Except as provided in paragraph E14.306.b, electrical equipment and wiring shall be of a type suitable for use in an explosive petrol and air mixture.

#### *Guidance*

*Refer to the recommendations of the International Electrotechnical Commission, in particular publication 60079.*

#### *End of guidance*

- b. In case of other than special category spaces below the bulkhead deck, notwithstanding the provisions in paragraph E14.306.a above a height of 450 mm from the deck and from each platform for vehicles, if fitted, except platforms with openings of sufficient size permitting penetration of petrol gases downwards, electrical equipment of a type so enclosed and protected as to prevent the escape of sparks shall be permitted as an alternative on condition that the ventilation system is so designed and operated as to provide continuous ventilation of the cargo spaces at the rate of at least ten air changes per hour whenever vehicles are on board.

### 307. Electrical equipment and wiring in exhaust ventilation ducts

Electrical equipment and wiring, if installed in an exhaust ventilation duct, shall be of a type approved for use in explosive petrol and air mixtures and the outlet from any exhaust duct shall be sited in a safe position, having regard to other possible sources of ignition.

### 308. Other ignition sources

Other equipment which may constitute a source of ignition of flammable vapours shall not be permitted.

### 309. Scuppers and discharges

Scuppers shall not be led to machinery or other spaces where sources of ignition may be present.

### 400. Detection and alarm

#### 401. Fixed fire detection and fire alarm systems

Except as provided in paragraph E14.403.a, there shall be provided a fixed fire detection and fire alarm system complying with the requirements of the Fire Safety Systems Code. The fixed fire detection system shall be capable of rapidly detecting the onset of fire. The type of detectors and their spacing and location shall be to the satisfaction of the RBNA taking into account the effects of ventilation and other relevant factors. After being installed the system shall be tested under normal ventilation conditions and shall give an overall response time to the satisfaction of the RBNA.

#### 402. Sample extraction smoke detection systems

Except open ro-ro spaces, open vehicle spaces and special category spaces, a sample extraction smoke detection system complying with the requirements of the Fire Safety Systems Code may be used as an alternative of the fixed fire detection and fire alarm system required in paragraph 4.1.

#### 403. Special category spaces

- a. An efficient fire patrol system shall be maintained in special category spaces. However, if an efficient fire patrol system is maintained by a continuous fire watch at all times during the voyage, a fixed fire detection and fire alarm systems is not required.
- b. 4.3.2 Manually operated call points shall be spaced so that no part of the space is more than 20 m from a manually operated call point, and one shall be placed close to each exit from such spaces.

### 500. Structural protection

501. Notwithstanding the provisions of regulation E9.300, in passenger ships carrying more than 36 passengers, the boundary bulkheads and decks of special category spaces and ro-ro spaces shall be insulated to "A-60" class standard. However, where a category (5), (9) and (10) space, as defined in regulation E9.303, is on one side of the division the standard may be reduced to "A-0". Where fuel oil tanks are below a special category space or a ro-ro space, the integrity of the deck between such spaces, may be reduced to "A-0" standard.

## 600. Fire-extinction

### 601. Fixed fire-extinguishing systems

- a. Vehicle spaces and ro-ro spaces, which are not special category spaces and are capable of being sealed from a location outside of the cargo spaces, shall be fitted with one of the following fixed fire-extinguishing systems:
  - a.1. a fixed gas fire-extinguishing system complying with the provisions of the Fire Safety Systems Code;
  - a.2. a fixed high-expansion foam fire-extinguishing system complying with the provisions of the Fire Safety Systems Code; or
  - a.3. a fixed water-based fire fighting system for ro-ro spaces and special category spaces complying with the provisions of the Fire Safety Systems Code and paragraphs 6.1.2.1 E6.100 to 6.1.2.4 E100.204.
- b. Vehicle spaces and ro-ro spaces not capable of being sealed and special category spaces shall be fitted with a fixed water-based fire-fighting system for ro-ro spaces and special category spaces complying with the provisions of the Fire Safety Systems Code which shall protect all parts of any deck and vehicle platform in such spaces. Such a water-based fire-fighting system shall have:
  - b.1. a pressure gauge on the valve manifold;
  - b.2. clear marking on each manifold valve indicating the spaces served;
  - b.3. instructions for maintenance and operation located in the valve room; and
  - b.4. a sufficient number of drainage valves to ensure complete drainage of the system.
- c. The RBNA may permit the use of any other fixed fire-extinguishing system \*\* that has been shown that it is not less effective by a full-scale test in conditions simulating a flowing petrol fire in a vehicle space or a ro-ro space in controlling fires likely to occur in such a space.
- d. Refer to the Guidelines for the approval of fixed water-based fire-fighting systems for ro-ro spaces and special category spaces equivalent to that referred to in resolution [A.123(V) (MSC.1/Circ.1430).]
- e. When fixed pressure water-spraying systems are fitted, in view of the serious loss of stability which could arise due to large quantities of water accumulating on the deck or decks during the operation of the fixed pressure water-spraying

system, the following arrangements shall be provided:

#### f. in passenger ships:

- f.1. in the spaces above the bulkhead deck, scuppers shall be fitted so as to ensure that such water is rapidly discharged directly overboard, taking into account the guidelines developed by RBNA;
- f.2. in ro-ro passenger ships, discharge valves for scuppers, fitted with positive means of closing operable from a position above the bulkhead deck in accordance with the requirements of the International Convention on Load Lines in force, shall be kept open while the ships are at sea;
- f.3. any operation of valves referred to in paragraph E14 601.e.1.v shall be recorded in the log-book;
- f.4. in the spaces below the bulkhead deck, the RBNA may require pumping and drainage facilities to be provided additional to the requirements of regulation II-1/35-1. In such case, the drainage system shall be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles, taking into account the guidelines developed by the RBNA. The drainage system valves shall be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells shall be of sufficient holding capacity and shall be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment;

#### Guidance

*Refer to Drainage of fire-fighting water from enclosed vehicle and ro-ro spaces and special category spaces for passenger and cargo ships (MSC.1/Circ.1234)*

#### End of guidance

- f.5. in cargo ships, the drainage and pumping arrangements shall be such as to prevent the build-up of free surfaces. In such case, the drainage system shall be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles, taking into account the guidelines developed by the RBNA. The drainage system valves shall be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells



shall be of sufficient holding capacity and shall be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. If this is not possible, the adverse effect upon stability of the added weight and free surface of water shall be taken into account to the extent deemed necessary by the RBNA in its approval of the stability information (\*\*). Such information shall be included in the stability information supplied to the master as required by regulation II-1/5-1.

*Guidance*

\* *Refer to Drainage of fire-fighting water from enclosed vehicle and ro-ro spaces and special category spaces for passenger and cargo ships (MSC.1/Circ.1234)*

\*\* *Refer to the Recommendation on fixed fire-extinguishing systems for special cargo spaces adopted by the RBNA by resolution A.123(V)*

*End of guidance*

- g. On all ships, for closed vehicles and ro-ro spaces and special category spaces, where fixed pressure water-spraying systems are fitted, means shall be provided to prevent the blockage of drainage arrangements, taking into account the guidelines developed by the RBNA. Ships constructed before 1 January 2010 shall comply with the requirements of this paragraph by the first survey after 1 January 2010.

**602. Portable fire extinguishers**

- a. Portable extinguishers shall be provided at each deck level in each hold or compartment where vehicles are carried, spaced not more than 20 m apart on both sides of the space. At least one portable fire-extinguisher shall be located at each access to such a cargo space.
- b. In addition to the provision of paragraph E9.200, the following fire extinguishing appliances shall be provided in vehicle, ro-ro and special category spaces intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion:
- b.1. at least three water-fog applicators; and
- b.2. one portable foam applicator unit complying with the provisions of the Fire Safety Systems Code, provided that at least two such units are available in the ship for use in such ro-ro spaces.

**E15. CASUALTY THRESHOLD, SAFE RETURN TO PORT AND SAFE AREAS**

**100. Application**

101. Passenger ships constructed on or after 1 July 2010 having length of 120 m or more or having three or more main vertical zones shall comply with the provisions of this regulation.

**200. Purpose**

201. The purpose of this regulation is to establish design criteria for a ship's safe return to port under its own propulsion after a casualty that does not exceed the casualty threshold and also provides functional requirements and performance standards for safe areas.

**300. Casualty threshold**

301. The casualty threshold, in the context of a fire, includes:

- a. loss of space of origin up to the nearest "A" class boundaries, which may be a part of the space of origin, if the space of origin is protected by a fixed fire extinguishing system; or
- b. loss of the space of origin and adjacent spaces up to the nearest "A" class boundaries, which are not part of the space of origin.

**400. Safe return to port for passenger vessels**

401. Refer to the Performance standards for the systems and services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty [MSC.1/Circ.1214].

402. When fire damage does not exceed the casualty threshold indicated in E14.300, the ship shall be capable of returning to port while providing a safe area as defined in E14.300. To be deemed capable of returning to port, the following systems shall remain operational in the remaining part of the ship not affected by fire:

- a. propulsion;
- b. steering systems and steering-control systems;
- c. navigational systems;
- d. systems for fill, transfer and service of fuel oil;
- e. internal communication between the bridge, engineering spaces, safety centre, fire-fighting and damage control teams, and as required for passenger and crew notification and mustering;
- f. external communication;
- g. fire main system;

- h. fixed fire-extinguishing systems;
- i. fire and smoke detection system;
- j. bilge and ballast system;
- k. . power-operated watertight and semi-watertight doors;
- l. systems intended to support "safe areas" as indicated in paragraph 5.1.2;
- m. flooding detection systems; and
- n. other systems determined by the RBNA to be vital to damage control efforts.

#### **500. Safe area(s)**

501. Functional requirements:

502. The safe area(s) shall generally be internal space(s); however, the use of an external space as a safe area may be allowed by the RBNA taking into account any restriction due to the area of operation and relevant expected environmental conditions;

503. The safe area(s) shall provide all occupants with the following basic services\* to ensure that the health of passengers and crew is maintained:

- a. sanitation;
- b. water;
- c. food;
- d. . alternate space for medical care;
- e. . shelter from the weather;
- f. . means of preventing heat stress and hypothermia;
- g. . light; and
- h. ventilation;

504. Refer to the Performance standards for the systems and services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty [MSC.1/Circ.1214].

505. Ventilation design shall reduce the risk that smoke and hot gases could affect the use of the safe area(s); and

506. Means of access to life-saving appliances shall be provided from each area identified or used as a safe area, taking into account that a main vertical zone may not be available for internal transit.

#### **600. Alternate space for medical care**

601. Alternate space for medical care shall conform to a standard acceptable to the RBNA.\*

### **E16. DESIGN CRITERIA FOR SYSTEMS TO REMAIN OPERATIONAL AFTER A FIRE CASUALTY**

#### **100. Application**

101. Passenger ships constructed on or after 1 July 2010 having length of 120 m or more or having three or more main vertical zones shall comply with the provisions of this regulation.

#### **200. Purpose**

201. The purpose of this regulation is to provide design criteria for systems required to remain operational for supporting the orderly evacuation and abandonment of a ship, if the casualty threshold is exceeded.

#### **300. Systems\***

301. Refer to the Performance standards for the systems and services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty. [IACS MSC.1/Circ.1214]

302. In case any one main vertical zone is unserviceable due to fire, the following systems shall be so arranged and segregated as to remain operational:

- a. fire main;
- b. internal communications (in support of fire-fighting as required for passenger and crew notification and evacuation);
- c. means of external communications;
- d. bilge systems for removal of fire-fighting water;
- e. lighting along escape routes, at assembly stations and at embarkation stations of life-saving appliances; and
- f. guidance systems for evacuation shall be available.

303. The above systems shall be capable of operation for at least 3 h based on the assumption of no damage outside the unserviceable main vertical zone. These systems are not required to remain operational within the unserviceable main vertical zones.

304. Cabling and piping within a trunk constructed to an "A-60" standard shall be deemed to remain intact and serviceable while passing through the unserviceable main vertical zone for the purposes of E15.302. An equivalent degree of protection for cabling and piping may be approved by the RBNA.

## **E17. SAFETY CENTER ON PASSENGER SHIPS**

### **100. Application**

101. Passenger ships constructed on or after 1 July 2010 shall have on board a safety centre complying with the requirements of this regulation.

### **200. Purpose**

201. The purpose of this regulation is to provide a space to assist with the management of emergency situations.

### **300. Location and arrangement**

301. The safety centre shall either be a part of the navigation bridge or be located in a separate space adjacent to and having direct access to the navigation bridge, so that the management of emergencies can be performed without distracting watch officers from their navigational duties.

### **400. Layout and ergonomic design**

401. The layout and ergonomic design of the safety centre shall take into account the guidelines developed by the IMO, as appropriate.

### **500. Communications**

501. Means of communication between the safety centre, the central control station, the navigation bridge, the engine control room, the storage room(s) for fire extinguishing system(s) and fire equipment lockers shall be provided.

### **600. Control and monitoring of safety systems**

601. Notwithstanding the requirements set out elsewhere in the Convention, the full functionality (operation, control, monitoring or any combination thereof, as required) of the safety systems listed below shall be available from the safety centre:

- a. all powered ventilation systems;
- b. fire doors;
- c. general emergency alarm system;
- d. public address system;
- e. electrically powered evacuation guidance systems;
- f. watertight and semi-watertight doors;
- g. indicators for shell doors, loading doors and other closing appliances;
- h. water leakage of inner/outer bow doors, stern doors and any other shell door;
- i. television surveillance system;

- j. fire detection and alarm system;
- k. fixed fire-fighting local application system(s);
- l. sprinkler and equivalent systems;
- m. water-based systems for machinery spaces;
- n. alarm to summon the crew;
- o. atrium smoke extraction system;
- p. flooding detection systems; and
- q. fire pumps and emergency fire pumps.

## **E18. HELICOPTER FACILITIES**

### **100. Purpose**

101. The purpose of this regulation is to provide additional measures in order to address the fire safety objectives of this chapter for ships fitted with special facilities for helicopters. For this purpose, the following functional requirements shall be met:

- a. helideck structure must be adequate to protect the ship from the fire hazards associated with helicopter operations;
- b. fire fighting appliances shall be provided to adequately protect the ship from the fire hazards associated with helicopter operations;
- c. refuelling and hangar facilities and operations shall provide the necessary measures to protect the ship from the fire hazards associated with helicopter operations; and
- d. operation manuals and training shall be provided.

### **200. Application**

201. In addition to complying with the requirements of regulations in parts B, C, D and E, as appropriate, ships equipped with helidecks shall comply with the requirements of this regulation.

202. Where helicopters land or conduct winching operations on an occasional or emergency basis on ships without helidecks, fire-fighting equipment fitted in accordance with the requirements in SOLAS II-2 Part C may be used. This equipment shall be made readily available in close proximity to the landing or winching areas during helicopter operations.

203. Notwithstanding the requirements of E18.202 above, ro-ro passenger ships without helidecks shall comply with SOLAS regulation III/28.

### 300. Structure

**301. Construction of steel or other equivalent material:** in general, the construction of the helidecks shall be of steel or other equivalent materials. If the helideck forms the deckhead of a deckhouse or superstructure, it shall be insulated to "A-60" class standard

**302. Construction of aluminium or other low melting point metals:** if the RBNA permits aluminium or other low melting point metal construction that is not made equivalent to steel, the following provisions shall be satisfied:

- a. if the platform is cantilevered over the side of the ship, after each fire on the ship or on the platform, the platform shall undergo a structural analysis to determine its suitability for further use; and
- b. if the platform is located above the ship's deckhouse or similar structure, the following conditions shall be satisfied:
- c. the deckhouse top and bulkheads under the platform shall have no openings;
- d. windows under the platform shall be provided with steel shutters; and
- e. after each fire on the platform or in close proximity, the platform shall undergo a structural analysis to determine its suitability for further use.

### 400. Means of escape

401. A helideck shall be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These shall be located as far apart from each other as is practicable and preferably on opposite sides of the helideck.

### 500. Fire fighting appliances

401. In close proximity to the helideck, the following fire-fighting appliances shall be provided and stored near the means of access to that helideck:

- a. at least two dry powder extinguishers having a total capacity of not less than 45 kg;

#### Guidance

*Note: Refer to Unified interpretation of SOLAS chapter II-2 on the number and arrangement of portable fire extinguishers on board ships (MSC.1/Circ.1275).*

#### End of guidance

- b. carbon dioxide extinguishers of a total capacity of not less than 18 kg or equivalent;

#### Guidance

*Refer to the International Civil Aviation Organization Airport Services Manual, part 1, Rescue and Fire Fighting, chapter 8, Extinguishing Agent Characteristics, paragraph 8.1.5, Foam Specifications table 8-1, level 'B'.*

#### End of guidance

- c. a suitable foam application system consisting of monitors or foam making branch pipes capable of delivering foam to all parts of the helideck in all weather conditions in which helicopters can operate. The system shall be capable of delivering a discharge rate as required in table 18.1 for at least five minutes;

**Table T.E10.501.1 – FOAM DISCHARGE RATES**

| Category | Helicopter overall length              | Discharge rate foam solution (l/min.) |
|----------|--|---------------------------------------|
| H1       | up to but not including 15 m           | 250                                   |
| H2       | from 15 m up to but not including 24 m | 500                                   |
| H3       | from 24 m up to but not including 35 m | 800                                   |

- d. the principal agent shall be suitable for use with salt water and conform to performance standards not inferior to those acceptable to the Organization;

#### Guidance

*Refer to the International Civil Aviation Organization Airport Services Manual, part 1 - Rescue and Fire fighting, Chapter 8 - Extinguishing Agent Characteristics, Paragraph 8.1.5 - Foam Specifications Table 8-1, Level "B".*

#### End of guidance

- e. at least two nozzles of an approved dual-purpose type (jet/spray) and hoses sufficient to reach any part of the helideck;
- f. in addition to the requirements of regulation 10.10, two sets of fire-fighter's outfits; and
- g. at least the following equipment shall be stored in a manner that provides for immediate use and protection from the elements:
  - g.1. adjustable wrench;
  - g.2. blanket, fire-resistant;
  - g.3. cutters, bolt 60 cm;
  - g.4. hook, grabber/salvage;
  - g.5. hacksaw, heavy duty complete with 6

spare blades;

g.6. ladder;

g.7. lift line 5 mm diameter x 15 m in length;

g.8. pliers, sidecutting;

g.9. set of assorted screwdrivers; and

g.10. harness knife complete with sheath.

## 600. Drainage facilities

601. Drainage facilities in way of helidecks shall be constructed of steel and shall lead directly overboard independent of any other system and shall be designed so that drainage does not fall onto any part of the ship.

## 700. Helicopter refuelling and hangar facilities

701. Where the ship has helicopter refuelling and hangar facilities, the following requirements shall be complied with:

- a. a designated area shall be provided for the storage of fuel tanks which shall be:
  - a.1. as remote as is practicable from accommodation spaces, escape routes and embarkation stations; and
  - a.2. isolated from areas containing a source of vapour ignition;
- b. .2 the fuel storage area shall be provided with arrangements whereby fuel spillage may be collected and drained to a safe location;
- c. .3 tanks and associated equipment shall be protected against physical damage and from a fire in an adjacent space or area;
- d. .4 where portable fuel storage tanks are used, special attention shall be given to:
  - d.1. .4.1 design of the tank for its intended purpose;
  - d.2. .4.2 mounting and securing arrangements;
  - d.3. .4.3 electric bonding; and
  - d.4. .4.4 inspection procedures;
- e. storage tank fuel pumps shall be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity fuelling system is installed, equivalent closing arrangements shall be provided to isolate the fuel source;

- f. .6 the fuel pumping unit shall be connected to one tank at a time. The piping between the tank and the pumping unit shall be of steel or equivalent material, as short as possible, and protected against damage;
- g. .7 electrical fuel pumping units and associated control equipment shall be of a type suitable for the location and potential hazards;
- h. .8 fuel pumping units shall incorporate a device which will prevent over-pressurization of the delivery or filling hose;
- i. .9 equipment used in refuelling operations shall be electrically bonded;
- j. .10 "NO SMOKING" signs shall be displayed at appropriate locations;
- k. .11 hangar, refuelling and maintenance facilities shall be treated as category "A" machinery spaces with regard to structural fire protection, fixed fire-extinguishing and detection system requirements;
- l. .12 enclosed hangar facilities or enclosed spaces containing refuelling installations shall be provided with mechanical ventilation, as required by regulation 20.3 for closed ro-ro spaces of cargo ships. Ventilation fans shall be of non-sparking type; and
- m. .13 electric equipment and wiring in enclosed hangar or enclosed spaces containing refuelling installations shall comply with regulations 20.3.2, 20.3.3 and 20.3.4.

