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

TITLE 11 SHIPS IN GENERAL

SECTION 6 PIPING

CHAPTERS

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CHAPTER A
SCOPE

CHAPTER CONTENTS

A1. APPLICATION

100. Piping systems

101. The present Rules apply to piping systems, including pumps, valves and accessories, of the following systems:

a. for safety of the cargo

Guidance
See proper Titles for specialized vessels. RBNA may, after special analysis, allow changes for the present Rules when applied to small vessels.

End of guidance

b. for the safety of the vessel; and

c. for operation of the main propulsion system, its auxiliaries and equipments.

A2. DEFINITIONS

100. Terms and acronyms

101. In the present Rules the following terms are used:

a. **Diagram**: flow chart of piping lines with indications of function, flow, diameters, materials and other relevant parameters.

b. **Bilge water piping**: bilge systems are to comply with the requirements of the SOLAS Convention in case of flooding. The Engine Room bilge system or the bilge systems for other locations subject to pollutant material are to be independent from the main hull bilge system.

A3. TECNICAL DOCUMENTS

100. Submission

101. The drawings to be submitted shall contain all the information necessary for the full understanding of the design, stating in detail the characteristics of equipment, pipes and accessories as well as service pressures, materials and location of the pumps.

102. Where necessary, the calculation sheets of the piping systems, as well as the description of its operation, are also to be submitted.

103. Any modification in the design or in the use of any part of the piping systems which have already been approved is to be submitted to RBNA before its construction.

104. Drawings and documents to be submitted to the RBNA should have all the dimensions and information given in the international system. Consecratedly adopted dimensions given in another unit system are to also have an indication of the corresponding values in the international system.

200. List of documents

201. The documents for piping systems below, in form of diagrams, are to be submitted for approval of the RBNA in 3 hard copies or in virtual files:

Cargo pipelines (for specialized vessels, see proper Title);

Hull pipelines:

a. bilge system;

b. oily water;

c. fire and ballast;

d. service and fresh water;

e. Sewage and sanitary water;

f. Air venting, overflow and sounding;

g. Ventilation, as listed below:

g.1. characteriics and volumes of spaces for which ventilation is intended;

g.2. Duct materials and dimensions;

g.3. Arrangement of ducts and suctions;

g.4. fans / exhaustors and their prime movers specifications;

h. hydraulic power for hull essential services.

i. Machinery piping systems:

i.1. heavy fuel (transfer and feed of engines and boilers);

i.2. Diesel fuel;

i.3. engine lubrication;

i.4. water cooling of engines;

i.5. exhaust gases from internal combustion engines;

i.6. compressed air for starting of engines and other purposes;

i.7. hydraulic power for machinery essential services;

i.8. steam, feed water and condensate;

j. pipelines against pollution:

j.1. oily bilge water; and

j.2. sewage.

202. The documents relating to the combined arrangement of pipes, fittings and equipment are to be forwarded for approval.

CHAPTER B
MATERIALS AND WORKMANSHIP

CHAPTER CONTENTS

B1. STANDARDS

100. Application

101. The present Rules do not replace national and international standards in force. Materials with characteristics other than those listed here may be used, provided that their specifications are submitted for approval of the RBNA.

102. The requiremets of the present Cetion 6 are in accordance with the unified requirements of the IACS Unified requirements UR P.

B2. PIPES

100. Carbon steel pipes

101. Characterisitics:

a. furnace welded seam in: according to NBR 5590 (or equivalent ASTM A 53. or API 5L), with the following restrictions:

a.1. pipings with pressure greater than 14.7 bar (15 kgf/cm^2) or temperature above 200^o C; and

a.2. fuel oil pipes or flammable fluid in engine room or boiler compartment and with pressure greater than 9.8 bar (10 kgf/cm^2);

b. seamless or manufactured by electric resistance welding, according to NBR 5590 (or equivalent ASTM A 53. or API 5L) grade B, with the following restrictions:

b.1. temperature above 340^o C; and

b.2. NBR 5590 (ASTM A 53.) pipes grade B can only be cold bent.

c. seamless: characteristics according to NBR 6321 (ASTM A 106.) grades A and B, used for high-temperature service, with the following restrictions:

c.1. can only be cold bent.

d. for further details, see subchapter D below

200. Other alloy steel pipes

201. The characteristics of alloys are to be approved by the RBNA along with the characteristics of the design.

300. Copper pipes

301. Characteristics as per ASTM B 42.

302. When cold drawn seamless, copper pipes can be used for all the pipings where the temperature does not exceed 200^o C.