## 800. Operations manual and fire-fighting service

801. Each helicopter facility shall have an operations manual, including a description and a checklist of safety precautions, procedures and equipment requirements. This manual may be part of the ship's emergency response procedures.

802. The procedures and precautions to be followed during refuelling operations shall be in accordance with recognized safe practices and contained in the operations manual.

803. Fire-fighting personnel consisting of at least two persons trained for rescue and fire-fighting duties and fire-fighting equipment shall be immediately available at all times when helicopter operations are expected.

804. Fire-fighting personnel shall be present during refuelling operations. However, the fire-fighting personnel shall not be involved with refuelling activities.

805. On-board refresher training shall be carried out and additional supplies of fire-fighting media shall be



provided for training and testing of the equipment.

## CHAPTER F

### **FIRE FIGHTING FOR VESSELS WITH AB < 500** **[IACS Rec 99 – Recommendations for the Safety of** **Cargo Vessels of Less than Convention Size]**

#### CHAPTER CONTENTS

#### F1. APPLICATION

F2. FIRE PUMPS AND FIRE MAIN PIPING See  
Part II, Title 11, Section 6, Chapter F, Subchapter  
F2.

#### F3. FIRE SAFETY MEASURES

#### F4. RECOMENDATORY FIXED FIRE FIGHTING SYSTEMS

#### F5. FIRE-FIGHTING EQUIPMENT

#### F6. ALTERNATIVE DESIGN AND ARRANGEMENTS

#### F7. REQUIREMENTS FOR NON-PROPELLED VESSELS

#### F1. APPLICATION

##### 100. Application

101. The requirements of the present F are in conformity with the requirements of IACS Rec 99 for vessels under 500 GT.

- a. For vessel under the Brazilian Flag RBNA the recommendations of NORMAM 01 are to be taken into account;
- b. For vessels under foreing flags, the National RBNA are to be taken into account;
- c. Where there are no National RBNA regulations, the Rules requirements are to be taken into account;
- d. Where there is conflict between the Rules and the National RBNA requirements, the stricter regulations are to be adoptes.

102. Vessels carrying Chemicals in Bulk or Gas Carriers are subject to the IMO Bulk Chemical Code and to the IMO International Gas Carried Cod, according to Chapter 3SectionI, item 302ofNORMAM 01.

## 200. Fire safety objectives

201. The fire safety objectives of this chapter are to:

- a. prevent the occurrence of fire and explosion;
- b. reduce the risk to life caused by fire;
- c. reduce the risk of damage caused by fire to the vessel, its cargo and the environment;
- d. contain, control and suppress fire and explosion in the compartment of origin; and provide adequate and readily accessible means of escape for crew.

## 300. Achievement of the fire safety objectives

301. The fire safety objectives set out above could be achieved by ensuring compliance with Subchapters F1 to F5 or by alternative design and arrangements which comply with Subchapter F6.

302. A ship could be considered to achieve the fire safety objectives set out in first paragraph when either:

- a. the vessel's designs and arrangements, as a whole, comply with Subchapters F1 to F5, as applicable;
- b. the vessel's designs and arrangements, as a whole, have been reviewed and approved in accordance with Section 7; or
- c. part(s) of the vessel's designs and arrangements have been reviewed and approved in accordance with Section 7 and
- d. the remaining parts of the vessel comply with the relevant requirements of Subchapters F1 to F5.

### F3. FIRE SAFETY MEASURES

#### 100. Purpose

101. The purpose of this regulation shall contain a fire in the space of origin. For this purpose, the following functional Recommendations shall be met:

- a. the vessel shall be subdivided by thermal and structural boundaries;

- b. thermal insulation of boundaries shall have due regard to the fire risk of the space and adjacent spaces;

- c. the fire integrity of the divisions shall be maintained at openings and penetrations.

#### 200. Structural fire protection

201. The minimum fire integrity of bulkheads and decks shall be as prescribed in Table T.F3.201.1.

**TABLE T.F3.201.1 MINIMUM FIRE INTEGRITY OF BULKHEADS AND DECKS**

| Item | Compartment  | Separated by | Separated from the compartment   |
|------|--|--------------|--|
| 1    | Compartment of Class A machinery service spaces, compartments of high-risk vehicle | A-60         | Accommodations / control stations / gangways / stairs / service spaces of greater fire risk / compartment for vehicles |
| 2    | Compartment of Class A machinery   | A-0          | Other compartments other than those of item 1  |
| 3    | Kitchen  | A-0          | Unless specified otherwise   |
| 4    | Service space with greater fire risk except the kitchen                            | B-15         | Unless specified above (item 1)  |
| 5    | Corridor<br>Stairs   | B-0          | Unless specified above (item 1)  |
| 6    | Cargo compartment (except Ro-Ro compartment and compartments for vehicles)         | A-0          | Unless specified above (item 1)  |
| 7    | Ro-Ro compartment and compartments for vehicles (except open deck)                 | A-60         | Control stations / machinery spaces category A   |
| 8    | Ro-Ro compartment and compartments for vehicles (except open deck)                 | A-0          | Unless specified above (item 1)  |

202. Category 'A' machinery spaces shall be enclosed by A-60 Class divisions, where adjacent to:

- a. Accommodation spaces
- b. Control stations
- c. Corridors and staircases
- d. Service spaces of high fire risk,

and by A-0 Class divisions elsewhere. The divisions used to separate spaces, not mentioned above, shall be of non-combustible material.

203. The hull, superstructure, 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 SOLAS, the 'applicable fire exposure' shall be one hour. Vessels built of materials other than steel shall be specially considered.

204. It is recommended that stairways shall be enclosed, at least at one level, by divisions and doors or hatches, in order to restrict the free flow of smoke to other decks in the vessel and the supply of air to the fire. Doors forming such enclosures shall be self-closing.

205. Openings in 'A' Class divisions shall be provided with permanently attached means of closing which shall be at least as effective for resisting fires as the divisions in which they are fitted.

206. Interior stairways serving machinery spaces, accommodation spaces, service spaces or control stations shall be of steel or other equivalent material.

207. Doors shall be self-closing in way of Category 'A' machinery spaces and galleys, except where they are normally kept closed.

208. Where 'A' Class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for girders, beams or other structural members, arrangements shall be made to ensure that the fire resistance is not impaired. Arrangements shall also prevent the transmission of heat to un-insulated boundaries at the intersections and terminal points of the divisions and penetrations by insulating the horizontal and vertical boundaries or penetrations for a distance of 450 mm.

### 300. Materials

301. Paints, varnishes and other finishes used on exposed interior surfaces shall not be capable of producing excessive quantities of smoke, toxic gases or vapours and shall be of the low flame spread type in accordance with the IMO FTP Code, Annex 1, Parts 2 and 5.

302. Except in cargo spaces or refrigerated compartments of service spaces, insulating materials shall be non-combustible.

303. Where pipes penetrate 'A' or 'B' Class divisions, the pipes or their penetration piece shall be of steel or other approved materials having regard to the temperature and integrity recommendations such divisions are required to withstand.

304. Pipes conveying oil or combustible liquids through accommodation and service spaces shall be of steel or other approved materials having regard to the fire risk.

305. 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 the danger of flooding.

306. Primary deck coverings within accommodation spaces, service spaces and control stations shall be of a type which will not readily ignite, or give rise to toxic or explosive hazards at elevated temperatures in accordance with the IMO FTP Code, Annex 1, Parts 2 and 6.

307. Materials used for insulating pipes, etc., in machinery spaces and other compartments containing high fire risks shall be non-combustible. Vapour barriers and adhesives used in conjunction with insulation, as well as the insulation of pipe fittings, for cold service systems practicable and their exposed surfaces shall have low flame spread characteristics.

### 400. Surface of insulation

401. In spaces where penetration of oil products is possible, the surface of the insulation shall be impervious to oil or oil vapours. Insulation boundaries shall be arranged to avoid immersion in oil spillage.

### 500. Ventilation systems

501. Ventilation fans shall be capable of being stopped and main inlets and outlets of ventilation systems closed from outside the spaces being served.

502. Ventilation ducts for Category 'A' machinery spaces, ro-ro spaces and vehicle spaces shall not pass through accommodation spaces, galleys, service spaces or control stations, unless the ducts are constructed of steel and arranged to preserve the integrity of the division.

503. Ventilation ducts for accommodation spaces, service spaces or control stations shall not pass through Category 'A' machinery spaces or galleys unless the ducts are constructed of steel and arranged to preserve the integrity of the division.

504. Ventilation arrangement for store rooms containing highly flammable products shall be specially considered.

505. Ventilation systems serving Category 'A' machinery spaces and galley exhaust ducts shall be independent of systems serving other spaces.

506. Ventilation shall be provided to prevent the accumulation of gases that may be emitted from batteries.

507. Ventilation openings may be fitted in and under the lower parts of cabin, mess and dayroom doors in corridor bulkheads. The total net area of any such openings is not to exceed 0,05 m<sup>2</sup>. Balancing ducts shall not be permitted in fire divisions.

#### 600. Oil fuel arrangements

601. In a cargo vessel in which oil fuel is used, the arrangements for the storage, distribution and utilization of the oil fuel shall be such as to ensure the safety of the vessel and persons on board.

602. Oil fuel tanks situated within the boundaries of Category 'A' machinery spaces shall not contain oil fuel having a flashpoint of less than 60°C.

603. Oil fuel, lubricating oil and other flammable oils shall not be carried in forepeak tanks.

604. For vessels of 150 GT or more, and as far as practicable:

- a. oil fuel lines shall be arranged far apart from hot surfaces, electrical installations or other sources of ignition and shall be screened or otherwise suitably protected to avoid oil spray or oil leakage onto the sources of ignition. The number of joints in such piping systems shall be kept to a minimum.
- b. surfaces with temperatures above 220°C which may be impinged as a result of a fuel system failure shall be properly insulated. Precautions shall be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.
- c. External high-pressure fuel delivery lines between the high pressure fuel pumps and fuel injectors shall be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. A suitable enclosure on engines having an output of 375 kW or less having fuel injection pumps serving more than one injector may be used as an alternative to the jacketed piping system.

#### 700. Special arrangements in Category 'A' machinery spaces and where necessary other machinery spaces

701. The number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces shall be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the cargo vessel.

702. Skylights shall be of steel and are not to contain glass panels. Suitable arrangements shall be made to permit the release of smoke, in the event of fire, from the space to be protected.

703. Windows shall not be fitted in machinery space boundaries. This does not preclude the use of glass in control rooms within the machinery spaces.

704. Means of control shall be provided for:

- a. opening and closure of skylights, closure of openings in funnels which normally allow
- b. exhaust ventilation, and closure of ventilator dampers;
- c. permitting the release of smoke;
- d. closing power-operated doors or actuating release mechanism on doors other than power-operated watertight doors;
- e. stopping ventilating fans; and
- f. stopping forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps and other similar fuel pumps.

705. The controls required in F3.704 above shall be located outside the space concerned, where they will not be cut off in the event of fire in the space they serve. Such controls and the controls for any required fire-extinguishing system shall be situated at one control position or grouped in as few positions as possible. Such positions shall have a safe access from the open deck.

#### 800. Arrangements for gaseous fuel for domestic purposes and oil heating

801. Where gaseous fuel is used for domestic purposes, the arrangements for the storage, distribution and utilization of the fuel shall be specially considered.

802. Space heaters, if used, shall be fixed in position and so constructed as to reduce fire risks to a minimum. The design and location of these units shall be such that clothing, curtains or other similar materials cannot be scorched or set on fire by heat from the unit.

#### 900. Means of escape

901. Purpose: the purpose of this Recommendation is to provide means of escape so that persons on board can safely and swiftly escape to the lifeboat and liferaft embarkation deck. For this purpose, the following functional Recommendations shall be met:

- a. safe escape routes shall be provided;
- b. escape routes shall be maintained in a safe condition, clear of obstacles; and
- c. additional aids for escape shall be provided as necessary to ensure accessibility, clear marking, and adequate design for emergency situations.

902. Stairways, ladders and corridors serving crew spaces and other spaces to which the crew normally have access shall be arranged so as to provide ready means of escape to a deck from which embarkation into survival craft may be effected.

903. There shall be at least two means of escape, as widely separated as possible, from each section of accommodation and service spaces and control stations.

- a. The normal means of access to the accommodation and service spaces below the open deck shall be arranged so that it is possible to reach the open deck without passing through spaces containing a possible source of fire (e.g. machinery spaces, storage spaces of flammable liquids).
- b. The second means of escape may be through portholes or hatches of adequate size and preferably leading directly to the open deck.
- c. Dead-end corridors having a length of more than 7m shall not be accepted.

903. At least two means of escape shall be provided from machinery spaces, except where the small size of a machinery space makes it impracticable. Escape shall be by steel ladders that shall be as widely separated as possible.

#### **F4. RECOMMENDATORY FIXED FIRE FIGHTING SYSTEMS**

##### **100. Purpose**

101. The purpose of this recommendatory Chapter F4 shall suppress and swiftly extinguish a fire in the space of origin. For this purpose, the following functional Recommendations shall be met:

- a. fixed fire-extinguishing systems shall be installed, as applicable, having due
- b. regard to the fire growth potential of the protected spaces; and
- c. fire-extinguishing appliances shall be readily available.

##### **200. Recommendation for fixed fire-extinguishing arrangements in Category 'A' machinery spaces**

201. For machinery spaces of category 'A' on vessels with GT greater than or equal to 150 and operating in unrestricted or restricted waters, the provision of an approved fixed fire-extinguishing system, as specified in item F5.203 below is recommended.

202. Machinery spaces of category 'A' on vessels operating in protected areas may be exempted from this recommendation.

203. Fixed fire-fighting systems where required, shall be in accordance with the requirements of the IMO FSS Code.

##### **300. Protection of paint lockers and flammable liquid lockers**

301. The recommendations for the protection of paint lockers and flammable liquid lockers shall be specially considered.

##### **400. Portable Fire-extinguishers**

401. See Subchapter D5 above.

#### **F5. FIRE FIGHTING EQUIPMENT**

##### **100. General**

101. The fire fighting equipment shall comply with the minimum Recommendations as specified below, regardless of service in areas 01 or 02.

##### **200. Fire blanket**

201. A fire blanket shall be provided.

##### **300. Fire-fighter's outfit (which includes an axe)**

301. Fire Axe A fire axe is required to be carried on all such vessels over 20 meters in length. Firefighter's outfits are not required.

##### **400. Safety Plan and Fire Fighting Plan**

401. In all cargo vessels fire control plans shall comply with NORMAM 1, Annex 3-F and shall be permanently exhibited for the guidance of the vessel's officers, using graphical symbols that are in accordance with IMO Resolution A.952(23), which show clearly for each deck the control stations, the various fire sections enclosed by steel or 'A' Class divisions, together with particulars of:

- a. the fire detection and fire-alarm systems;
- b. fixed fire-fighting system, when fitted;
- c. the fire-extinguishing appliances;
- d. the means of access to different compartments, decks, etc.;
- e. the ventilating system, including particulars of the fan control positions, the position of dampers and identification numbers of the ventilating fans serving each section; and
- f. the location and arrangement of the emergency stop for the oil fuel unit pumps and for closing the valves on the pipes from oil fuel tanks.



402. The plans shall be kept up to date, any alterations being recorded thereon as soon as practicable. Description in such plans shall be in the official language of the Flag State. In addition, instructions concerning the maintenance and operation of all the equipment and installations on board for the fighting and containment of fire shall be kept under one cover, readily available in an accessible position.

403. In all cargo vessels greater than or equal to 150 GT, a duplicate set of fire-control plans shall be permanently stored in a prominently marked weather-tight enclosure outside the deckhouse for the assistance of shore-side fire-fighting personnel.

## F6. ALTERNATIVE DESIGN AND ARRANGEMENTS

### 100. General

101. Fire safety design and arrangements may deviate from sub chapters F1 to F6 of this Chapter, provided that the design and arrangements meet the fire safety objectives and the functional Recommendations, e que estejam em conformidade com os requisitos da NORMAM 01, Capítulo 4, Seção VII.

102. When fire safety design or arrangements deviate from the Recommendations of this Chapter, engineering analysis, evaluation and approval of the alternative design and arrangements shall be carried out in accordance with this regulation\*.

\* Reference can be made to MSC/Circ. 1002 *Guidelines on alternative design and arrangements for fire safety*

### 200. Engineering analysis

201. The engineering analysis shall be prepared and submitted to the Member Society, based on the guidelines developed by the International Maritime RBNA and shall include, as a minimum, the following elements:

- a. determination of the vessel type and space(s) concerned;
- b. identification of recommendation(s) with which the vessel or the space(s) will not comply;
- c. identification of the fire and explosion hazards of the vessel or the space(s) concerned:
  - c.1. identification of the possible ignition sources;
  - c.2. identification of the fire growth potential of each space concerned;
  - c.3. identification of the smoke and toxic effluent generation potential for each space concerned;

c.4. identification of the potential for the spread of fire, smoke or of toxic effluents from the space(s) concerned to other spaces;

d. determination of the required fire safety performance criteria for the vessel or the space(s) concerned:

d.1. performance criteria shall be based on the fire safety objectives and on the functional Recommendations of this Chapter;

d.2. performance criteria shall provide a degree of safety not less than that achieved by the recommendation in sub chapters F1 to F6 ; and

d.3. performance criteria shall be quantifiable and measurable;

e. detailed description of the alternative design and arrangements, including a list of the assumptions used in the design and any proposed operational restrictions or conditions; and

f. technical justification demonstrating that the alternative design and arrangements meet the required fire safety performance criteria.

### 300. Evaluation of the alternative design and arrangements

301. The engineering analysis required in F2.200 shall be evaluated and approved by Member Society taking into account the guidelines developed by the International Maritime RBNA and the requirements of NORMAM 01.

302. A copy of the documentation, as approved by the Member Society, indicating that the alternative design and arrangements comply with this regulation shall be carried onboard the vessel.

### 400. Re-evaluation due to change of conditions

401. If the assumptions, and operational restrictions that were stipulated in the alternative design and arrangements are changed, the engineering analysis shall be carried out under the changed condition and shall be approved by the RBNA.

Section 8 Fire extinguishing Recommendations for vessels not fitted with propelling machinery

## F7. REQUIREMENTS FOR NON-PROPELLED VESSELS

### 100. Basic Recommendations

101. Arrangements for fire protection, detection and extinction in vessels not fitted with propelling machinery shall be specially considered in each case and shall depend

on the size and purpose of the vessel and the presence of accommodation spaces, machinery and combustible materials on board.

## CHAPTER G. SHIP MANEUVERING: RUDDERS, SOLE PIECES AND RUDDER HORNS [IACS UR S10]

### CHAPTER CONTENTS

- G1. APPLICATION, DEFINITION, MATERIALS.
- G2. RUDDER FORCE AND RUDDER TORQUE
- G3. RUDDER STOCK.
- G4. RUDDER BLADE SCANTLINGS
- G5. RUDDER STOCK COUPLINGS AND PINTLES
- G6. RUDDER STOCK-, RUDDER SHAFT- AND PINTLE BEARINGS
- G7. STRENGTH OF SOLE PIECES AND OF RUDDER HORNS
- G8. GUIDELINES FOR CALCULATION OF BENDING MOMENT AND SHEAR FORCE DISTRIBUTION
- G9. PROPELLER NOZZLES

### G1. APPLICATION, DEFINITION, MATERIALS.

#### 100. General

101. Application. All self propelled vessel will have a system that gives manoeuvring conditions, in accordance with these Rules, appropriate to their maximum speed, the service and the navigation zone for which they are intended. There shall be two drives, a main and a stand by, independent of each other. The main shall be, in principle, by driving force.

102. The selected manoeuvring system shall be approved by the RBNA

103. The Rules that follow give the requirements for the conventional system, with rudder of common forms, with or without sole piece, and for its actuation, including the manual.

104. For special systems will be checked the direct calculation to be submitted for approval.

105. For steering gear mechanical components and transmissions, see Part II, Title 11, Section 5 – Engines and mechanics, Chapter f.

106. For hydraulic steering gear piping system, see Part II, Title 11, Section 6 - Piping Systems, Sub Chapter F7.

### 200. Definitions

201. Terms used herein.

- a. **Lower rudder stock diameter DI:** diameter of the region where the lower stock fits to the hull bearing, considered extending throughout the area just below, which receives and transmits bending and torsional stresses, in mm.
- b. **Upper rudder stock diameter DS:** diameter of coupling to the tiller handle (or quadrant), which receives and transmits torque only effort, in mm.
- c. **Hull bearing:** bearing (bearings in special cases) linked directly to the hull of the vessel, above the rudder, which supports the DS and absorbs the bending stress of the rudder stock.
- d. **Bottom bearing:** bearing supporting the lower stock, which may not exist in the case of suspended rudder, or roughly in the middle of its height, fixed in post in balance (rudder horn).
- e. **Support (or thrust) bearing:** support bearing in the axial direction, to support the weight and movement of the rudder and the stock; can be part of the driving engine.
- f. **Wheel ropes:** mechanical transmission devices of the rudder torque at the tiller by cables, rods, pulleys and gears, without actuation by driving force.

### 300. Basic assumptions

301. The following requirements apply to ordinary profile rudders, without any special arrangement for increasing the rudder force, such as fins, flaps, steering propellers, etc. Rudders not conforming to the ordinary types will be subject to special consideration.

302. These Rules does not apply to CSR Bulk Carriers.

### 400. Design considerations

401. Effective means are to be provided for supporting the weight of the rudder without excessive bearing pressure, e.g. by a rudder carrier attached to the upper part of the rudder stock. The hull structure in way of the rudder carrier is to be suitably strengthened.

402. Suitable arrangements are to be provided to prevent the rudder from lifting.

403. In rudder trunks which are open to the sea, a seal or stuffing box is to be fitted above the deepest load waterline, to prevent water from entering the steering gear compartment and the lubricant from being washed away from the rudder carrier.

404. If the top of the rudder trunk is below the deepest waterline, two separate stuffing boxes are to be provided.

## 500. Materials

501. Rudder stocks, pintles, coupling bolts, keys and cast parts of rudders are to be made of rolled, forged or cast carbon manganese steel in accordance with the Rules (see Part III, Title 61, Section 2, Chapter D, Part III, Title 62, Section 5, Chapter C; Part III, Title 61, Section 2, Chapter C . Part III, Title 62, Section 5, Chapter B; Part III, Title 61, Section 2, Chapter B, Subchapters B2, B3, B8, B9, B10, B11).

502. For rudder stocks, pintles, keys and bolts the minimum yield stress is not to be less than 200 N/mm<sup>2</sup>. The following requirements are based on a material's yield stress of 235 N/mm<sup>2</sup>.

503. If material is used having a yield stress differing from 235 N/mm<sup>2</sup> the material factor is to be determined as follows:

$$K = \left( \frac{235}{\sigma_f} \right)^e$$

with

$e = 0.75$  for  $\sigma_f > 235 \text{ N/mm}^2$

$e = 1.00$  for  $\sigma_f \leq 235 \text{ N/mm}^2$

$\sigma_f$  = yield stress (N/mm<sup>2</sup>) of material used, and is not

to be taken greater than  $0.7 \sigma_T$

or 450 N/mm<sup>2</sup>, whichever is the smaller value

$\sigma_T$  = tensile strength of material used

504. Before significant reductions in rudder stock diameter due to the application of steels with yield stresses exceeding 235 N/mm<sup>2</sup> are granted, the Society may require the evaluation of the rudder stock deformations. Large deformations shall be avoided in order to avoid excessive edge pressures in way of bearings.

505. Welded parts of rudders are to be made of approved rolled hull materials. Required scantlings may be reduced when higher tensile steels are applied. The material factor according to Part II, Title 11, Section 2, Subchapter C2 is to be used.

## G2. RUDDER FORCE AND RUDDER TORQUE

### 100. Rudder blades without cut-outs. See Fig. F.G2.100.1.

101. The total rudder force upon which the rudder scantlings are to be based is to be determined from the following formula:

$$C_R = K_1 * K_2 * K_3 * 132 * A * V^2 * K_{th} \quad [\text{N}]$$

Where:

$C_R$  = rudder force [N];

$A$  = area of rudder blade [m<sup>2</sup>];

$V$  = maximum service speed (knots) with the ship on summer load waterline. When the speed is less than 10 knots,  $V$  is to be replaced by the expression:

$$V_{min} = (V + 20) / 3$$

For the astern condition the maximum astern speed is to be used, however, in no case less than:

$$V_{astern} = 0.5 * V$$

$K_1$  = factor depending on the aspect ratio  $\lambda$  of the rudder area;

$K_1 = (\lambda + 2) / 3$ , with  $\lambda$  not to be taken greater than 2;

$\lambda = b^2 / A_t$ , where  $b$  = mean height of the rudder area [m].

Mean breadth and mean height of rudder are calculated acc. to the coordinate system in Fig F.G2.100.1;

$A_t$  = sum of rudder blade area  $A$  and area of rudder post or rudder horn, if any, within the height  $b$  [m<sup>2</sup>];

$K_3 = 0.8$  for rudders outside the propeller jet;

= 1.15 for rudders behind a fixed propeller nozzle;

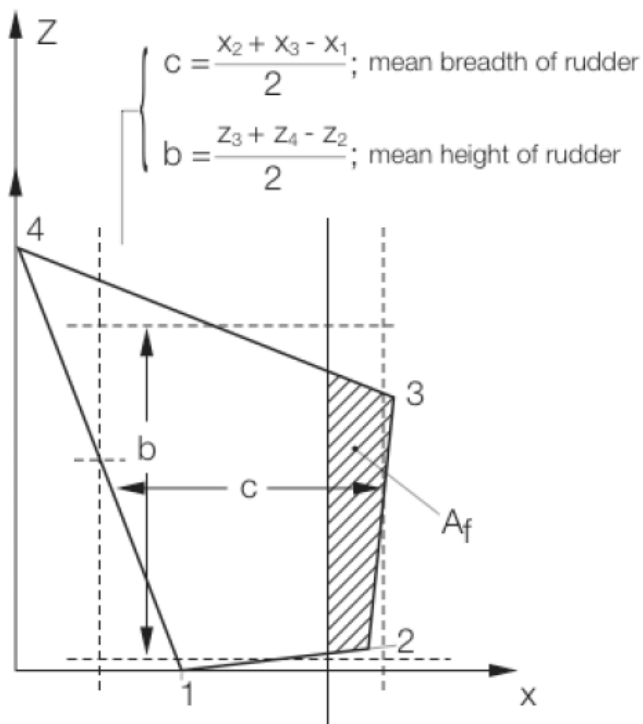
= 1.0 elsewhere, including also rudders within the propeller jet;

$$K_{th} = C_R (C_{th}) / C_R (C_{th} = 1.0).$$

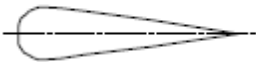


$C_{th}$  = thrust coefficient

$K_{th}$  is usually equal to 1.0 for rudders behind the propeller. For cases, where  $C_{th}$  is larger than one, it is left to the discretion of RBNA to consider the factor  $K_{th}$  with thrust coefficient  $C_{th}$  larger than 1.

**FIG F.G2.100.1 RUDDER BLADES WITHOUT CUT-OUTS.**



**TABLE T.G2.100.1 COEFFICIENT K<sub>2</sub>**

| Profile type   | <b>K<sub>2</sub></b> |                   |
|--|----------------------|-------------------|
|  | Ahead conditions     | Astern conditions |
| NACA-00 series Gottingen-profiles<br> | 1.1                  | 0.80              |
| Hollow profiles<br>                   | 1.35                 | 0.90              |
| Flat side profiles<br>                | 1.1                  | 0.90              |
| <b>High-lift Performance Rudders</b>   |                      |                   |
| Fish tail (e.g., Schilling high-lift rudder)   | 1.4                  | 0.8               |
| Flap rudder  | 1.7                  | 1.3               |
| Rudder with steering nozzle  | 1.9                  | 1.5               |

102. The rudder torque is to be calculated for both the ahead and astern condition according to the formula:

$$Q_R = C_R \cdot r \text{ [Nm]}$$

$$r = c (\alpha - k) \text{ [m]}$$

$c$  = mean breadth of rudder area [m], see Fig F.G2.100.1

$\alpha = 0.33$  for ahead condition

$\alpha = 0.66$  for astern condition

$\alpha = 0.75$  for astern condition (hollow profiles)

For parts of a rudder behind a fixed structure such as a rudder horn:

$\alpha = 0.25$  for ahead condition

$\alpha = 0.55$  for astern condition

$k$  = balance factor as follows

$$k = A_f / A$$

where  $A_f$  = portion of the rudder blade area situated ahead of the centreline of the rudder stock

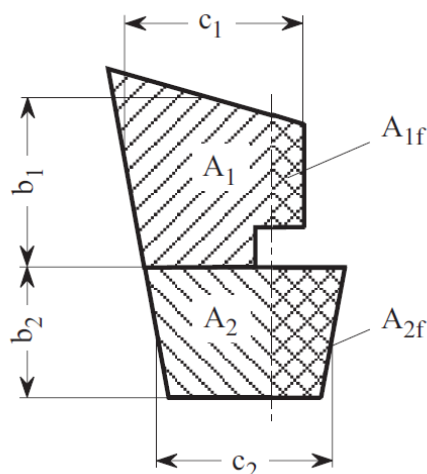
$r_{\min} = 0.1c$  [m] for ahead condition

## 200. Rudder blades with cut-outs (semi-spade rudders)

201. The total rudder force  $C_R$  is to be calculated according to G2.101. The pressure distribution over the rudder area, upon which the determination of rudder torque and rudder blade strength is to be based, is to be derived as follows:

202. The rudder area may be divided into two rectangular or trapezoidal parts with areas  $A_1$  and  $A_2$ , so that  $A = A_1 + A_2$  (see Fig. F.G2.202.1).

**FIG. F.G2.202.1 PARTIAL RUDDER AREAS  $A_1$  AND  $A_2$**



203. The levers  $r_1$  and  $r_2$  are to be determined as follows:

$$r_1 = c_1 (\alpha - K_1) \text{ [m]}$$

$$r_2 = c_2 (\alpha - K_2) \text{ [m]}$$

$c_1, c_2$  = mean breadth of partial areas  $A_1, A_2$  determined, where applicable, in accordance with Fig. F.G2.100.1 in G2.101 above.

$$k_1 = \frac{A_{1f}}{A_1}$$

$$k_2 = \frac{A_{2f}}{A_2}$$

$\alpha = 0.33$  for ahead condition

$\alpha = 0.66$  for astern condition

For parts of a rudder behind a fixed structure such as the rudder horn

$\alpha = 0.25$  for ahead condition

$\alpha = 0.55$  for astern condition

204. The resulting force of each part may be taken as:

$$C_{R1} = C_R \frac{A_1}{A} \text{ [N]}$$

$$C_{R2} = C_R \frac{A_2}{A} \text{ [N]}$$

205. The resulting torque of each part may be taken as:

$$Q_{R1} = C_{R1} \cdot r_1 \text{ [Nm]}$$

$$Q_{R2} = C_{R2} \cdot r_2 \text{ [Nm]}$$

206. The total rudder torque is to be calculated for both the ahead and astern condition according to the formula:

$$Q_R = Q_{R1} + Q_{R2} \text{ [Nm]}$$

207. For ahead condition  $Q_R$  is not to be taken less than

$$Q_{R\min} = 0.1 C_R \frac{A_1 c_1 + A_2 c_2}{A}$$

## G3. RUDDER STOCK.

### 100. Rudder stock scantlings in way of the tiller.

101. The rudder stock diameter required for the transmission of the rudder torque is to be dimensioned such that the torsional stress will not exceed the following value:

$$\tau = 68 / K$$



102. The rudder stock diameter for the transmission of the rudder torque is therefore not to be less than:

$$d_t = 4.2 \sqrt[3]{Q_R \cdot K} \quad [\text{mm}]$$

$Q_R$  = total rudder torque [Nm] as calculated in G2.102 and/or G2.206.

For the application of the material factor  $K$  see also G1.504.

## 200. Rudder strength calculation

201. The rudder force and resulting rudder torque causes bending moments and shear forces in the rudder body, bending moments and torques in the rudder stock, supporting forces in pintle bearings and rudder stock bearings and bending moments, shear forces and torques in rudder horns and heel pieces.

202. The rudder body is to be stiffened by horizontal and vertical webs enabling it to act as a bending girder.

203. The bending moments, shear forces and torques as well as the reaction forces are to be determined by a direct calculation or by an approximate simplified method considered appropriate by the Society.

204. For rudders supported by sole pieces or rudder horns these structures are to be included in the calculation model in order to account for the elastic support of the rudder body. Guidelines for calculation of bending moment and shear force distribution are given in Subchapter G8 below.

## 300. Rudder stock scantlings due to combined loads

301. If the rudder stock is subjected to combined torque and bending, the equivalent stress in the rudder stock is not to exceed 118 /  $K$ .

302. The equivalent stress is to be determined by the formula:

$$\sigma_c = \sqrt{\sigma_b^2 + 3\tau_t^2} \quad [\text{N/mm}^2]$$

Bending stress:  $\sigma_b = 10.2 M / d_c^3 \quad [\text{N/mm}^2]$

Torsional stress:  $\tau_t = 5.1 Q_R / d_c^3 \quad [\text{N/mm}^2]$

303. The rudder stock diameter at the lower part is therefore not less than:

$$d_c = d_t \sqrt[6]{1 + 4/3 [M / Q_R]^2} \quad [\text{mm}]$$

## G4. RUDDER BLADE SCANTLINGS

### 100. Permissible stresses.

101. The section modulus and the web area of a horizontal section of the rudder blade made of ordinary hull structural steel are to be such that the following stresses will not be exceeded:

a. rudder blades without cut-outs (Fig. F.G2.100.1)

- bending stress  $\sigma_b = 110 \text{ N/mm}^2$

- shear stress  $\tau = 50 \text{ N/mm}^2$

- equivalent stress  $\sigma_c = \sqrt{\sigma_b^2 + 3\tau^2} = 120 \text{ N/mm}^2$

b. rudder blades with cut-outs (e.g. semi-spade rudders. Fig. F.G2.202.1)

- bending stress  $\sigma_b = 75 \text{ N/mm}^2$

- shear stress  $\tau = 50 \text{ N/mm}^2$

- equivalent stress  $\sigma_c = \sqrt{\sigma_b^2 + 3\tau^2} = 100 \text{ N/mm}^2$

### 200. Rudder blade scantlings.

201. The thickness of the rudder side, top and bottom plating made of ordinary hull structural steel is not to be less than:

$$t = 5.5 s \beta \sqrt{d + C_R 10^{-4} / A} + 2.5 \quad [\text{mm}]$$

$d$  = summer loadline draught [m] of the ship;

$C_R$  = rudder force [N] according to G2.101;

$A$  = rudder area [ $\text{m}^2$ ];

$$\beta = \sqrt{1.1 - 0.5 [s / b]^2} \quad \text{max. } 1.00 \text{ if } b/s \geq 2.5$$

$s$  = smallest unsupported width of plating in [m];

$b$  = greatest unsupported width of plating in [m].

202. The thickness of the nose plates may be increased to the discretion of the Society. The thickness of web plates is not to be less than 70% of the rudder side plating, however not less than 8 mm. For higher tensile steels the material factor according to Part II, Title 11, Section 2, Chapter C is to be used correspondingly.

### 300. Single plate rudders

301. **Mainpiece diameter.** The mainpiece diameter is calculated according to G3.100 and G3.300 above respectively. For spade rudders the lower third may taper down to 0.75 times stock diameter.

302. **Blade thickness.** The blade thickness is not to be



d = stock diameter;

n = total number of bolts, which is not to be less than 8;

$k_b$  = material factor for bolts as given in G1.500;

$k_s$  = material factor for stock as given in G1.500;

302. The first moment of area of the bolts about the centre of the coupling, m, must be at least:

$$m = 0.00043 d^3$$

303. The thickness of the coupling flanges must be at least equal to the bolt diameter, and the width of the flange material outside the bolt holes must be greater than or equal to  $0.67d_b$ .

#### 400. Pintles

401. Pintles are to have a conical attachment to the gudgeons with a taper on diameter not greater than:

1:8 - 1:12 for keyed and other manually assembled pintles applying locking by slugging nut;  
1:12 - 1:20 on diameter for pintles mounted with oil injection and hydraulic nut.

402. The length of the pintle housing in the gudgeon is not to be less than the maximum pintle diameter:

$$d_p = 0.35 \sqrt{Bk_p}$$

where B is the relevant bearing force and  $k_p$  is the material factor as given in G1.500

403. The minimum dimensions of threads and nuts are to be determined according to para G5.204.

**TABLE T G6.104.1. ALLOWABLE SURFACE PRESSURE  $q_a$**

| Bearing material   | $q_a$ [N/mm <sup>2</sup> ] |
|--|----------------------------|
| lignum vitae   | 2.5                        |
| white metal, oil lubricated  | 4.5                        |
| synthetic material with hardness between 60 and 70 Shore D <sup>1)</sup> | 5.5                        |
| steel <sup>2)</sup> and bronze and hot-pressed bronze-graphite materials | 7.0                        |

<sup>1)</sup> Indentation hardness test at 23°C and with 50% moisture, acc. to a recognized standard. Synthetic bearing materials to be of approved type.

<sup>2)</sup> Stainless and wear-resistant steel in an approved combination with stock liner.

#### 200. Length of bearings.

201. The length/diameter ratio of the bearing surface is not to be greater than 1.2.

#### 300. Bearing clearances

301. With metal bearings, clearances shall not be less than  $d_b / 1000 + 1.0$  [mm] on the diameter.

302. If non-metallic bearing material is applied, the bearing clearance is to be specially determined considering the material's swelling and thermal expansion properties.

303. This clearance is not to be taken less than 1.5 mm on bearing diameter unless a smaller clearance is supported by the manufacturer's recommendation and there is documented evidence of satisfactory service history with a reduced clearance.

### G6. RUDDER STOCK-, RUDDER SHAFT- AND PINTLE BEARINGS

#### 100. Minimum bearing surface

102. An adequate lubrication is to be provided.

103. The bearing surface  $A_b$  (defined as the projected area: length x outer diameter of liner) is not to be less than:

$$A_b = P / q_a \text{ [mm}^2\text{]}$$

where

P = reaction force [N] in bearing as determined in G3.203-G3.204 above;

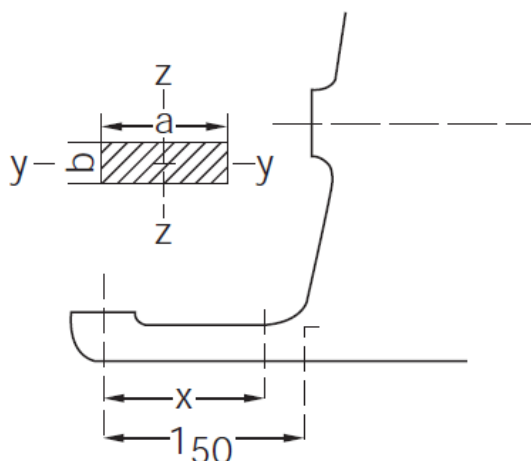
$q_a$  = allowable surface pressure according to the table T G6.104.1. below.

104. The maximum surface pressure  $q_a$  for the various combinations is to be taken as reported in the table below. Higher values than given in the table may be taken in accordance with makers' specifications if they are verified by tests:

## G7. STRENGTH OF SOLE PIECES AND OF RUDDER HORNS

### 100. Sole piece

FIG. F.G7.100.1 SOLE PIECE



101. The section modulus around the vertical (z)-axis is not to be less than:

$$Z_z = M_b K / 80 \text{ [cm}^3\text{]}$$

102. The section modulus around the transverse (y)-axis is not to be less than:

$$Z_y = 0.5 Z_z$$

103. The sectional area is not to be less than:

$$A_s = B_1 K / 48 \text{ [mm}^2\text{]}$$

K = material factor as given in G1.500 or in Part II, Title 11, Section 2, Chapter C respectively.