303. In fuel oil pipings within the engine room copper pipes can be used for diameters up to 25 mm, when they have undergone appropriate heat treatment.

304. When welded by brazing copper pipes can be used for pressure up to 5.2 bar (5.3 kgf/cm$^{2)}$ and temperature up to 200^o C.

400. Brass pipes

401. Characteristics as ASTM B 43.

402. When cold drawn seamless, can be used for all the pipes where the temperature does not exceed 200^{o} C.

403. Are not to be used for piping in cargo holds, in the engine or boilers rooms, in spaces where there is installation of fuel oil and in fuel oil tank bulkheads.

500. Lead pipes

501. Are to be adequately protected against mechanical damage and can be used in seawater supply piping to appliances and sewage drains in sanitary facilities.

B3. VALVES AND ACCESSORIES

100 Steel

101. Cast steel, characteristics according to item Part III, Title 61, Section 2, Chapter C.

200. Cast iron

201. Gray cast iron, characteristics according to item Part III, Title 61, Section 2, Chapter C.

202. When the pressure exceeds 9.8 bar (10 kgf/cm^2) or when the temperature reaches 220^{o} C, the use of cast iron will not be allowed for the following fluids:

a. steam and boiler feed water;

b. compressed air;

c. heated fuel oil (temperature above 60° C); and

d. ammonia used as refrigerant.

203. Nodular cast iron, characteristics according to item Part III, Title 61, Section 2, Chapter C, being allowed its use for temperatures up to 300° C.

204. Restrictions on the use of nodular cast iron, according to item 202, being allowed its use for temperatures up to 300° C.

300. Stainless steel

301. The characteristics of the stainless steel to be employed are to be submitted for the RBNA approval.

400. Bronze

401. Cast Bronze will have charateristcs as per item C2.200 of the Section 5.

402. Bronze is not allowed to be used in steam or compressed air pipelines where the pressure exceeds 14.7 bar (15 kgf/cm^2) or the temperature reaches 230^{o} C.

B4. INSTALLATION OF PLASTIC PIPES

100. Application

101. This subchapter is applicable where plastic pipes are employed in the piping installations on board.

102. Part III, Title 62, Section 6, Chapter

200. Installation of plastic pipes [IACS UR P4.6]

201. **Supports**

a. Selection and spacing of pipe supports in shipboard systems are to be determined as a function of allowable stresses and maximum deflection criteria. Support spacing is not to be greater than the pipe Manufacturer's recommended spacing. The selection and spacing of pipe supports are to take into account pipe dimensions, mechanical and physical properties of the pipe material, mass of pipe and contained fluid, external pressure, operating temperature, thermal expansion effects, loads due to external forces, thrust forces, water hammer, vibrations, maximum accelerations to which the system may be subjected.

b. Combination of loads is to be considered.

b.1. Each support is to evenly distribute the load of the pipe and its contents over the full width of the support. Measures are to be taken to minimize wear of the pipes where they contact the supports.

b.2. Heavy components in the piping system such as valves and expansion joints are to be independently supported.

202. **Expansion**

a. Suitable provision is to be made in each pipeline to allow for relative movement between pipes made of plastic and the steel structure, having due regard to:

a.1. the difference in the coefficients of thermal expansion;

a.2. deformations of the ship's hull and its structure.

b. When calculating the thermal expansions, account is to be taken of the system working temperature and the temperature at which assembly is performed.

203. **External Loads**

a. When installing the piping, allowance is to be made for temporary point loads, where applicable. Such allowances are to include at least the force

exerted by a load (person) of 100 kg at mid-span on any pipe of more than 100 mm nominal outside diameter.

Besides for providing adequate robustness for all piping including open-ended piping a minimum wall thickness, complying with PIII, T62, S6, Item D1.302 may be increased upon the demand of the RBNA taking into account the conditions encountered during service on board ships.

b. Pipes are to be protected from mechanical damage where necessary.

204. **Strength of Connections**

a. The strength of connections is to be no less than that of the piping system in which they are installed.

b. Pipes may be assembled using adhesive-bonded, welded, flanged or other joints.

c. Adhesives, when used for joint assembly, are to be suitable for providing a permanent seal between the pipes and fittings throughout the temperature and pressure range of the intended application.

d. Tightening of joints is to be performed in accordance with Manufacturer's instructions.