104. **Equivalent stress.** At no section within the length  $\ell_{50}$  is the equivalent stress to exceed  $115 / K$ . The equivalent stress is to be determined by the following formula:

$$\sigma_c = \sqrt{\sigma_b^2 + 3\tau^2} \text{ [N/mm}^2\text{]}$$

$$\sigma_b = M_b / Z_z(x) \text{ [N/mm}^2\text{]}$$

$$\tau = B_1 / A_s \text{ [N/mm}^2\text{]}$$

$M_b$  – bending moment at the section considered [Nm]

$$M_b = B_1 x \text{ [Nm]}$$

$$M_{bmax} = B_1 \ell_{50} \text{ [Nm]}$$

$B_1$  = supporting force in the pintle bearing [N]  
(normally  $B_1 = C_R / 2$ ).

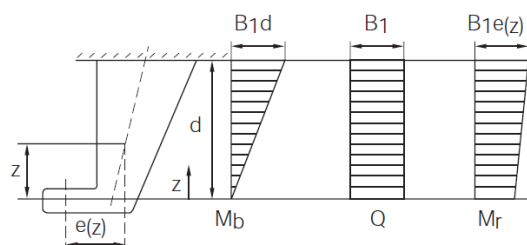
### 200. Rudder horn.

201. When the connection between the rudder horn and the hull structure is designed as a curved transition into the hull plating, special consideration shall be given to the effectiveness of the rudder horn plate in bending and to the stresses in the transverse web plates.

202. The loads on the rudder horn are as follows:

- $M_b$  = bending moment =  $B_1 z$  [Nm],  $M_{bmax} = B_1 d$  [Nm]
- $q$  = shear force =  $B_1$  [N]
- $M_T(z)$  = torsional moment =  $B_1 e(z)$  [Nm]

FIG. F.G7.202.1 RUDDER HORN.



203. An estimate for  $B_1$  is:

$$B_1 = C_R b / (\ell_{20} + \ell_{30}) \text{ [N]}.$$

For  $b$ ,  $\ell_{20}$  and  $\ell_{30}$ , see Fig. F.G8.100.2 of Subchapter G8 below.

204. The section modulus around the horizontal x-axis is not to be less than:

$$Z_x = M_b K / 67 \text{ [cm}^3\text{]}.$$

205. The shear stress is not to be larger than:

$$\tau = 48 / K \text{ [N/mm}^2\text{]}.$$

206. **Equivalent stress.** At no section within the length  $d$  is the equivalent stress to exceed  $120 / K$ . The equivalent stress is to be calculated by the following formula:

$$\sigma_c = \sqrt{\sigma_b^2 + 3(\tau^2 + \tau_T^2)} \text{ [N/mm}^2\text{]}$$

$$\sigma_b = M_b / Z_x \text{ [cm}^3\text{]}$$

$$\tau = B_1 / A_h \text{ [N/mm}^2\text{]}$$

$$\tau_T = M_T 10^3 / 2 A_T t_h \text{ [N/mm}^2\text{]}$$

$A_h$  = effective shear area of rudder horn in y-direction;

$A_T$  = area in the horizontal section enclosed by the rudder horn [mm<sup>2</sup>];

$t_h$  = plate thickness of rudder horn [mm];

K = material factor as given in G1.500 or in Part II, Title 11, Section 2, Chapter C respectively.

### 300. Pintle housing

301. The bearing length  $L_p$  of the pintle is to be such that

$$D_p \leq L_p \leq 1.2 D_p$$

302. The length of the pintle housing in the gudgeon is not to be less than the pintle diameter  $D_p$ .

303. The thickness of the pintle housing is not to be less than  $0.25 D_p$

## G8. GUIDELINES FOR CALCULATION OF BENDING MOMENT AND SHEAR FORCE DISTRIBUTION

### 100. General

101. The evaluation of bending moments, shear forces and support forces for the system rudder –rudder stock may be carried out for some basic rudder types as shown in Fig. F.G8.101.1-F.G8.101.3 as outlined below.

### 200. Data for the analysis

201. The following data shall submitted for analysis:

$\ell_{10}$  -  $\ell_{50}$  = lengths of the individual girders of the system in [m];

$I_{10}$  -  $I_{50}$  = moments of inertia of these girders in [cm<sup>4</sup>].

202. For rudders supported by a sole piece the length  $\ell_{20}$  is the distance between lower edge of rudder body and centre of sole piece and  $I_{20}$  the moment of inertia of the pintle in the sole piece.

### 203. Load of rudder body (general)

$$P_R = C_R / 10^3 * \ell_{10} \text{ [kN/m]}.$$

### 204. Load for semi-spade rudders

$$P_{R10} = C_{R2} / \ell_{10} * 10^3 \text{ [kN/m]};$$

$$P_{R20} = C_{R1} / \ell_{10} * 10^3 \text{ [kN/m]}$$

for  $C_R$ ,  $C_{R1}$ ,  $C_{R2}$ , see G2.200

Z = spring constant of support in the sole piece or rudder horn respectively;

$Z = 6.18 * I_{50} / \ell_{50}^3 \text{ [kN/m]}$  for the support in the sole piece (Fig. F.G8.100.1)

$I_{50}$  = moment of inertia of sole piece around the z-axis [cm<sup>4</sup>];

$l_{50}$  = effective length of sole piece in [m];

$Z = 1 / (f_b + f_t) \text{ [kN/m]}$  for the support in the rudder horn (Fig. F.G8.100.2);

$f_b$  = unit displacement of rudder horn in [m] due to a unit force of 1 kN acting in the centre of support;

$$f_b = 1.3 d^3 / (6.18 I_n) \text{ [m/kN]} \text{ (guidance value);}$$

$I_n$  = moment of inertia of rudder horn around the x-axis in [cm<sup>4</sup>] (see also Fig. F.G7.202.1);

$f_t$  = unit displacement due to torsion;

$$f_t = d e^2 \sum u_i / t_i / (3.14 \times 10^8 F_T^2) \text{ [m/kN]};$$

$F_T$  = mean sectional area of rudder horn in [m<sup>2</sup>];

$u_i$  = breadth in [mm] of the individual plates forming the mean horn sectional area;

$t_i$  = thickness within the individual breadth  $u_i$  in [mm];

for e, d, see Fig. F.G8.100.2.

### 300. Moments and forces to be evaluated

301. The bending moment  $M_R$  and the shear force  $Q_1$  in the rudder body, the bending moment  $M_b$  in the neck bearing and the support forces  $B_1$ ,  $B_2$ ,  $B_3$  are to be evaluated.

302. The so evaluated moments and forces are to be used for the stress analyses required by G3.200, G5.100-G5.300, G6 and G7.

### 400. Estimates for spade rudders

401. For spade rudders the moments and forces may be determined by the following formulae:

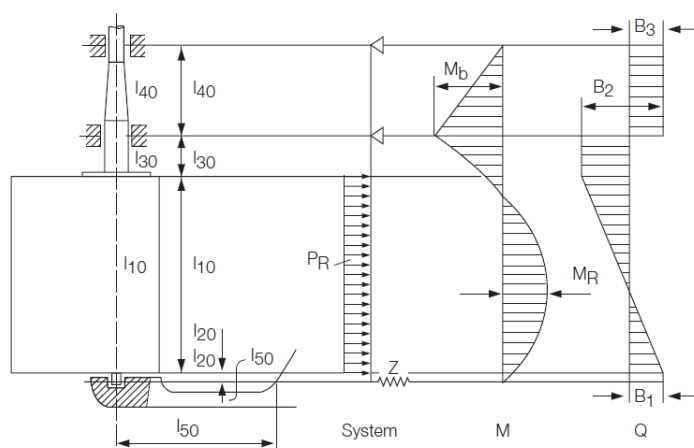
$$M_b = C_R (\ell_{20} + (\ell_{10} (2 c_1 + c_2) / 3 (c_1 + c_2))) \text{ [Nm]};$$

$$B_3 = M_b / \ell_{30} \text{ [N]};$$

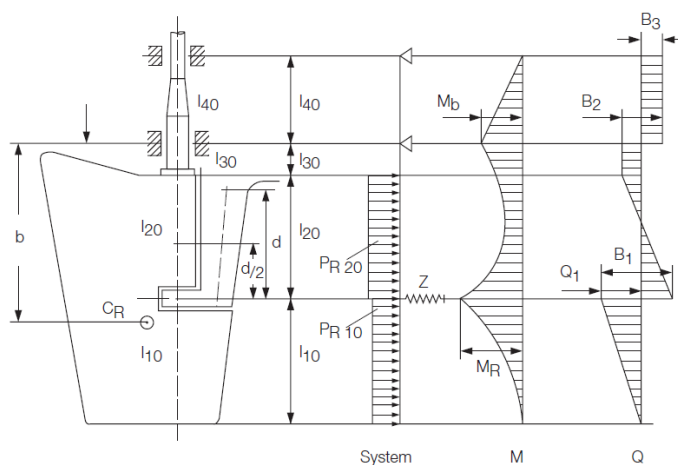
$$B_2 = C_R + B_3 \text{ [N]}.$$



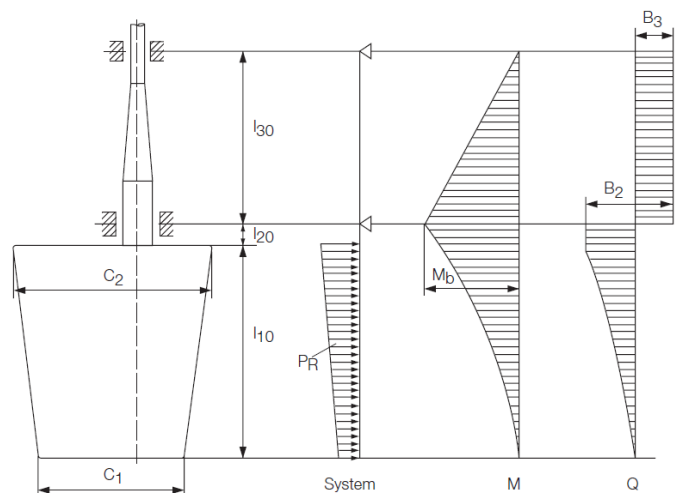
**FIGURE. F.G8.101.1 - RUDDER SUPPORTED BY SOLE PIECE**



**FIGURE F.G8.101.2 - SEMI-SPADE RUDDER**



**FIGURE F.G8.101.3 - SPADE RUDDER**



**G9. PROPELLER NOZZLES****100. Application**

101. The requirements in this section are applicable for fixed propeller nozzles with inner diameter  $d$  of 5 meters (16.4 feet) or less.

102. Nozzles of larger inner diameter are subject to special consideration with all supporting documents and calculations submitted for review.

**200. Design Pressure**

201. The design pressure of the nozzle is to be obtained from the following:

$$p_d = 10^{-6} \cdot c \cdot \varepsilon \cdot \left( \frac{N}{A_p} \right) \text{ N/mm}^2 \text{ (kgf/mm}^2, \text{ psi)}$$

where

$c$  = coefficient as indicated in T.G9.200.1.

$\varepsilon$  = coefficient as indicated in T.G9.200.2, but not to be taken less than 10

$N$  = maximum shaft power, in kW ( $h_p$ )

$A_p$  = propeller disc area =  $D^2 \frac{\pi}{4}$ , in  $m^2$  ( $ft^2$ )

$D$  = propeller diameter, in  $m$  ( $ft$ )

**TABLE T.G9.200.1 COEFFICIENT  $c$** 

| Propeller Zone<br>(see FIG. F.G9.200.1) | $c$               |                     |                     |
|---|-------------------|---------------------|---------------------|
|   | $p_d$ in $N/mm^2$ | $p_d$ in $kgf/mm^2$ | $p_d$ in $psi$      |
| 2                                       | 10.0              | 1.02                | $11.62 \times 10^3$ |
| 1&3                                     | 5.0               | 0.51                | $5.81 \times 10^3$  |
| 4                                       | 3.5               | 0.36                | $4.067 \times 10^3$ |

**TABLE T.G9.200.1 COEFFICIENT  $\varepsilon$** 

|               | $p_d$ in $N/mm^2$                                    | $p_d$ in $kgf/mm^2$                                  | $p_d$ in $psi$  |
|---------------|--|--|---|
| $\varepsilon$ | $21 - 2 \times 10^{-2} \left( \frac{N}{A_p} \right)$ | $21 - 2 \times 10^{-2} \left( \frac{N}{A_p} \right)$ | $21 - 16 \times 10^{-2} \left( \frac{N}{A_p} \right)$ |

**300. Nozzle Cylinder**

301. **Shell Plate Thickness.** The thickness of the nozzle shell plating, in  $mm$  ( $in.$ ), is not to be less than:  $t = t_o + t_c$ , but not to be taken less than 7.5 (0.3)  $mm$  ( $in.$ ), where  $t_o$  = thickness obtained from the following formula:

$$t_o = c_n \cdot S_p \cdot \sqrt{p_d} \text{ mm (in.)}$$

$c_n$  = coefficient as indicated in T.G9.300.1

$S_p$  = spacing of ring webs in  $mm$  ( $in.$ )

$p_d$  = nozzle design pressure in  $N/mm^2$  ( $kgf/mm^2$ ,  $psi$ ), as defined in G9.200.

$t_c$  = corrosion allowance determined by T.G9.300.2

$K_n$  = nozzle material factor as defined in G1.500 above.

**TABLE T.G9.300.1 COEFFICIENT  $c_n$** 

|       | $p_d$ in $N/mm^2$     | $p_d$ in $kgf/mm^2$   | $p_d$ in $psi$        |
|-------|-----------------------|-----------------------|-----------------------|
| $c_n$ | $1.58 \times 10^{-1}$ | $4.95 \times 10^{-1}$ | $1.32 \times 10^{-2}$ |

**TABLE T.G9.300.2 CORROSION ALLOWANCE  $t_c$** 

| Value of $t_o$           | $t_c$                    |
|--------------------------|--------------------------|
| If $t_o \leq 10.0$ (0.4) | 1.5 (0.06)               |
| If $t_o > 10.0$ (0.4)    | The lesser of $b_1, b_2$ |

where  
 $b = 3.0$  (0.12)  $mm$  ( $in.$ )  
 $b_2 = \left( \frac{t_o}{\sqrt{K_n}} + 5 \right) \times 10^{-1} \text{ mm}$  or  $b_2 = \left( \frac{t_o}{\sqrt{K_n}} + 0.2 \right) \times 10^{-1} \text{ in.}$

**400. Internal Diaphragm Thickness**

401. Thickness of nozzle internal ring web is not to be less than the required nozzle shell plating for Zone 3.

**500. Nozzle Section Modulus**

501. The minimum requirement for nozzle section modulus is obtained from the following formula:

$$SM = d^2 b V_d^2 Q n \text{ cm}^3 \text{ (in}^3\text{)}$$

where

$d$  = nozzle inner diameter, in  $m$  ( $ft$ )

$b$  = nozzle length, in  $m$  ( $ft$ )

$V_d$  = design speed in ahead condition, in knots, as defined in G2.101 above.

$Q$  = reduction factor conditional on material type

= 1.0 for ordinary strength steel

= 0.78 for H32 strength steel

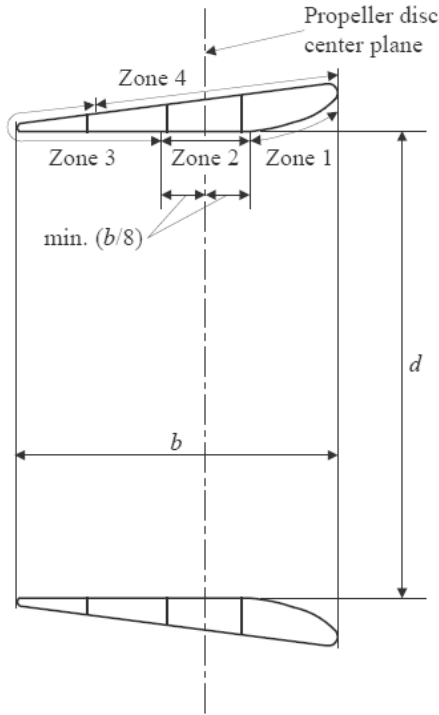
= 0.72 for H36 strength steel

= 0.68 for H40 strength steel

$Q$  factor for steel having yield strength other than above is to be specially considered.

$n$  = nozzle type coefficient taken equal to 0.7 (0.0012) for fixed nozzles

FIG. F.G9.200.1 NOZZLE RING SECTION VIEW

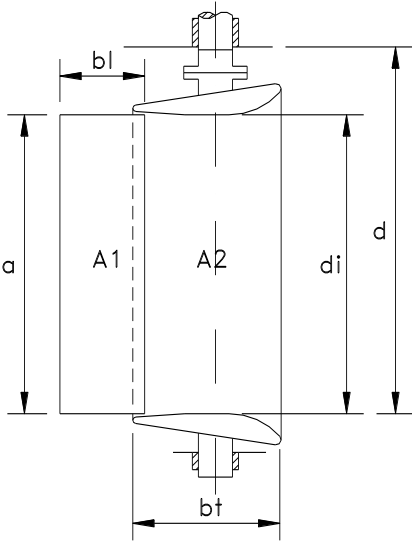


600. Moving propeller nozzles

601. For moving propeller nozzles the area, the centre of the area and the force are to be calculated considering twice the lateral área of the nozzle and considering the height at the diameter  $d_i$  added to the area of the rudder blade aft of the nozzle.

602. The bending moment taken from the figure F.G9.601.1. below is calculated by the following formula:

FIGURE F.G9.602.1 – MOVING PROPELLER NOZZLE



$$M = \frac{F \cdot d_i}{8} \left[ \frac{d_i^2}{d} \right]$$

603. The torsional moment is calculated by the following formula:

$$MT = F \cdot x \quad \text{kgf} \cdot \text{m} \quad (\text{daN} \cdot \text{m})$$

CHAPTER H  
EVALUATION OF SCANTLINGS OF HATCH  
COVERS AND HATCH COAMINGS AND CLOSING  
ARRANGEMENTS OF CARGO HOLDS OF SHIPS  
[IACS UR S21A]

CHAPTER CONTENTS

- H1. APPLICATION AND DEFINITIONS
- H2. HATCH COVER AND COAMING LOAD MODEL
- H3. HATCH COVER STRENGTH CRITERIA
- H4. DETAILS OF HATCH COVERS
- H5. HATCH COAMING STRENGTH CRITERIA
- H6. CLOSING ARRANGEMENTS
- H7. CORROSION ADDITION AND STEEL RENEWAL
- H8. CORROSION ADDITION AND STEEL RENEWAL

H1. APPLICATION AND DEFINITIONS  
[UR S21A1]

100. Application  
[IACS UR S21A1.1.]

- 101. These requirements apply to all ships except bulk carriers, ore carriers and combination carriers, and are for all cargo hatch covers and coamings on exposed decks.
- 102. The strength requirements are applicable to hatch covers and hatch coamings of stiffened plate construction and its closing arrangements.
- 103. This Chapter H is applicable to hatch covers and coamings made of steel. In case of alternative materials and innovative designs the approval is subject to the

individual class society.

104. This Chapter H does not apply to portable covers secured weathertight by tarpaulins and battening devices, or pontoon covers, as defined in ICLL Regulation 15.

105. This Chapter H applies for ships contracted for construction on or after **1 July 2012**. These requirements are in addition to the requirements of the ICLL.

106. The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of “contract for construction”, refer to IACS Procedural Requirement (PR) No. 29.

## **200. Definitions** **[IACS UR S21A1.2.]**

201. ICLL Where ICLL is referred to in the text, this is to be taken as the International Convention on Load Lines, 1966 as amended by the 1988 protocol, as amended in 2003.

### **201. Hatch cover types [IACS UR S21A.1.2.1]**

- a. **Single skin cover:** a hatch cover made of steel or equivalent material that is designed to comply with ICLL Regulation 16. The cover has continuous top and side plating, but is open underneath with the stiffening structure exposed. The cover is weathertight and fitted with gaskets and clamping devices unless such fittings are specifically excluded.
- b. **Double skin cover:** a hatch cover as above but with continuous bottom plating such that all the stiffening structure and internals are protected from the environment.
- c. **Pontoon type cover:** a special type of portable cover, secured weathertight by tarpaulins and battening devices. Such covers are to be designed in accordance with ICLL Regulation 15 and are not covered by this UR.

#### *Guidance:*

*Modern hatch cover designs of lift-away-covers are in many cases called pontoon covers. This definition does not fit to the definition above. Modern lift-away hatch cover designs shall belong to one of the two categories single skin covers or double skin cover.*

#### *End of guidance*

202. **Positions [UR S21A1.2.2.]:** the hatchways are classified according to their position as follows:

- a. Position 1 Upon exposed freeboard and raised quarterdecks, and upon exposed superstructure

decks situated forward of a point located a quarter of ship's length from forward perpendicular.

- b. Position 2 Upon exposed superstructure decks situated abaft a quarter of the ship's length from the forward perpendicular and located at least one standard height of the superstructure above the freeboard deck.

- c. Upon exposed superstructure decks situated forward of a point located a quarter of the ship's length from the forward perpendicular and located at least two standard height of the superstructure above the freeboard deck.

203. ICLL – IMO International Convention for Load Line

204. FEM – Finite element method (of calculation).

## **300. Material** **[IACS UR S21A-1.3]**

301. Hatch covers and coamings are to be made of material in accordance with the definitions of Part II, Title 11, Section 2, Chapter C (UR S6). A material class I is to be applied for hatch covers.

## **400. General requirements** **[IACS UR S21A-1.4.]**

401. Primary supporting members and secondary stiffeners of hatch covers are to be continuous over the breadth and length of hatch covers, as far as practical. When this is impractical, sniped end connections are not to be used and appropriate arrangements are to be adopted to provide sufficient load carrying capacity.

402. The spacing of primary supporting members parallel to the direction of secondary stiffeners is not to exceed 1/3 of the span of primary supporting members. When strength calculation is carried out by FE analysis using plane strain or shell elements, this requirement can be waived.

403. Secondary stiffeners of hatch coamings are to be continuous over the breadth and length of hatch coamings.

## **500. Net scantling approach** **[IACS UR S21A1.5.]**

501. Unless otherwise quoted, the thicknesses *t* of the following sections are net thicknesses.

502. The net thicknesses are the member thicknesses necessary to obtain the minimum net scantlings required by Subchapters H3. and H5. below.

503. The required gross thicknesses are obtained by adding corrosion additions, *ts*, given in Table T.H7.101.1.

in subchapter H7. below.

504. Strength calculations using beam theory, grillage analysis or FEM are to be performed with net scantlings.

## **H2. HATCH COVER AND COAMING LOADMODEL [IACS UR S21A-2]**

### **100. Definitions**

101. Structural assessment of hatch covers and hatch coamings is to be carried out using the design loads, defined in this chapter. **See Table T.H2.101.1.**

$L$  = length of ship, in m, as defined in [UR S2]

$L_{LL}$  = length of ship, in m, as defined in ICLL Regulation 3

$x$  = longitudinal co-ordinate of mid point of assessed structural member measured from aft end of length  $L$  or  $L_{LL}$ , as applicable

$T_{fb}$  = draught, in m, corresponding to the assigned summer load line

$h_N$  = standard superstructure height in m  
 $= 1,05 + 0,01L_{LL}$ ,  $1,8 \leq h_N \leq 2,3$

### **200. Vertical weather design load [IACSUR S21A2.1.]**

201. The pressure  $p_H$ , in kN/m<sup>2</sup>, on the hatch cover panels is given by ICLL. This may be taken from Table T.H2.101.1. The vertical weather design load needs not to be combined with cargo loads according to H2.400. and H2.500. below.

202. In Figure F.H2.202.1. the positions 1 and 2 are illustrated for an example ship.

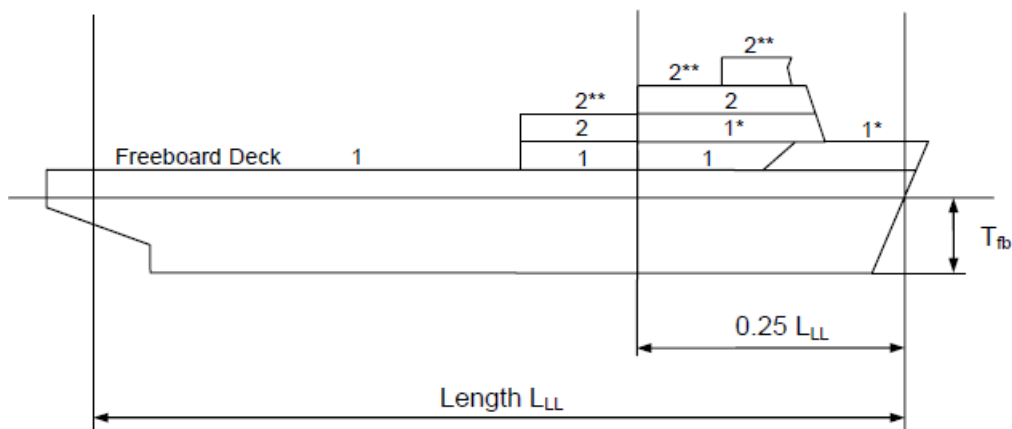
203. Where an increased freeboard is assigned, the design load for hatch covers according to Table T.H2.101.1 on the actual freeboard deck may be as required for a superstructure deck, provided the summer freeboard is such that the resulting draught will not be greater than that corresponding to the minimum freeboard calculated from an assumed freeboard deck situated at a distance at least equal to the standard superstructure height  $h_N$  below the actual freeboard deck, see Figure F.H2.203.1.



**TABLE T.H2.101.1 - DESIGN LOAD  $p_H$  OF WEATHER DECK HATCHES**

| Position | Design load $p_H$ [kN/m <sup>2</sup> ]   |   |
|----------|--|---|
|          | $\frac{x}{L_{LL}} \leq 0,75$   | $0,75 < \frac{x}{L_{LL}} \leq 1,0$  |
| 1        | for $24 \text{ m} \leq L_{LL} \leq 100 \text{ m}$  |   |
|          | $\frac{9,81}{76} \cdot (1,5 \cdot L_{LL} + 116)$   | on freeboard deck   |
|          |  | $\frac{9,81}{76} \cdot \left[ (4,28 \cdot L_{LL} + 28) \cdot \frac{x}{L_{LL}} - 1,71 \cdot L_{LL} + 95 \right]$ |
|          |  | upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck  |
|          |  | $\frac{9,81}{76} \cdot (1,5 \cdot L_{LL} + 116)$  |
|          | for $L_{LL} > 100 \text{ m}$   |   |
|          | 9,81 · 3,5   | on freeboard deck for type B ships according to ICLL  |
|          |  | $9,81 \cdot \left[ (0,0296 \cdot L_1 + 3,04) \cdot \frac{x}{L_{LL}} - 0,0222 \cdot L_1 + 1,22 \right]$          |
|          |  | on freeboard deck for ships with less freeboard than type B according to ICLL                                   |
|          |  | $9,81 \cdot \left[ (0,1452 \cdot L_1 - 8,52) \cdot \frac{x}{L_{LL}} - 0,1089 \cdot L_1 + 9,89 \right]$          |
| 2        |  | $L_1 = L_{LL}$ but not more than 340 m  |
|          |  | upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck  |
|          |  | 9,81 · 3,5  |
|          | for $24 \text{ m} \leq L_{LL} \leq 100 \text{ m}$  |   |
|          | $\frac{9,81}{76} \cdot (1,1 \cdot L_{LL} + 87,6)$  |   |
|          | for $L_{LL} > 100 \text{ m}$   |   |
|          | 9,81 · 2,6   |   |
|          | upon exposed superstructure decks located at least one superstructure standard height above the lowest Position 2 deck |   |
|          | 9,81 · 2,1   |   |

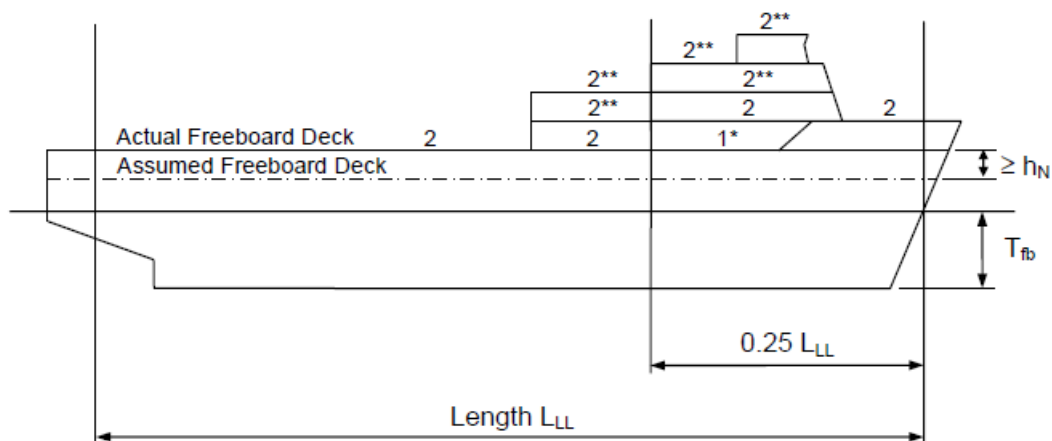
**FIGURE F.H2.202.1 - POSITIONS 1 AND 2**



\* reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck

\*\* reduced load upon exposed superstructure decks of vessels with  $L_{LL} > 100$  m located at least one superstructure standard height above the lowest Position 2 deck

**FIGURE FLH2.203.1 - POSITIONS 1 AND 2 FOR AN INCREASED FREEBOARD**



\* reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck

\*\* reduced load upon exposed superstructure decks of vessels with  $L_{LL} > 100$  m located at least one superstructure standard height above the lowest Position 2 deck

### 300. Horizontal weather design load [UR S21A2.2.]

301. The horizontal weather design load, in kN/m<sup>2</sup>, for determining the scantlings of outer edge girders (skirt plates) of weather deck hatch covers and of hatch coamings is:

$$p_A = a \cdot c \cdot (b \cdot c_L \cdot f - z)$$

$$f = \frac{L}{25} + 4,1 \text{ for } L < 90 \text{ m}$$

$$= 10,75 - \left(\frac{300-L}{100}\right)^{1,5} \text{ for } 90 \text{ m} \leq L < 300 \text{ m}$$

$$= 10,75 \text{ for } 300 \text{ m} \leq L < 350 \text{ m}$$

$$= 10,75 - \left(\frac{L-350}{150}\right)^{1,5} \text{ for } 350 \text{ m} \leq L \leq 500 \text{ m}$$

$$c_L = \sqrt{\frac{L}{90}} \text{ for } L < 90 \text{ m}$$

$$= 1 \text{ for } L \geq 90 \text{ m}$$

$a = 20 + \frac{L_1}{12}$  for unprotected front coaming and hatch cover skirt plates

$a = 10 + \frac{L_1}{12}$  for unprotected front coamings and hatch cover skirt plates, where the distance from the actual freeboard deck to the summer load line exceeds the minimum non-corrected tabular freeboard according to ICLL by at least one standard superstructure height  $h_N$

$a = 5 + \frac{L_1}{15}$  for side and protected front coaming and hatch cover skirt plates

$a = 7 + \frac{L_1}{100} - 8 \cdot \frac{x'}{L}$  for aft ends of coaming and aft hatch cover skirt plates abaft amidships

$a = 5 + \frac{L_1}{100} - 4 \cdot \frac{x'}{L}$  for aft ends of coaming and aft hatch cover skirt plates forward of amidships

$L_1 = L$ , need not be taken greater than 300 m

$$b = 1,0 + \left(\frac{\frac{x'}{L} - 0,45}{C_B + 0,2}\right)^2 \text{ for } \frac{x'}{L} < 0,45$$

$$= 1,0 + 1,5 \cdot \left(\frac{\frac{x'}{L} - 0,45}{C_B + 0,2}\right)^2 \text{ for } \frac{x'}{L} \geq 0,45$$

$0,6 \leq C_B \leq 0,8$ , when determining scantlings of coamings and aft hatch cover skirt plates forward of amidships,  $C_B$  need not be taken less than 0,8.

$x'$  = distance in m between the transverse coaming or hatch cover skirt plate considered and aft end of the length  $L$ . When determining side coamings or side hatch cover skirt plates, the side is to be subdivided into parts of approximately equal length, not exceeding  $0,15 L$  each, and  $x'$  is to be taken as the distance between aft end of the length  $L$  and the centre of each part considered.

$z$  = vertical distance in m from the summer load line to the midpoint of stiffener span, or to the middle of the plate field

$$c = 0,3 + 0,7 \cdot \frac{b'}{B'}$$

$b'$  = breadth of coaming in m at the position considered

$B'$  = actual maximum breadth of ship in m on the exposed weather deck at the position considered.

$b'/B'$  is not to be taken less than 0,25.

The design load  $p_A$  is not to be taken less than the minimum values given in Table.2 T.H2.301.1.

**TABLE T.H2.301.1 - MINIMUM DESIGN LOAD**  
**P<sub>Amin</sub>**

| L     | P <sub>Amin</sub> in kN/m <sup>2</sup> for |                       |
|-------|--|-----------------------|
|       | unprotected fronts                         | elsewhere             |
| ≤ 50  | 30   | 15                    |
| > 50  | $25 + \frac{L}{10}$                        | $12,5 + \frac{L}{20}$ |
| < 250 |  |                       |
| ≥ 250 | 50   | 25                    |

### 400. Distributed Cargo loads [IACS UR S21A2.3]

401. **Distributed loads** [UR S21A2.3.1.]: the load on hatch covers due to cargo loads  $p_L$ , in kN/m<sup>2</sup>, resulting from heave and pitch is to be determined according to the following formula:

$$p_L = p_C (1 + a_v)$$

where:

$p_C$  = uniform cargo load in kN/m<sup>2</sup>

$a_v$  = acceleration addition as follows:

$$a_v = F \cdot m$$

$$F = 0,11 \cdot \frac{v_0}{\sqrt{L}}$$

$$m = m_o - 5(m_o - 1) \frac{x}{L} \text{ for } 0 \leq \frac{x}{L} \leq 0,2$$

$$= 1,0 \text{ for } 0,2 < \frac{x}{L} \leq 0,7$$

$$= 1 + \frac{m_o + 1}{0,3} \left[ \frac{x}{L} - 0,7 \right] \text{ for } 0,7 < \frac{x}{L} \leq 1,0$$

$$m_o = 1,5 + F$$

$v_0$  = max. speed at summer load line draught,  $v_0$  is not to be taken less than  $\sqrt{L}$  in kN.

**402. Point loads[IACS UR S21A2.3.2.]:** the loads due to single forces  $P$  in kN resulting from heave and pitch (e.g. in case of containers) are to be determined as follows:

$$P = P_S(1 + a_v)$$

$P_S$  = single force in kN

**500. Container loads**  
**[IACS UR S21A 2.4.]**

501. Where containers are stowed on hatch covers the following loads in kN due to heave, pitch, and the ship's rolling motion are to be considered, see also Fig.3. Figure F.H2.501.1.

$$A_z = 9,81 \frac{M}{2} (1 + a_v) \left( 0,45 - 0,42 \frac{h_m}{b} \right)$$

$$B_z = 9,81 \frac{M}{2} (1 + a_v) \left( 0,45 + 0,42 \frac{h_m}{b} \right)$$

$$B_y = 2,4 \cdot M$$

$a_v$  = acceleration addition according to 2.3.1 H2.401.

$M$  = maximum designed mass of container stack in t

$h_m$  = designed height of centre of gravity of stack above hatch cover supports in m

$b$  = distance between foot points in m

$A_z, B_z$  = support forces in z-direction at the forward and aft stack corners

$B_y$  = support force in y-direction at the forward and aft stack corners

*Note:*

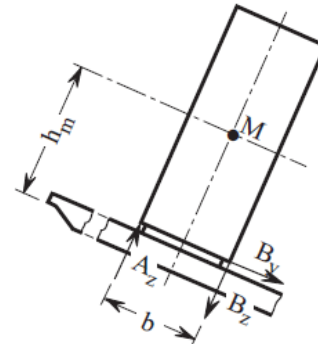
*For  $M$  and  $h_m$  it is recommended to apply those values, which are used for the calculations of cargo securing (container lashing). If different assumptions are made for  $M$  and  $h_m$ , the designer has to verify that, in the calculation model, the hatch cover structure is not loaded less than by those values recommended.*

*When strength of the hatch cover structure is assessed by FE analysis according to H3.502 using shell or plane strain elements,  $h_m$  may be taken as the designed height of centre of gravity of stack above the hatch cover top plate.*

502. Values of  $M$  and  $h_m$  applied for the assessment of hatch cover strength are to be shown in the drawings of the hatch covers. In case of container stacks secured to lashing bridges or carried in cell guides the forces acting on the hatch cover may be specially considered. Alternatively, container loads may be applied based on accelerations calculated by an individual acceleration

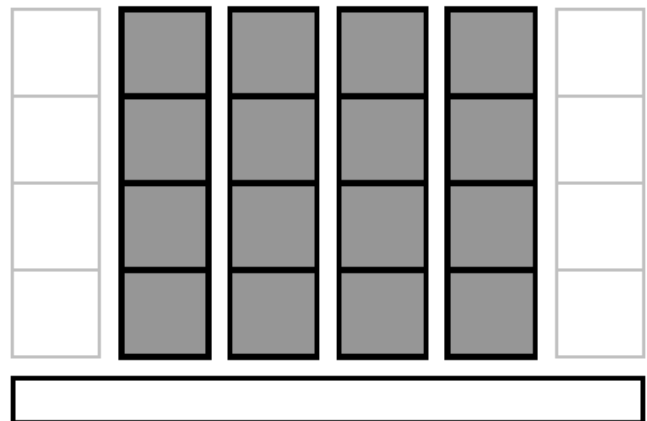
analysis for the used lashing system. The individual acceleration analysis shall be carried out by the individual classification society.

**FIGURE F.H2.501.1 - FORCES DUE TO CONTAINER LOADS**



503. **Load cases with partial loading[IACS S21A2.4.1.]:** the load cases H2.400. and H2.500. are also to be considered for partial non homogeneous loading which may occur in practice, e.g. where specified container stack places are empty. The load case partial loading of container hatch covers can be evaluated using a simplified approach, where the hatch cover is loaded without the outermost stacks, see Figure F.H2.503.1.

**FIGURE F.H2.503.1 - PARTIAL LOADING OF A CONTAINER HATCH**



## 600. Loads due to elastic deformations of the ship's hull

601. Hatch covers, which in addition to the loads according to H2.200. to H2.500. are loaded in the ship's transverse direction by forces due to elastic deformations of the ship's hull, are to be designed such that the sum of stresses does not exceed the permissible values given in H3.101. [IACS UR S21A 2.4.2.]

## H3. HATCH COVER STRENGTH CRITERIA [IACS UR S21-A 3]

### 100. Permissible stresses and deflections [IACS UR S21-A 3.1.]

101. **Stresses**[IACS UR S21- A 3.1.1.]: the equivalent stress  $\sigma_v$  in steel hatch cover structures related to the net thickness shall not exceed  $0,8 \times \sigma_F$ , where  $\sigma_F$  is the minimum yield stress, in N/mm<sup>2</sup>, of the material. For design loads according to H2.300. 2.2 to H2.504. 2.5, the equivalent stress  $\sigma_v$  related to the net thickness shall not exceed  $0,9 \cdot \sigma_F$  when the stresses are assessed by means of FEM<sup>(\*)</sup> using plane stress or shell elements. For steels with a minimum yield stress of more than 355 N/mm<sup>2</sup>, the value of  $\sigma_F$  to be applied throughout this requirement is subject to the individual classification society but is not to be more than the minimum yield stress of the material. For beam element calculations and grillage analysis, the equivalent stress may be taken as follows:

(\*) FEM = Finite Element Method (of calculation)

$$\sigma_v = \sqrt{\sigma^2 + 3\tau^2} \text{ in N/mm}^2$$

$\sigma$  = normal stress in N/mm<sup>2</sup>

$\tau$  = shear stress in N/mm<sup>2</sup>

For FEM calculations, the equivalent stress may be taken as follows:

$$\sigma_v = \sqrt{\sigma_x^2 - \sigma_x \cdot \sigma_y + \sigma_y^2 + 3\tau^2} \text{ in N/mm}^2$$

$\sigma_x$  = normal stress, in N/mm<sup>2</sup>, in x-direction

$\sigma_y$  = normal stress, in N/mm<sup>2</sup>, in y-direction

$\tau$  = shear stress, in N/mm<sup>2</sup>, in the x-y plane

Indices x and y are coordinates of a two-dimensional Cartesian system in the plane of the considered structural element. In case of FEM calculations using shell or plane strain elements, the stresses are to be read from the centre of the individual element. Where shell elements are used, the stresses are to be evaluated at the mid plane of the element. Stress concentrations are to be assessed to the satisfaction of the individual classification society RBNA.