205. **Installation of Conductive Pipes**

a. In piping systems for fluids with conductivity less than 1000 pico siemens per metre (pS/m) such as refined products and distillates use is to be made of conductive pipes.

b. Regardless of the fluid being conveyed, plastic piping is to be electrically conductive if the piping passes through a hazardous area. The resistance to earth from any point in the piping system is not to exceed 1 x 106 Ohm. It is preferred that pipes and fittings be homogeneously conductive. Pipes and fittings having conductive layers are to be protected against a possibility of spark damage to the pipe wall. Satisfactory earthing is to be provided.

c. After completion of the installation, the resistance to earth is to be verified. Earthing wires are to be accessible for inspection.

206. **Application of Fire Protection Coatings**

a. Fire protection coatings are to be applied on the joints, where necessary for meeting the required fire endurance as for Part III, Title 62, Section 6, item 302, after performing hydrostatic pressure tests of the piping system.

b. The fire protection coatings are to be applied in accordance with Manufacturer's recommendations, using a procedure approved in each particular case.

207. **Penetration of Divisions**

a. Where plastic pipes pass through "A" or "B" class divisions, arrangements are to be made to ensure that the fire endurance is not impaired. These arrangements are to be tested in accordance with Recommendations for fire test procedures for "A", "B" and "F" bulkheads (Resolution A.754(18) as amended).

b. When plastic pipes pass through watertight bulkheads or decks, the watertight integrity of the bulkhead or deck is to be maintained.

c. If the bulkhead or deck is also a fire division and destruction by fire of plastic pipes may cause the inflow of liquid from tanks, a metallic shut-off valve operable from above the freeboard deck are to be fitted at the bulkhead or deck.

208. **Control During Installation**

a. Installation is to be in accordance with the Manufacturer's guidelines.

b. Prior to commencing the work, joining techniques are to be approved by the RBNA.

c. The tests and explanations specified in this subchapter are to be completed before shipboard piping installation commences.

d. The personnel performing this work are to be properly qualified and certified to the satisfaction of the RBNA.

e. The procedure of making bonds is to include:

e.1. materials used,

e.2. tools and fixtures,

e.3. oint preparation requirements,

e.4. cure temperature,

e.5. dimensional requirements and tolerances, and

e.6. tests acceptance criteria upon completion of the assembly.

d. Any change in the bonding procedure which will affect the physical and mechanical properties of the joint is to require the procedure to be requalified.

209. **Bonding Procedure Quality Testing**

a. A test assembly is to be fabricated in accordance with the procedure to be qualified and it is to consist of at least one pipe-to-pipe joint and one pipe-to-fitting joint.

b. When the test assembly has been cured, it is to be subjected to a hydrostatic test pressure at a safety factor 2.5 times the design pressure of the test assembly, for no less than one hour. No leakage or separation of joints is allowed. The test is to be conducted so that the joint is loaded in both longitudinal and circumferential directions.

c. Selection of the pipes used for test assembly, is to be in accordance with the following:

c.1. When the largest size to be joined is 200 mm nominal outside diameter, or smaller, the test assembly is to be the largest piping size to be joined.

c.2. When the largest size to be joined is greater than 200 mm nominal outside diameter, the size of the test assembly is to be either 200 mm or 25% of the largest piping size to be joined, whichever is greater.

d. When conducting performance qualifications, each bonder and each bonding operator are to make up test assemblies, the size and number of which are to be as required above.

CHAPTER C
PRINCIPLES FOR THE CONSTRUCITON

CHAPTER CONTENTS

C1. PIPELINE ARRANGEMENT

100. Interferences

101. The passage of pipes near control panels and other electrical devices is to be avoided. When this is not possible, the piping is to be provided with a device to prevent dripping of liquid or steam spraying on electrical devices.

102. The integrity of the structure and its tightness is to be ensured, when the piping passes through girders, watertight bulkheads, decks, or tank tops.

103. The pipes are to be fixed to the structure of the ship by means of clamps or similar devices.

104. When the cargo, fresh water or salt water in general piping pass through fuel oil tanks they are to be of reinforced material and all the connections inside the tank are to be welded with reinforced flanges. The number of connections inside tanks is to be kept to a minimum.

105. Pipings containing heated liquids, such as steering gear hydraulic oil, are not to pass through fuel oil tanks.

200. Protections

201. The pipes in cargo holds are to be protected against shocks by using reinforced ducts.

202. Effective protection of the piping against corrosion is to be provided, particularly in the more exposed lines.

300. Expansions

301. The expansions of pipes due to temperature rise or deformations of the structure are to be compensated by suitably located curves, expansion joints or similar devices.

302. Overlapped type expansion joints are not to be used in cargo holds, deep tanks and in seldom accessed locations.

C2. ACCESSORIES / CONNECTIONS

100. Identification and access

101. The valves, taps and other accessories are to be installed in easily visible and accessible locations to maneuvering, control and maintenance.