102. **Deflection**[IACS UR S21A 3.1.2.]: the vertical deflection of primary supporting members due to the vertical weather design load according to H2.200 is to be not more than  $0,0056 \times l_g$ , where  $l_g$  is the greatest span of primary supporting members.

*Note:*

Where hatch covers are arranged for carrying containers and mixed stowage is allowed, i.e., a 40'-container stowed on top of two 20'-containers, particular attention shall be paid to the deflections of hatch covers. Further the possible contact of deflected hatch covers with in hold cargo has to be observed.

### 200. Local net plate thickness: [UR S21A 3.2.]

201. The local net plate thickness  $t$ , in mm, of the hatch cover top plating is not to be less than:

$$t = F_p \cdot 15,8 \cdot S \sqrt{\frac{p}{0,95 \cdot \sigma_F}}$$

and to be not less than 1% of the spacing of the stiffener or 6 mm if that be greater.

$F_p$  = factor for combined membrane and bending response

= 1, 5 in general

=  $1,9 \cdot \frac{\sigma}{\sigma_a}$ , for  $\frac{\sigma}{\sigma_a} \geq 0,8$  for the attached plate flange of primary supporting members

$s$  = stiffener spacing in m

$p$  = pressure  $p_H$  and  $p_L$ , in kN/m<sup>2</sup>, as defined in 2.

$\sigma$  = normal stress, in N/mm<sup>2</sup>, of hatch cover top plating

$\sigma_a = 0,8 \sigma_F$  in N/mm<sup>2</sup>

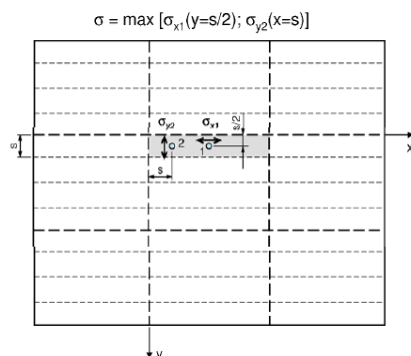
For flange plates under compression sufficient buckling strength according to H4 is to be demonstrated.

*Note:*

The normal stress  $\sigma$  of the hatch cover plating may be determined in a distance  $s$  from webs of adjacent primary supporting members perpendicular to secondary stiffeners and in a distance  $s/2$  from the web of an adjacent primary supporting member parallel to secondary stiffeners, refer to F.H3.201.1. The greater of both stresses is to be taken. For the distribution of normal stress  $\sigma$  between two parallel girders, refer to H4.105.b.



### FIGURE F.H3.201.1. - DETERMINATION OF NORMAL STRESS OF THE HATCH COVER PLATING



202. **Local net plate thickness of hatch covers for wheel loading**[IACS UR S21A3.2.1.]: the thickness have to be derived from the RBNA Rules.

203. **Lower plating of double skin hatch covers and box girders**[IACS UR S21A3.2.2.]: the thickness to fulfill the strength requirements is to be obtained from the calculation according to H3.500. under consideration of permissible stresses according to H3.101. The net thickness must not be less than the larger of the following values when the lower plating is taken into account as a strength member of the hatch cover:

$$t = 6,5 \times s \quad \text{in mm}$$

$$t_{\min} = 5 \text{ mm}$$

s = stiffener spacing in m

When the lower plating is not considered as a strength member of the hatch cover, the thickness of the lower plating shall be determined according to the individual class society's Rules.

#### 300. Net scantling of secondary stiffeners [UR S21A3.3.]

301. The net section modulus Z and net shear area  $A_s$  of uniformly loaded hatch cover stiffeners constraint at both ends must not be less than:

$$Z = \frac{10^4}{\sigma_F} \cdot s \cdot l^2 \cdot p \quad \text{in cm}^3$$

$$A_s = \frac{10 \cdot s \cdot l \cdot p}{\sigma_F} \quad \text{in cm}^2$$

l = secondary stiffener span, in m, to be taken as the spacing, in m, of primary supporting members or the distance between a primary supporting member and the edge support, as applicable.

s = secondary stiffener spacing in m

p = pressure  $p_H$  and  $p_L$ , in  $\text{kN/m}^2$ , as defined in H2. 2.

302. The net section modulus of the secondary stiffeners is to be determined based on an attached plate width assumed equal to the stiffener spacing.

303. For flat bar secondary stiffeners and buckling stiffeners, the ratio  $h/t_w$  is to be not greater than  $15 \cdot k^{0.5}$ , where:

h = height of the stiffener

$t_w$  = net thickness of the stiffener

$$k = 235/\sigma_F$$

304. Stiffeners parallel to primary supporting members and arranged within the effective breadth according to H3.501 must be continuous at crossing primary supporting member and may be regarded for calculating the cross sectional properties of primary supporting members. It is to be verified that the combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures does not exceed the permissible stresses according to H3.101.

305. For hatch cover stiffeners under compression sufficient safety against lateral and torsional buckling according to H4.105 is to be verified.

306. For hatch covers subject to wheel loading stiffener scantlings are to be determined by direct calculations under consideration of the permissible stresses according to H3.101 or are to be determined according to the individual class society's Rules.

#### 400. Net scantling of primary supporting members [IACS UR S21A3.4.]

401. **Primary supporting members**[IACS UR S21A 3.4.1.]: scantlings are obtained from calculations according to H3.500. under consideration of permissible stresses according to H3.101. For all components of primary supporting members sufficient safety against buckling must be verified according to H4. For biaxial compressed flange plates this is to be verified within the effective widths according to H4.

402. The net thickness, in mm, of webs of primary supporting members shall not be less than:

$$t = 6,5 \cdot s \quad \text{in mm}$$

$$t_{\min} = 5 \text{ mm}$$

s = stiffener spacing in m

402. **Edge girders (Skirt plates)**[IACS URS21A]3.4.2.]: scantlings of edge girders are obtained

from the calculations according to H3.500. under consideration of permissible stresses according to H3.101. The net thickness, in mm, of the outer edge girders exposed to wash of sea shall not be less than the largest of the following values:

$$t = 15,8 \cdot s \cdot \sqrt{\frac{P_A}{0,95 \cdot \sigma_F}}$$

$t = 8,5$  s in mm

$t_{\min} = 5$  mm

$P_A$  = horizontal pressure as defined in H3.300..

$s$  = stiffener spacing in m

The stiffness of edge girders is to be sufficient to maintain adequate sealing pressure between securing devices. The moment of inertia, in  $\text{cm}^4$ , of edge girders is not to be less than:

$$I = 6 \cdot q \cdot S_{SD}^4$$

$q$  = packing line pressure in N/mm, minimum 5 N/mm

$S_{SD}$  = spacing, in m, of securing devices

## 500. Strength calculations [IACS UR S21A 3.5.]

**501. Effective cross-sectional properties for calculation by beam theory or grillage analysis [UR S21A3.5.1.]:** strength calculation for hatch covers may be carried out by either, using beam theory, grillage analysis or FEM. Cross-sectional properties are to be determined considering the effective breadth. Cross sectional areas of secondary stiffeners parallel to the primary supporting member under consideration within the effective breadth can be included, refer Figure F.H4.501. The effective breadth of plating  $e_m$  of primary supporting members is to be determined according to T.H4.504.1. Considering the type of loading. Special calculations may be required for determining the effective breadth of one-sided or non-symmetrical flanges. The effective cross sectional area of plates is not to be less than the cross sectional area of the face plate. For flange plates under compression with secondary stiffeners perpendicular to the web of the primary supporting member, the effective width is to be determined according to H4.105.b.

### T.H4.504.1. EFFECTIVE BREADTH $e_m$ OF PLATING OF PRIMARY SUPPORTING MEMBERS

| 1/e        | 0 | 1    | 2    | 3    | 4    | 5    | 6    | 7    | $\geq 8$ |
|------------|---|------|------|------|------|------|------|------|----------|
| $e_{m1}/e$ | 0 | 0,36 | 0,64 | 0,82 | 0,91 | 0,96 | 0,98 | 1,00 | 1,00     |
| $e_{m2}/e$ | 0 | 0,2  | 0,37 | 0,52 | 0,65 | 0,75 | 0,84 | 0,89 | 0,90     |

$e_{m1}$  is to be applied where primary supporting members are loaded by uniformly distributed loads or else by not less than 6 equally spaced single loads

$e_{m2}$  is to be applied where primary supporting members are loaded by 3 or less single loads Intermediate values may be obtained by direct interpolation.

$l$  length of zero-points of bending moment curve:

$l = 10$  for simply supported primary supporting members

$l = 0,6 \cdot 10$  for primary supporting members with both ends constraint,

where  $10$  is the unsupported length of the primary supporting member

$e$  width of plating supported, measured from centre to centre of the adjacent unsupported fields

**502. General requirements for FEM<sup>(\*)</sup> calculations**[IACS UR S21A3.5.2.]: for strength calculations of hatch covers by means of finite elements, the cover geometry shall be idealized as realistically as possible. Element size must be appropriate to account for effective breadth. In no case element width shall be larger than stiffener spacing. In way of force transfer points and cutouts the mesh has to be refined where applicable. The ratio of element length to width shall not exceed 4. The element height of webs of primary supporting member must not exceed one-third of the web height. Stiffeners, supporting plates against pressure loads, have to be included in the idealization. Buckling stiffeners may be disregarded for the stress calculation.

(\*) FEM = Finite Element Method (of calculation)

#### H4. BUCKLING STRENGTH OF HATCHCOVER STRUCTURES [UR S21A3.6.]

##### 100. General

101. For hatch cover structures sufficient buckling strength is to be demonstrated. The buckling strength assessment of coaming parts is to be done according to the RBNA Rules.

##### 102. Definitions

a = length of the longer side of a single plate field in mm (x-direction)

b = breadth of the shorter side of a single plate field in mm (y-direction)

$\alpha$  = aspect ratio of single plate field  
=  $a / b$

n = number of single plate field breadths within the partial or total plate field

t = net plate thickness in mm

$\sigma_x$  = membrane stress, in  $\text{N/mm}^2$ , in x-direction  
 $\sigma_y$  = membrane stress, in  $\text{N/mm}^2$ , in y-direction

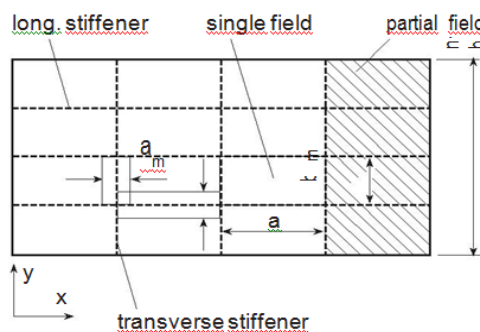
$\tau$  = shear stress, in  $\text{N/mm}^2$ , in the x-y plane

E = modulus of elasticity, in  $\text{N/mm}^2$ , of the material  
=  $2,06 \cdot 10^5 \text{ N/mm}^2$  for steel

$\sigma_F$  = minimum yield stress, in  $\text{N/mm}^2$ , of the material

Compressive and shear stresses are to be taken positive, tension stresses are to be taken negative.

**FIGURE F.H4.102.1. GENERAL ARRANGEMENT OF PANEL**



**longitudinal: stiffener in the direction of the length a**  
**transverse: stiffener in the direction of the breadth b**

Note:

If stresses in the x- and y-direction already contain the Poisson-effect (calculated using FEM), the following modified stress values may be used. Both stresses  $\sigma_x^*$  and  $\sigma_y^*$  are to be compressive stresses, in order to apply the stress reduction according to the following formulae:

$$\sigma_x = (\sigma_x^* - 0,3 \sigma_y^*) / 0,91$$

$$\sigma_y = (\sigma_y^* - 0,3 \sigma_x^*) / 0,91$$

$\sigma_x^*, \sigma_y^*$  = stresses containing the Poisson-effect

Where compressive stress fulfils the condition  $\sigma_y^* < 0,3 \sigma_x^*$ , then  $\sigma_y = 0$  and  $\sigma_x = \sigma_x^*$

F1 = correction factor for boundary condition at the longitudinal stiffeners according to Table T.H4.102.1.

**TABLE T.H4.102.1 – CORRECTION FACTOR F<sub>1</sub>**

|   |   |
|---|---|
| Stiffeners sniped at both ends  | 1,00  |
| Guidance values <sup>1</sup> where both ends are effectively connected to adjacent structures   | 1,05 for flat bars<br>1,10 for bulb sections<br>1,20 for angle and tee-sections<br>1,30 for u-type sections <sup>2</sup> and girders of high rigidity |
| An average value of F <sub>1</sub> is to be used for plate panels having different edge stiffeners  |   |
| <sup>1</sup> Exact values may be determined by direct calculations<br><sup>2</sup> Higher value may be taken if it is verified by a buckling strength check of the partial plate field using non-linear FEA and deemed appropriate by the individual class society but not greater than 2.0 |   |

$\sigma_e$  = reference stress, in  $\text{N/mm}^2$ , taken equal to

$$= 0,9 \cdot E (t/b)^2$$

$\Psi$  = edge stress ratio taken equal to

$$= \sigma_2 / \sigma_1 \text{ where}$$

$\sigma_1$  = maximum compressive stress

$\sigma_2$  = minimum compressive stress or tension stress

S = safety factor (based on net scantling approach), taken equal to

= 1.25 for hatch covers when subjected to the vertical weather design load according to H2.200

= 1.10 for hatch covers when subjected to loads according to H2.300 to H2.600

$\lambda$  = reference degree of slenderness, taken equal to:

$$= \sqrt{\frac{\sigma_F}{k \cdot \sigma_e}}$$

K = buckling factor according to Table T.H4.103.2.

### 103. Proof of top and lower hatch cover plating

Proof is to be provided that the following condition is complied with for the single plate field a b:

$$\left( \frac{|\sigma_x| \cdot S}{k_x \cdot \sigma_F} \right)^{e_1} + \left( \frac{|\sigma_y| \cdot S}{k_y \cdot \sigma_F} \right)^{e_2} - B \left( \frac{\sigma_x \cdot \sigma_y \cdot S^2}{\sigma_F^2} \right) + \left( \frac{|\tau| \cdot S \cdot \sqrt{3}}{k_t \cdot \sigma_F} \right)^{e_3} \leq 1,0$$

The first two terms and the last term of the above condition shall not exceed 1,0.

The reduction factors  $\kappa_x$ ,  $\kappa_y$  and  $\kappa_t$  are given in Table T.H4.103.2.

Where  $\sigma_x \leq 0$  (tension stress),  $\kappa_x = 1,0$ .

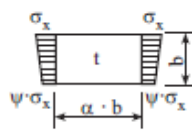
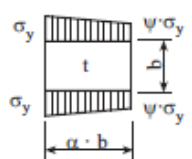
Where  $\sigma_y \leq 0$  (tension stress),  $\kappa_y = 1,0$ .

The exponents  $e_1$ ,  $e_2$  and  $e_3$  as well as the factor B are to be taken as given by Table T.H4.103.1.

**TABLE T.H4.103.1. – COEFFICIENTS  $E_1$ ,  $E_2$ ,  $E_3$  AND FACTOR B**

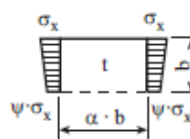
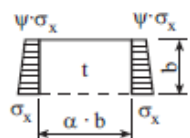
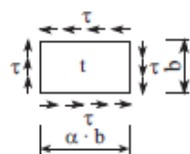
| Exponents $e_1$ - $e_3$ and factor B                            | Plate panel  |
|---|--|
| $e_1$   | $1 + \kappa_x^4$   |
| $e_2$   | $1 + \kappa_y^4$   |
| $e_3$   | $1 + \kappa_x \cdot \kappa_y \cdot \kappa_t^2$   |
| B<br>$\sigma_x$ and $\sigma_y$ positive<br>(compression stress) | $\left( \frac{\kappa_x \cdot \kappa_y \cdot \kappa_t}{\kappa_x + \kappa_y + \kappa_t} \right)^5$ |
| B<br>$\sigma_x$ or $\sigma_y$ negative<br>(tension stress)      | 1  |

TABLE T.H4.103.2. – BUCKLING AND REDUCTION FACTORS FOR PLANE ELEMENTARY PLATE PANELS

| Buckling-<br>Load Case   | Edge stress<br>ratio $\psi$ | Asp. ratio<br>$\alpha = a/b$               | Buckling factor K  | Reduction factor $\kappa$  |
|--|-----------------------------|--|--|--|
| <b>1</b><br>      | $1 \geq \psi \geq 0$        | $\alpha \geq 1$                            | $K = \frac{8,4}{\psi + 1,1}$   | $\kappa_x = 1$ for $\lambda \leq \lambda_c$  |
|  | $0 > \psi > -1$             |  | $K = 7,63 - \psi(6,26 - 10\psi)$   | $\kappa_x = c \left( \frac{1}{\lambda} - \frac{0,22}{\lambda^2} \right)$ for $\lambda > \lambda_c$   |
|  | $\psi \leq -1$              |  | $K = (1 - \psi)^2 \cdot 5,975$   | $c = (1,25 - 0,12\psi) \leq 1,25$<br>$\lambda_c = \frac{c}{2} \left( 1 + \sqrt{1 - \frac{0,88}{c}} \right)$  |
| <b>2</b><br>      | $1 \geq \psi \geq 0$        | $\alpha \geq 1$                            | $K = F_1 \left( 1 + \frac{1}{\alpha^2} \right)^2 \cdot \frac{2,1}{(\psi + 1,1)}$   | $\kappa_y = c \left( \frac{1}{\lambda} - \frac{R + F^2(H - R)}{\lambda^2} \right)$   |
|  | $0 > \psi > -1$             | $1 \leq \alpha \leq 1,5$                   | $K = F_1 \left[ \left( 1 + \frac{1}{\alpha^2} \right)^2 \cdot \frac{2,1(1 + \psi)}{1,1} - \frac{\psi}{\alpha^2} (13,9 - 10\psi) \right]$   | $c = (1,25 - 0,12\psi) \leq 1,25$<br>$R = \lambda \left( 1 - \frac{\lambda}{c} \right)$ for $\lambda < \lambda_c$<br>$R = 0,22$ for $\lambda \geq \lambda_c$<br>$\lambda_c = \frac{c}{2} \left( 1 + \sqrt{1 - \frac{0,88}{c}} \right)$   |
|  |                             | $\alpha > 1,5$                             | $K = F_1 \left[ \left( 1 + \frac{1}{\alpha^2} \right)^2 \cdot \frac{2,1(1 + \psi)}{1,1} - \frac{\psi}{\alpha^2} \cdot (5,87 + 1,87\alpha^2 + \frac{8,6}{\alpha^2} - 10\psi) \right]$ | $F = \left( 1 - \frac{\frac{K}{\lambda_p^2} - 1}{\frac{0,91}{\lambda_p^2}} \right) \cdot c_1 \geq 0$<br>$\lambda_p^2 = \lambda^2 - 0,5$ for $1 \leq \lambda_p^2 \leq 3$<br>$c_1 = \left( 1 - \frac{F_1}{\alpha} \right) \geq 0$<br>$H = \lambda - \frac{2\lambda}{c \left( T + \sqrt{T^2 - 4} \right)} \geq R$ |
|  | $\psi \leq -1$              | $1 \leq \alpha \leq \frac{3(1 - \psi)}{4}$ | $K = F_1 \left( \frac{1 - \psi}{\alpha} \right)^2 \cdot 5,975$   | $T = \lambda + \frac{14}{15\lambda} + \frac{1}{3}$   |
|  |                             | $\alpha > \frac{3(1 - \psi)}{4}$           | $K = F_1 \left[ \left( \frac{1 - \psi}{\alpha} \right)^2 \cdot 3,9675 + 0,5375 \left( \frac{1 - \psi}{\alpha} \right)^4 + 1,87 \right]$  |  |
|  |                             |  |  |  |
| Explanations for boundary conditions<br>- - - - plate edge free<br>——— plate edge simply supported |                             |  |  |  |



**TABLE T.H4.103.3. – BUCKLING AND REDUCTION FACTORS FOR PLANE ELEMENTARY PLATE PANELS**

|   |                       |                  |  |  |
|---|-----------------------|------------------|--|--|
| <b>3</b><br> | $1 \geq \psi \geq 0$  | $\alpha > 0$     | $K = \frac{4 \left( 0,425 + \frac{1}{\alpha^2} \right)}{3\psi + 1}$                | $\kappa_x = 1$ for $\lambda \leq 0,7$<br>$\kappa_x = \frac{1}{\lambda^2 + 0,51}$ for $\lambda > 0,7$   |
|   | $0 > \psi \geq -1$    |                  | $K = 4 \left( 0,425 + \frac{1}{\alpha^2} \right) (1 + \psi) - 5\psi(1 - 3,42\psi)$ |  |
| <b>4</b><br> | $1 \geq \psi \geq -1$ | $\alpha > 0$     | $K = \left( 0,425 + \frac{1}{\alpha^2} \right) \frac{3 - \psi}{2}$                 |  |
| <b>5</b><br> | ==                    |                  | $K = K_\tau \cdot \sqrt{3}$  | $\kappa_\tau = 1$ for $\lambda \leq 0,84$<br>$\kappa_\tau = \frac{0,84}{\lambda}$ for $\lambda > 0,84$ |
|   |                       | $\alpha \geq 1$  | $K_\tau = \left[ 5,34 + \frac{4}{\alpha^2} \right]$                                |  |
|   |                       | $0 < \alpha < 1$ | $K_\tau = \left[ 4 + \frac{5,34}{\alpha^2} \right]$                                |  |
| Explanations for boundary conditions  |                       |                  |  |  |
| ----- plate edge free<br>———— plate edge simply supported                                     |                       |                  |  |  |

104. Webs and flanges of primary supporting members: for non-stiffened webs and flanges of primary supporting members sufficient buckling strength as for the hatch cover top and lower plating is to be demonstrated according to H4.103.

105. Proof of partial and total fields of hatch covers

- Longitudinal and transverse secondary stiffeners: It is to be demonstrated that the continuous longitudinal and transverse stiffeners of partial and total plate fields comply with the conditions set out in H4.105.c through H4.105.d.
- Effective width of top and lower hatch cover plating: For demonstration of buckling strength according to H4.105.c through H4.105.d the effective width of plating may be determined by the following formulae:

$$b_m = k_x \cdot b \quad \text{for longitudinal stiffeners}$$

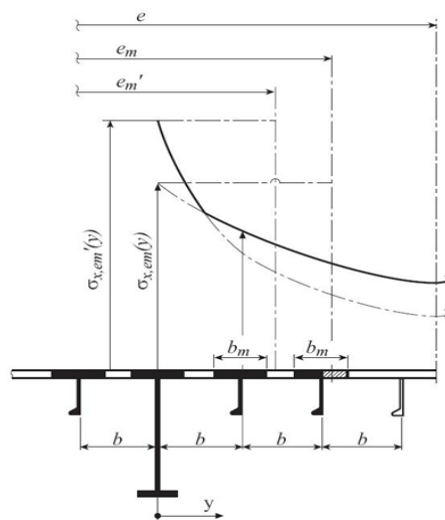
$$a_m = k_y \cdot a \quad \text{for transverse stiffeners}$$

see also Figure F.H4.102.1.

The effective width of plating is not to be taken greater than the value obtained from H3.501.

The effective width  $e'_m$  of stiffened flange plates of primary supporting members may be determined as follows:

**FIGURE F.H4.105B.1 – STIFFENING PARALLEL TO WEB OF PRIMARY SUPPORTING MEMBER**



$$b < e_m$$

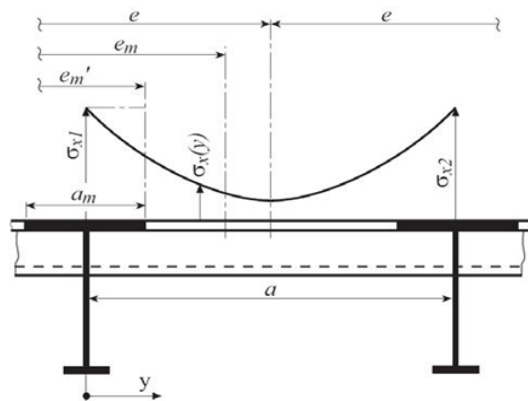
$$e'_m = n \cdot b_m$$

$n$  = integer number of stiffener spacings  $b$  inside the

effective breadth  $e_m$  according to H3.501

$$= \text{int}(e_m/b)$$

**FIGURE F.H4.105B.2 – STIFFENING PERPENDICULAR TO WEB OF PRIMARY SUPPORTING MEMBER**



$$a \geq e_m$$

$$e'_m = n \cdot a_m < e_m$$

$$n = 2,7 (e_m / a) \leq 1$$

$e$  = width of plating supported according to 3.5.1

For  $b \geq e_m$  or  $a < e_m$ , respectively,  $b$  and  $a$  have to be exchanged.

$a_m$  and  $b_m$  for flange plates are in general to be determined for  $\psi = 1$ .

*Note:*

Scantlings of plates and stiffeners are in general to be determined according to the maximum stresses  $\sigma_x(y)$  at webs of primary supporting member and stiffeners, respectively. For stiffeners with spacing  $b$  under compression arranged parallel to primary supporting members no value less than  $0,25 \sigma_F$  shall be inserted for  $\sigma_x(y=b)$ .

The stress distribution between two primary supporting members can be obtained by the following formula

$$\sigma_x(y) = \sigma_{x1} \cdot \left\{ 1 - \frac{y}{e} \left[ 3 + c_1 - 4 \cdot c_2 - 2 \frac{y}{e} (1 + c_1 - 2c_2) \right] \right\}$$

$$c_1 = \frac{\sigma_{x2}}{\sigma_{x1}} \quad 0 \leq c_1 \leq 1$$

$$c_2 = \frac{1,5}{e} \cdot (e''_{m1} + e''_{m2}) - 0,5$$

$e''_{m1}$  = proportionate effective breadth  $e_{m1}$  or

proportionate effective width  $e'_{m1}$  of primary supporting member 1 within the distance  $e$ , as appropriate

$e'_{m2}$  = proportionate effective breadth  $e_{m2}$  or proportionate effective width  $e'_{m2}$  of primary supporting member 2 within the distance  $e$ , as appropriate

$\sigma_{x1}$ ,  $\sigma_{x2}$  = normal stresses in flange plates of adjacent primary supporting member 1 and 2 with spacing  $e$ , based on cross-sectional properties considering the effective breadth or effective width, as appropriate

$y$  = distance of considered location from primary supporting member 1

Shear stress distribution in the flange plates may be assumed linearly.

a. Lateral buckling of secondary stiffeners

$$\frac{\sigma_a + \sigma_b}{\sigma_F} S \leq 1$$

$\sigma_a$  = uniformly distributed compressive stress, in  $N/mm^2$  in the direction of the stiffener axis

$\sigma_a = \sigma_x$  for longitudinal stiffeners

$\sigma_a = \sigma_y$  for transverse stiffeners

$\sigma_b$  = bending stress, in  $N/mm^2$ , in the stiffener

$$= \frac{M_0 + M_1}{Z_{st} \cdot 10^3}$$

$M_0$  = bending moment, in Nmm, due to the deformation  $w$  of stiffener, taken equal to:

$$M_0 = F_{ki} \frac{p_z \cdot w}{c_f - p_z} \text{ with } (c_f - p_z) > 0$$

$M_1$  = bending moment, in Nmm, due to the lateral load  $p$  equal to:

$$M_1 = \frac{p \cdot b \cdot a^2}{24 \cdot 10^3} \text{ for longitudinal stiffeners}$$

$$M_1 = \frac{p \cdot a \cdot (n \cdot b)^2}{c_s \cdot 8 \cdot 10^3} \text{ for transverse stiffeners}$$

$n$  is to be taken equal to 1 for ordinary transverse stiffeners.

$p$  = lateral load in  $kN/m^2$

$F_{ki}$  = ideal buckling force, in  $N$ , of the stiffener

$$F_{kix} = \left( \frac{\pi^2}{a^2} \right) \cdot E \cdot I_x \cdot 10^4 \text{ for longitudinal stiffeners}$$

$$F_{kiy} = \left[ \frac{\pi^2}{(n \cdot b)^2} \right] \cdot E \cdot I_y \cdot 10^4 \text{ for transverse stiffeners}$$

$I_x$ ,  $I_y$  = net moments of inertia, in  $cm^4$ , of the

longitudinal or transverse stiffener including effective width of attached plating according to H4.105.b.  $I_x$  and  $I_y$  are to comply with the following criteria:

$$I_x \geq \frac{b \cdot t^3}{12 \cdot 10^4}$$

$$I_y \geq \frac{a \cdot t^3}{12 \cdot 10^4}$$

$P_z$  = nominal lateral load, in  $N/mm^2$ , of the stiffener due to  $\sigma_x$ ,  $\sigma_y$  and  $\tau$

$$p_{zx} = \frac{t}{b} \left( \sigma_{xl} \left( \frac{\pi \cdot b}{a} \right)^2 + 2 \cdot c_y \cdot \sigma_y + \sqrt{2\tau_1} \right) \quad \text{for longitudinal stiffeners}$$

$$p_{zy} = \frac{t}{a} \left( 2 \cdot c_x \cdot \sigma_{xl} + \sigma_y \left( \frac{\pi \cdot a}{n \cdot b} \right)^2 \left( 1 + \frac{A_y}{a \cdot t} \right) + \sqrt{2\tau_1} \right) \quad \text{for transverse stiffeners}$$

$$\sigma_{xl} = \sigma_x \left( 1 + \frac{A_x}{b \cdot t} \right)$$

$c_x$ ,  $c_y$  = factor taking into account the stresses perpendicular to the stiffener's axis and distributed variable along the stiffener's length

$$= 0,5 (1 + \psi) \text{ for } 0 \leq \psi \leq 1$$

$$= \frac{0,5}{1 - \psi} \text{ for } \psi < 0$$

$A_x$ ,  $A_y$  = net sectional area, in  $mm^2$ , of the longitudinal or transverse stiffener, respectively, without attached plating

$$\tau_1 = \left[ \tau - t \sqrt{\sigma_F \cdot E \left( \frac{m_1}{a^2} + \frac{m_2}{b^2} \right)} \right] \geq 0$$

for longitudinal stiffeners:

$$\frac{a}{b} \geq 2,0 \quad m_1 = 1,47 ; m_2 = 0,49$$

$$\frac{a}{b} < 2,0 \quad m_1 = 1,96 ; m_2 = 0,37$$

for transverse stiffeners:

$$\frac{a}{n \cdot b} \geq 0,5 \quad m_1 = 0,37 ; m_2 = 1,96 / n^2$$

$$\frac{a}{n \cdot b} \geq 0,5 \quad m_1 = 0,49 ; m_2 = 1,47 / n^2$$

$$w = w_0 + w_1$$

$w_0$  = assumed imperfection in mm

$$w_{0x} \leq \min \left( \frac{a}{250}, \frac{b}{250}, 10 \right) \text{ for longitudinal stiffeners}$$

$$w_{0y} \leq \min \left( \frac{a}{250}, \frac{n.b}{250}, 10 \right) \text{ for transverse stiffeners}$$

Note:

For stiffeners sniped at both ends  $w_o$  must not be taken less than the distance from the midpoint of plating to the neutral axis of the profile including effective width of plating.

$w_1$  = Deformation of stiffener, in mm, at midpoint of stiffener span due to lateral load  $p$ . In case of uniformly distributed load the following values for  $w_1$  may be used:

$$w_1 = \frac{p.b.a^4}{384.10^7.E.I_x} \text{ for longitudinal stiffeners}$$

$$w_1 = \frac{5.a.p.(n.b)^4}{384.10^7.E.I_y.c_s^2} \text{ for transverse stiffeners}$$

$c_f$  = elastic support provided by the stiffener, in  $N/mm^2$

i. For longitudinal stiffeners:

$$c_{fx} = F_{kix} \frac{\pi^2}{a^2} (1 + c_{px})$$

$$c_{px} = \frac{1}{1 + \frac{0,91 \left( \frac{12.10^4.I_x}{t^3.b} - 1 \right)}{c_{xa}}}$$

$$c_{xa} = \left[ \frac{a}{2b} + \frac{2b}{a} \right]^2 \text{ for } a \geq 2b$$

$$c_{xa} = \left[ 1 + \left( \frac{a}{2b} \right)^2 \right]^2 \text{ for } a < 2b$$

ii. For transverse stiffeners:

$$c_{fy} = c_s.F_{kiy} \cdot \frac{\pi^2}{(n.b)^2} \cdot (1 + c_{py})$$

$$c_{py} = \frac{1}{1 + \frac{0,91 \left( \frac{12.10^4.I_y}{t^3.a} - 1 \right)}{c_{ya}}}$$

$$c_{ya} = \left[ \frac{n.b}{2a} + \frac{2a}{n.b} \right]^2 \text{ for } n.b \geq 2a$$

$$c_{ya} = \left[ 1 + \left( \frac{n.b}{2a} \right)^2 \right]^2 \text{ for } n.b < 2a$$

$c_s$  = factor accounting for the boundary conditions of the transverse stiffener:

= 1,0 for simply supported stiffeners

= 2,0 for partially constraint stiffeners

$Z_{st}$  = net section modulus of stiffener (long. or

transverse) in  $cm^3$  including effective width of plating according to H4.105b.

If no lateral load  $p$  is acting the bending stress  $\sigma_b$  is to be calculated at the midpoint of the stiffener span for that fibre which results in the largest stress value. If a lateral load  $p$  is acting, the stress calculation is to be carried out for both fibres of the stiffener's cross sectional area (if necessary for the biaxial stress field at the plating side).

b. Torsional buckling of secondary stiffeners

b.1. i Longitudinal secondary stiffeners:

The longitudinal ordinary stiffeners are to comply with the following criteria:

$$\frac{\sigma_x \cdot S}{k_T \cdot \sigma_F} \leq 1,0$$

$k_T$  = coefficient taken equal to:

$$k_T = 1,0 \text{ for } \lambda_T \leq 0,2$$

$$k_T = \frac{1}{\Phi + \sqrt{\Phi^2 - \lambda_T^2}} \text{ for } \lambda_T > 0,2$$

$$\Phi = 0,5(1 + 0,21(\lambda_T - 0,2) + \lambda_T^2)$$

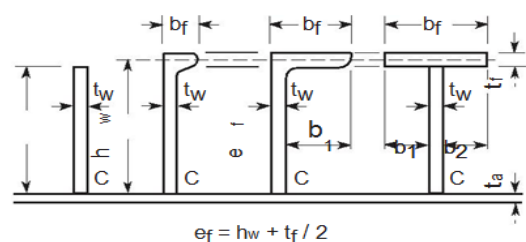
$\lambda_T$  = reference degree of slenderness taken equal to:

$$\lambda_T = \sqrt{\frac{\sigma_F}{\sigma_{kiT}}}$$

$$\sigma_{kiT} = \frac{E}{I_p} \left( \frac{\pi^2.I_w.10^2}{a^2} \varepsilon + 0,385 \right), \text{ in } N/mm^2.$$

For  $I_p$ ,  $I_T$ ,  $I_w$  see F.H4.105.d.i. and T.H4.105.d.i.

**FIGURE F.H4.105.D.I. – DIMENSIONS OF STIFFENER**



$I_p$  = net polar moment of inertia of the stiffener, in  $cm^4$ , related to the point C

$I_T$  = net St. Venant's moment of inertia of the stiffener, in  $cm^4$

$I_w$  = net sectorial moment of inertia of the stiffener, in  $cm^6$ , related to the point C

$\varepsilon$  = degree of fixation taken equal to:

$$\varepsilon = 1 + 10^{-3} \sqrt{\frac{a^4}{\frac{3}{4} \pi^4 I_w \left( \frac{b}{t^3} + \frac{4h_w}{3t_w^3} \right)}}$$

$h_w$  = web height, in mm

$t_w$  = net web thickness, in mm

$b_f$  = flange breadth, in mm

$t_f$  = net flange thickness, in mm

$A_w$  = net web area equal to:  $A_w = h_w \cdot t_w$

$A_f$  = net flange area equal to:  $A_f = b_f \cdot t_f$

$e_f = h_w + \frac{t_f}{2}$ , in mm

**TABLE T.H4.105D.I. – MOMENTS OF INERTIA**

| Section                      | $I_p$  | $I_T$   | $I_\omega$   |
|------------------------------|--|---|--|
| Flat bar                     | $\frac{h_w^3 \cdot t_w}{3 \cdot 10^4}$                               | $\frac{h_w \cdot t_w^3}{3 \cdot 10^4} \left( 1 - 0,63 \frac{t_w}{h_w} \right)$  | $\frac{h_w^3 \cdot t_w^3}{36 \cdot 10^6}$  |
| Sections with bulb or flange | $\left( \frac{A_w \cdot h_w^2}{3} + A_f \cdot e_f^2 \right) 10^{-4}$ | $\frac{h_w \cdot t_w^3}{3 \cdot 10^4} \left( 1 - 0,63 \frac{t_w}{h_w} \right) + \frac{b_f \cdot t_f^3}{3 \cdot 10^4} \left( 1 - 0,63 \frac{t_f}{b_f} \right)$ | for bulb and angle sections:<br>$\frac{A_f \cdot e_f^2 \cdot b_f^2}{12 \cdot 10^6} \left( \frac{A_f + 2,6A_w}{A_f + A_w} \right)$<br>for tee-sections<br>$\frac{b_f^3 \cdot t_f \cdot e_f^2}{12 \cdot 10^6}$ |



- b.2. Transverse secondary stiffeners: For transverse secondary stiffeners loaded by compressive stresses and which are not supported by longitudinal stiffeners, sufficient torsional buckling strength is to be demonstrated analogously in accordance with H4.105.d.i.

## H5. DETAIL OF HATCH COVER [UR S21A 4]

### 100. Container foundations on hatch covers

101. Container foundations are to be designed to the satisfaction of the individual class society. The substructures of container foundations are to be designed for cargo and container loads according to 2, applying the permissible stresses according to H3.101.

### 200. Weather tightness: Further to the following requirements IACS Rec. 14 is applicable to hatch covers.

201. Packing material (General): The packing material is to be suitable for all expected service conditions of the ship and is to be compatible with the cargoes to be transported. The packing material is to be selected with regard to dimensions and elasticity in such a way that expected deformations can be carried. Forces are to be carried by the steel structure only. The packings are to be compressed so as to give the necessary tightness effect for all expected operating conditions. Special consideration shall be given to the packing arrangement in ships with large relative movements between hatch covers and coamings or between hatch cover sections.

202. Dispensation of weather tight gaskets: For hatch covers of cargo holds solely for the transport of containers, upon request by the owners and subject to compliance with the following conditions the fitting of weather tight gaskets according to H5.201 may be dispensed with:

- a. The hatchway coamings shall be not less than 600 mm in height.
- b. The exposed deck on which the hatch covers are located is situated above a depth  $H(x)$ .  $H(x)$  is to be shown to comply with the following criteria:
  - b.1.  $H(x) \geq T_{fb} + f_b + h$  in m
  - b.2.  $T_{fb}$  = draught, in m, corresponding to the assigned summer load line
  - b.3.  $f_b$  = minimum required freeboard, in m, determined in accordance with ICLL Reg. 28 as modified by further regulations as applicable

$$b.4. \quad h = 4,6m \text{ for } \frac{x}{L_{LL}} \leq 0,75$$

$$b.5. \quad = 6,9m \text{ for } \frac{x}{L_{LL}} > 0,75$$

- c. Labyrinths, gutter bars or equivalents are to be fitted proximate to the edges of each panel in way of the coamings. The clear profile of these openings is to be kept as small as possible.
- d. Where a hatch is covered by several hatch cover panels the clear opening of the gap in between the panels shall be not wider than 50mm.
- e. The labyrinths and gaps between hatch cover panels shall be considered as unprotected openings with respect to the requirements of intact and damage stability calculations.
- f. With regard to drainage of cargo holds and the necessary fire-fighting system reference is made to the sections Piping Systems, Valves and Pumps and Fire Protection and Fire Extinguishing Equipment of the RBNA.
- g. Bilge alarms shall be provided in each hold fitted with non-weathertight covers.
- h. Furthermore, Chapter 3 of IMO MSC/Circ. 1087 is to be referred to concerning the stowage and segregation of containers containing dangerous goods.