102. Indicative plates are to be placed on the valves and taps, identifying them and indicating the system they serve. Pipes, according to their fluids, are to be identified by colors.

200. Flexible Hoses [IACS UR P2.12]

201. Definition: Flexible hose assembly short length of metallic or non-metallic hose normally with prefabricated end fittings ready for installation.

202. The requirements C2.205 to C2.206* apply to flexible hoses of metallic or non-metallic material intended for a permanent connection between a fixed piping system and items of machinery. The requirements may also be applied to temporary connected flexible hoses or hoses of portable equipment.

*Note: Requirements for tests are in Part III, Title 62, Section 6, Cahpter T, T74.200 (12.5 and 12.6)

203 Flexible hose assemblies as defined in C2.201 may be accepted for use in fuel oil, lubricating, hydraulic and thermal oil systems, fresh water and sea water cooling systems, compressed air systems, bilge and ballast systems, and Class III steam systems where they comply with C2.205. to C2.206*. Flexible hoses in high pressure fuel oil injection systems are not to be accepted.

*Note: Requirements for tests are in Part III, Title 62, Section 6, Chapter T, T74.200.

204. These requirements for flexible hose assemblies are not applicable to hoses intended to be used in fixed fire extinguishing systems.

Note: Requirements for tests are in Part III, Title 62, Section 6, Cahpter T, 74.200 (12.5 and 12.6)

205. **Design and construction**

a. Flexible hoses are to be designed and constructed in accordance with recognised National or International standards acceptable to the RBNA. Flexible hoses constructed of rubber materials and intended for use in bilge, ballast, compressed air, fuel oil, lubricating, hydraulic and thermal oil systems are to incorporate a single, double or more, closely woven integral wire braid or other suitable material reinforcement.

a.1. Flexible hoses of plastics materials for the same purposes, such as Teflon or Nylon, which are unable to be reinforced by incorporating closely woven integral wire braid are to have suitable material reinforcement as far as practicable.

a.2. Where rubber or plastics materials hoses are to be used in oil supply lines to burners, the hoses are to have external wire braid protection in addition to the reinforcement mentioned above. Flexible hoses for use in steam systems are to be of metallic construction.

b. Flexible hoses are to be complete with approved end fittings in accordance with manufacturer's specification. The end connections that do not have a flange are to comply with B5.201 as applicable and each type of hose/fitting combination is to be subject to prototype testing to the same standard as that required by the hose with particular reference to pressure and impulse tests.

c. The use of hose clamps and similar types of end attachments is not acceptable for flexible hoses in piping systems for steam, flammable media, starting air systems or for sea water systems where failure may result in flooding. In other piping systems, the use of hose clamps may be accepted where the working pressure is less than 5 bar and provided there are double clamps at each end connection.

d. Flexible hose assemblies intended for installation in piping systems where pressure pulses and/or high levels of vibration are expected to occur in service, are to be designed for the maximum expected impulse peak pressure and forces due to vibration. The tests required by B1.608 are to take into consideration the maximum anticipated in-service pressures, vibration frequencies and forces due to installation.

e. Flexible hose assemblies constructed of non-metallic materials intended for installation in piping systems for flammable media and sea water systems where failure may result in flooding, are to be of fire-resistant type. Fire resistance is to be demonstrated by testing to ISO 15540 and ISO 15541.

f. Flexible hose assemblies are to be selected for the intended location and application taking into consideration ambient conditions, compatibility with fluids under working pressure and temperature conditions consistent with the manufacturer's instructions and any requirements of the RBNA.

206. **Installation**

a. In general, flexible hoses are to be limited to a length necessary to provide for relative movement between fixed and flexibly mounted items of machinery/equipment or systems.

b. Flexible hose assemblies are not to be installed where they may be subjected to torsion deformation (twisting) under normal operating conditions.

c. The number of flexible hoses, in piping systems mentioned in C2.203 is to be kept to minimum and to be limited for the purpose stated in C2.202.

d. Where flexible hoses are intended to be used in piping systems conveying flammable fluids that are in close proximity of heated surfaces the risk of ignition due to failure of the hose assembly and subsequent release of fluids is to be mitigated as far as practicable by the use of screens or other similar protection to the satisfaction of the RBNA.

e. Flexible hoses are to be installed in clearly visible and readily accessible locations.

f. The installation of flexible hose assemblies is to be in accordance with the manufacturer's instructions and use limitations with particular attention to the following:

f.1. Orientation

f.2. End connection support (where necessary)

f.3. Avoidance of hose contact that could cause rubbing and abrasion

f.4. Minimum bend radii

300. Thermal insulation

101. Pipelines containing steam or hot liquid, exhaust piping from air compressors and equipment whose surface reaches operating temperature above 60° C, are to be effectively insulated.