203. Drainage arrangements: Cross-Joints of multi-panel covers are to be provided with efficient drainage arrangements.

## H6. HATCH COAMING STRENGTH CRITERIA [UR S21A 5]

### 100. Local net plate thickness of coamings

101. The net thickness of weather deck hatch coamings shall not be less than the larger of the following values:

$$t = 14,2 \cdot s \sqrt{\frac{p_A}{0,95 \cdot \sigma_F}} \text{ in mm}$$

$$t_{min} = 6 + \frac{L_1}{100} \text{ in mm}$$

$s$  = stiffener spacing in m

$L_1 = L$ , need not be taken greater than 300 m

Longitudinal strength aspects are to be observed.

### 200. Net scantling of secondary stiffeners of coamings

201. The stiffeners must be continuous at the coaming

stays. For stiffeners with both ends constraint the elastic net section modulus  $Z$  in  $\text{cm}^3$  and net shear area  $A_s$  in  $\text{cm}^2$ , calculated on the basis of net thickness, must not be less than:

$$Z = \frac{83}{\sigma_F} \cdot S \cdot l^2 \cdot p_A$$

$$A_s = \frac{10 \cdot S \cdot l \cdot p_A}{\sigma_F}$$

$l$  = secondary stiffener span, in m, to be taken as the spacing of coaming stays

$S$  = stiffener spacing in m

202. For sniped stiffeners at coaming corners section modulus and shear area at the fixed support have to be increased by 35 %. The gross thickness of the coaming plate at the sniped stiffener end shall not be less than

$$t = 19,6 \sqrt{\frac{p_A \cdot S \cdot (l - 0,5 s)}{\sigma_F}} \text{ in mm}$$

203. Horizontal stiffeners on hatch coamings, which are part of the longitudinal hull structure, are to be designed according to the individual classification society's Rules.

**300. Coamings stays: Coaming stays are to be designed for the loads transmitted through them and permissible stresses according to 3.1.1 H3.101.**

301. Coaming stay section modulus: The net section modulus  $Z$  of coaming stays with a height of  $h_s < 1,6$  m and which are to be designed for the load  $p_A$ , shall not be less than:

$$Z = \frac{526}{\sigma_F} \cdot e \cdot h_s^2 \cdot p_A \text{ in cm}^3$$

$e$  = spacing of coaming stays in m

Coaming stays of coamings having a height of 1,6m or more are to be designed using direct calculations under consideration of the permissible stresses according to H3.101. The effective breadth of the coaming plate shall not be larger than the effective plate breadth according to H3.501.

Coaming stays are to be supported by appropriate substructures. Face plates may only be included in the calculation if an appropriate substructure is provided and welding provides an adequate joint.

302. Web thickness of coaming stays: Web gross thickness at the root point shall not be less than:

$$t_w = \frac{2}{\sigma_F} \cdot \frac{e \cdot h_s \cdot p_A}{h_w} + t_s$$

$h_w$  = web height of coaming stay at its lower end in m

$t_s$  = corrosion addition, in mm, according to 7

Webs are to be connected to the deck by fillet welds on both sides with a throat thickness of  $a = 0,44t_w$ . The size of welding for toes of webs at the lower end of coaming stays shall be according to the individual class society's Rules.

303. Coaming stays under friction load: For coaming stays, which transfer friction forces at hatch cover supports, sufficient fatigue strength is to be verified according to individual class society's Rules, refer to H7.202.

#### 400. Further requirements for hatch coamings

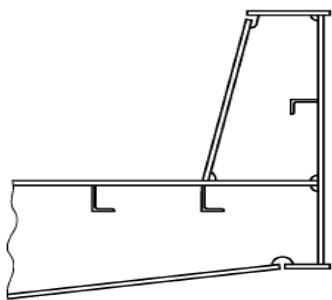
401. **Longitudinal strength:** Hatch coamings which are part of the longitudinal hull structure are to be designed according to the requirements for longitudinal strength of the individual classification society. For structural members welded to coamings and for cutouts in the top of coamings sufficient fatigue strength is to be verified. Longitudinal hatch coamings with a length exceeding  $0,1 \cdot L$  m are to be provided with tapered brackets or equivalent transitions and a corresponding substructure at both ends. At the end of the brackets they are to be connected to the deck by full penetration welds of minimum 300 mm in length.

402. **Local details:** If the design of local details is not regulated in 5, local details are to comply with the individual classification society's requirement for the purpose of transferring the loads on the hatch covers to the hatch coamings and, through them, to the deck structures below. Hatch coamings and supporting structures are to be adequately stiffened to accommodate the loading from hatch covers, in longitudinal, transverse and vertical directions. Structures under deck are to be checked against the load transmitted by the stays. Unless otherwise stated, weld connections and materials are to be dimensioned and selected in accordance with the individual classification society's requirements.

403. **Stays:** On ships carrying cargo on deck, such as timber, coal or coke, the stays are to be spaced not more than 1,5 m apart.

404. **Extend of coaming plates:** Coaming plates are to extend to the lower edge of the deck beams; they are to be flanged or fitted with face bars or half-round bars. F.H6.404.1 gives an example.

**FIGURE F.H6.404.1 - EXAMPLE FOR THE  
EXTEND OF COAMING PLATES**



405. Drainage arrangement at the coaming: If drain channels are provided inside the line of gasket by means of a gutter bar or vertical extension of the hatch side and end coaming, drain openings are to be provided at appropriate positions of the drain channels. Drain openings in hatch coamings are to be arranged with sufficient distance to areas of stress concentration (e.g. hatch corners, transitions to crane posts). Drain openings are to be arranged at the ends of drain channels and are to be provided with non-return valves to prevent ingress of water from outside. It is unacceptable to connect fire hoses to the drain openings for this purpose. If a continuous outer steel contact between cover and ship structure is arranged, drainage from the space between the steel contact and the gasket is also to be provided for.

## H7. CLOSING ARRANGEMENTS [UR S21A6]

### 100. Securing devices

101. General: Securing devices between cover and coaming and at cross-joints are to be installed to provideweathertightness. Sufficient packing line pressure is to be maintained. Securing devices must be appropriate to bridge displacements between cover and coaming due to hull deformations. Securing devices are to be of reliable construction and effectively attached to the hatchway coamings, decks or covers. Individual securing devices on each cover are to have approximately the same stiffness characteristics. Sufficient number of securing devices is to be provided at each side of the hatch cover. This applies also to hatch covers consisting of several parts. The materials of stoppers, securing devices and their weldings are to be to the satisfaction the individual class society. Specifications of the materials are to be shown in the drawings of the hatch covers.

102. **Road cleats:** Where rod cleats are fitted, resilient washers or cushions are to be incorporated.

103. **Hydraulic cleats:** Where hydraulic cleating is adopted, a positive means is to be provided so that it remains mechanically locked in the closed position in the event of failure of the hydraulic system.

104. Cross-sectional area of the securing devices: The

gross cross-sectional area in cm<sup>2</sup> of the securing devices is not to be less than:

$$A = 0,28 \cdot q \cdot S_{SD} \cdot k_l$$

q = packing line pressure in N/mm, minimum 5 N/mm

S<sub>SD</sub> = spacing between securing devices in m, not to be taken less than 2 m

$k_l = \left(\frac{235}{\sigma_F}\right)^e$ ,  $\sigma_F$  is the minimum yield strength of the material in N/mm<sup>2</sup>, but is not to be taken greater than 0,7 ·  $\sigma_m$ , where  $\sigma_m$  is the tensile strength of the material in N/mm<sup>2</sup>.

$$e = 0,75 \text{ for } \sigma_F > 235 \text{ N/mm}^2$$

$$= 1,00 \text{ for } \sigma_F \leq 235 \text{ N/mm}^2$$

Rods or bolts are to have a gross diameter not less than 19 mm for hatchways exceeding 5 m<sup>2</sup> in area.

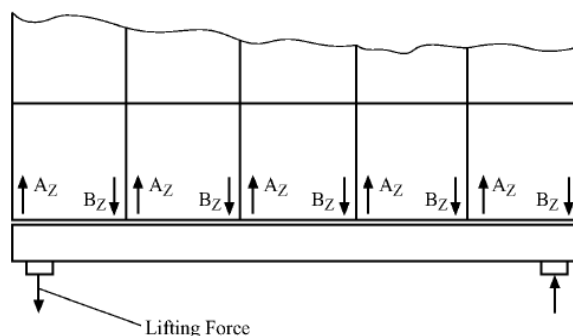
Securing devices of special design in which significant bending or shear stresses occur may be designed as anti-lifting devices according to 6.1.5 H7.105. As load the packing line pressure q multiplied by the spacing between securing devices S<sub>SD</sub> is to be applied.

105. **Anti lifting devices:** The securing devices of hatch covers, on which cargo is to be lashed, are to be designed for the lifting forces resulting from loads according to H2.500, refer F.H7.105.1. Unsymmetrical loadings, which may occur in practice, are to be considered. Under these loadings the equivalent stress in the securing devices is not to exceed:

$$\sigma_V = \frac{150}{k_l} \text{ in N/mm}^2$$

Chapter 5.6 of IACS Rec. 14 shall be referred to for the omission of anti lifting devices.

**FIGURE F.H7.105.1 - LIFTING FORCES AT A  
HATCH COVER**



### 200. Hatch cover supports, stoppers and supporting structures

201. **Horizontal mass forces:** For the design of the securing devices against shifting the horizontal mass

forces  $F_h = m \cdot a$  are to be calculated with the following accelerations:

$a_x = 0,2 \cdot g$  in longitudinal direction

$a_y = 0,5 \cdot g$  in transverse direction

$m$  = Sum of mass of cargo lashed on the hatch cover and mass of hatch cover

**202. Hatch cover supports:** For the transmission of the support forces resulting from the load cases specified in 2 and of the horizontal mass forces specified in H7.201, supports are to be provided which are to be designed such that the nominal surface pressures in general do not exceed the following values:

$$p_{n \max} = d \cdot p_n \text{ in N/mm}^2$$

$$d = 3,75 - 0,015L$$

$$d_{\max} = 3,0$$

$$d_{\min} = 1,0 \text{ in general}$$

$$= 2,0 \text{ for partial loading conditions, see H2.503}$$

$$p_n = \text{see T.H7.202.1.}$$

For metallic supporting surfaces not subjected to relative displacements the nominal surface pressure applies:

$$p_{n \max} = 3 \cdot p_n \text{ in N/mm}^2$$

Drawings of the supports must be submitted. In the drawings of supports the permitted maximum pressure given by the material manufacturer related to long time stress must be specified.

**TABLE T.H7.202.1. – PERMISSIBLE NOMINAL SURFACE PRESSURE  $P_N$**

| Support material           | $p_n$ [N/mm <sup>2</sup> ] when loaded by |                                |
|----------------------------|---|--------------------------------|
|                            | Vertical force                            | Horizontal force (on stoppers) |
| Hull structural steel      | 25  | 40                             |
| Hardened steel             | 35  | 50                             |
| Plastic materials on steel | 50  | –                              |

Where large relative displacements of the supporting surfaces are to be expected, the use of material having low wear and frictional properties is recommended.

If necessary, sufficient abrasive strength may be shown by tests demonstrating an abrasion of support surfaces of not more than 0,3 mm per year in service at a total distance of shifting of 15 000 m/year.

The substructures of the supports must be of such a design, that a uniform pressure distribution is achieved.

Irrespective of the arrangement of stoppers, the supports must be able to transmit the following force  $P_h$  in the longitudinal and transverse direction:

$$P_h = \mu \cdot \frac{P_v}{\sqrt{d}}$$

$P_v$  = vertical supporting force

$\mu$  = frictional coefficient

$$= 0,5 \text{ in general}$$

For non-metallic, low-friction support materials on steel, the friction coefficient may be reduced but not to be less than 0,35 and to the satisfaction of the individual class society.

Supports as well as the adjacent structures and substructures are to be designed such that the permissible stresses according to H3.101 are not exceeded.

For substructures and adjacent structures of supports subjected to horizontal forces  $P_h$ , a fatigue strength analysis is to be carried out according to the individual classification society's Rules.

**203. Hatch cover stoppers:** Hatch covers shall be sufficiently secured against horizontal shifting. Stoppers are to be provided for hatch covers on which cargo is carried.

The greater of the loads resulting from H2.300 and H7.201 is to be applied for the dimensioning of the stoppers and their substructures.

The permissible stress in stoppers and their substructures, in the cover, and of the coamings is to be determined according to H3.101. In addition, the provisions in H7.202 are to be observed.

**H8. CORROSION ADDITION AND STEEL RENEWAL**  
**[UR S21A7]****100. Corrosion addition for hatch covers and hatch coamings**  
**[UR S21A 7.1]**

101. The scantling requirements of the above sections imply the following general corrosion additions  $T_s$  – see Table T.H7.101.1.

**TABLE T.H7.101.1. CORROSION ADDITIONS  $T_s$  FOR HATCH COVERS AND HATCH COAMINGS [UR S21A 7.1 TAB. 9]**

| Application  | Structure  | $t_s$ [mm]              |
|--|--|-------------------------|
| Weather deck hatches of all other ship types covered by this UR                          | Hatch coamings   | according to RBNA = 2,0 |
|  | Hatch covers in general  | 2,0                     |
| Weather deck hatches of container ships, car carriers, paper carriers, passenger vessels | Weather exposed plating and bottom plating of double skin hatch covers | 1,5                     |
|  | Internal structure of double skin hatch covers and closed box girders  | 1,0                     |
|  | Hatch coamings not part of the longitudinal hull structure             | 1,5                     |
|  | Hatch coamings part of the longitudinal hull structure                 | according to RBNA = 2,0 |
|  | Coaming stays and stiffeners   | 1,5                     |
|  | Hatch covers   | 1,0                     |

**200. Steel renewal**  
**[UR S21A7.2]**

201. For single skin hatch covers and the plating of double skin hatch covers, steel renewal is required where the gauged thickness is less than  $t_{net} + 0,5$  mm. Where the gauged thickness is within the range  $t_{net} + 0,5$  mm and  $t_{net} + 1,0$  mm, coating (applied in accordance with the coating manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in **GOOD** condition.

*Guidance*

**Coating Condition:** Coating Condition is defined as follows:

**GOOD** condition with only minor spot rusting.

**FAIR** condition with local breakdown at edges of stiffeners and weld connection and/or light rusting over

20% or more of areas under consideration, but less than as defined for **POOR** condition.

**POOR** condition with general breakdown of coating over 20% or more, or hard scale

*End of guidance*

202. For the internal structure of double skin hatch covers, thickness gauging is required when hatch cover top or bottom plating renewal is to be carried out or when this is deemed necessary, at the discretion of the individual class society's surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than  $t_{net}$ .

203. For corrosion addition  $t_s = 1,0$  mm the thickness for steel renewal is  $t_{net}$  and the thickness for coating or annual gauging is when gauged thickness is between  $t_{net}$  and  $t_{net} + 0,5$  mm.



## CHAPTER T INSPECTIONS AND TESTS

### CHAPTER CONTENTS

- T1. CARGO OR SERVICE HANDLING**
- T2. ANCHORING, MOORING AND TOWING**
- T3. MANOEUVRING SYSTEM**
- T4. LIFESAVING APPLIANCES**
- T5. FIRE SAFETY EQUIPMENT**
- T6. HULL OPENINGS-  
PROTECTION AND CLOSING**
- T7. HULL EQUIPMENT AND APPENDAGES**

### T1. CARGO OR SERVICE HANDLING

#### 100. Performance trials

See RBNA “*Guide for Lifting Appliances*”.

### T2. MOORING AND ANCHORING

#### 100. Windlass test

##### 101. Purpose:

- a. Provide evidence that the minimum speed of hoisting, in windlass drive by driving force, is in compliance with subchapter D2.600.
- b. Provide evidence that, in the case of manual drive, a single person can hoist the anchor without excessive effort, is in compliance with the subchapter D2.600.
- c. Evidence shall be provided of the capacity of the windlass brake during the test of anchor free dropping.

#### 200. Test of anchor handling

201. During the anchor manoeuvring it shall be proved that there is not be the possibility of a "stuck anchor".

#### 300. Integrity test

301. The hawse pipes will be tightness tested as an independent tank, in accordance with the requirements laid down in Part II Section 2 of these Rules.

## T3. MANOEUVRING SYSTEM

### 100. Watertightness test of rudder and Kort Nozzle

101. In double plate rudder and propeller nozzle ring, a watertightness test shall be carried out at a pressure corresponding to the design draft (d), which can be replaced by air pressure equal to the greater of the values in bar: 1.96 or 0.98 d.

### 200. Hydraulic system test

201. The hydraulic piping system shall be tested at a hydrostatic pressure of 1.5 times the nominal working pressure.

### 300. Rudder steering test

301. The power operated steering gear shall be capable to move the rudder fully submerged, with the vessel running ahead at the maximum continuous rated speed, from 35 degrees on either side to 30 degrees on the other side in not more than 28 seconds. For tugboats the time for this manoeuvre shall be 18 seconds.

302. This manoeuvre shall also be carried out with the vessel in reverse, at the maximum rotation of the engines allowing, however, for a larger time interval.

303. The correspondence between the rudder angle indicator on the bridge and the local control of the steering gear compartment is to be verified, as well as the limit switches.

### 400. Manual steering test

401. The emergency and / or manual steering shall be tested and the result are to be registered.

## T4. LIFESAVING APPLIANCES

### 100. Certificates

101. The compliance with the Safety Plan is to be verified as well as the validity of the last servicing.

102. The certificates of homologation issued by the Maritime Authority (for Brazilian flag ships, the DPC) shall be verified.

### 200. Abandon ship test

201. The on-load release devices of the lifesaving equipment, such as lifeboat davits, are to be tested in accordance with the Flag statutory regulations.



## **T5. FIRE SAFETY EQUIPMENT**

### **100. Certificates and documents**

101. The compliance with the Safety Plan shall be checked as well as the validity of the last servicing.

102. The certificates of homologation issued by the Maritime Authority (for Brazilian flag ships, the DPC) shall be verified.

### **200. Inspections and tests**

201. Hydrants are to be tested in accordance with the RBNA Rules and Flag statutory regulations. See part II, Title 11, Section 6 – Piping systems, of these Rules.

202. **Tests for fire extinguishers:** the containers of fixed fire extinguishing system shall be subjected to hydrostatic tests every 05 (five) years. These tests shall comply with existing or ABNT standards or provided for in these Rules, if those are missing. If these containers have been inspected annually, and have not presented loss of pressure, corrosion, and have not been discharged in the period, the hydrostatic test can be postponed for 5 (five) more years, in at most 50% of the containers of the system; the other containers shall be tested in 5 (five) years. If any container shows unsatisfactory result on the hydrostatic testing, all other container component of the fixed system shall be tested.

#### **NORMAM 01**

203. Other life saving appliances will be inspected according to the the RBNA Rules and Flag statutory regulations. See Part II, Title 11, Section 6 – Piping systems, of these Rules.

## **T6. HULL OPENINGS-PROTECTION AND CLOSING**

### **100. Tests of the cargo hatch covers**

101. Cargo hatchcovers will be subjected to a hose testas required by subchapter D6.100.

### **200. Testing of hull accesses**

201. The hull accesses are to be hose tested, as required by subchapter D6.

## **T7. HULL EQUIPMENT AND APPENDAGES**

### **100. Installation**

101. Such facilities will be verified for operationality and connection to the hull