400. Pipe connections

401. In order to facilitate the installation and maintenance of pipelines detachable connections are to be provided, which are to be flanged. Thread unions for pipes with nominal diameter up to 50 mm will be accepted when the pipeline is of low pressure and the fluid is not lethal toxic, fuel oil or lubricating oil.

C3. SHIP'S SIDE AND BOTTOM CONNECTIONS

100. Valves

101. The inlet and outlet seawater pipes shall be provided with valves, fixed as follows:

a. Directly to the hull plating;

b. Directly to the sea-chests plating built in the hull;

c. In reinforced parts, as short as possible, welded in plating, which will have the thickness equal to the hull plating, but need not exceed 9 mm.

102 The use of cast iron valves and connections is not allowed for connecting to the openings in the bottom and on the sides located below the main deck.

103. Connections and valves for connection to the openings on the bottom and on the ship's sides, with a diameter greater than 80 mm are to be built of steel.

104. Hull valves are to be readily accessible and, if intended for the inlet and outlet of water, are to be operated from the top of the engine room's floor.

105. When the discharge of cooling water piping is fitted with an inverted siphon, whose high point is above the line of maximum draft, the installation of the discharge valve may be dispensed with.

200. Sea-chests

201. The sea-chests are to be located so that it is minimized the possibility of air ingress into the suction pipings. They are to be fitted with vents with openings leading out of the hull and arranged in such a way that the valves can be operated from the grid or the floor of the engine room.

202. A removable grating is to be installed in the ship's side, at the suction inlet for seawater. The free area of this grating is to be at least equal to twice the area of suction pipes this chest. Effective means are to be provided fot the cleaning of the grating.

203. Sea-chests for engine cooling pipelines: see Part II, Title 11, Section 6, Chapter G, subchapter G3, iems G3.100 and G3.200.

300. Ship's side water discharges

301. Discharges in the ship's sides intended for the drainage of deck and compartments and sanitary sewage, with internal ends inside of the hull, are to be provided with effective means to prevent the entry of water on board, in accordance with the requirements of the International Convention on Load Line.

C4. PROTECTION AGAINST OVER- PRESSURE

100. In systems

101. In closed systems, where the fluid can be heated, over-pressure protection devices are to be fitted.

102. Systems which in service may be subject to pressures greater than those for which they were designed are to be fitted with safety valves.

103. Over-pressure protection devices are to trigger when the pressure reaches 110% of the design project.

200. Equipaments and accessories

201. The positive displacement pumps are to be fitted with pressure relief valves which cannot be closed, to protect their casing.

202. Centrifugal pumps are to operate smoothly when the discharge valve is closed.

203. Safety valves are to be installed on the low pressure side of pressure reducing valves.

C5. INDEPENDENT TANKS

100. Structural dimensioning

101. Structural dimensioning of independent tanks is to be accordance with Part II Title 11 Section 2 of the Rules.

200. Accessories

201. The requirements for tank accessories are indicated in the Rules on items relating to each type of fluid.

CHAPTER D
PRINCIPLES FOR THE DIMENSIONING

CHAPTER CONTENTS

D1. BASIC PRINCIPLES

100. Application

101. The dimensioning presented in these Rules assume temperatures and viscosities typically found in the relevant fluids. The details are dealt with in the relevant Chapters.

D2. STANDARDS

100. Application

101. Piping systems, all their accessories, pumps and equipment are to be in compliance with the latest revisions of the standards of INMETRO and in the absence of such of the following organizations:

a. ANSI American National Standard Institute

b. ASTM American RBNA for Testing and Materials

c. ASME American RBNA of Mechanical Engineers

102. These Rules extend the aplication of the URP of the IACS also to ships with AB < 500, since such requirements are to be in accordance with the above standards.

D3. P1.2 STRENGTH OF PIPES [IACS UR P1]

100. Required wall thickness

101. The minimum wall thickness of pipes is not to be less than the greater of the values obtained by D3.202, D3.301 below, as applicable, or the minimum wall thickness required by D3.401 below.

200. Calculated wall thickness

201. T he following requirements apply for pipes where the ratio outside-diameter to inside-diameter does not exceed the value 1.7.

202. The calculated wall thickness for straight or bent pressure pipes is not to be less than determined from the following formula, as applicable:

$$t = t_0 + b + c$$

where

t = minimum calculated thickness(mm)

t_0 = thickness calculated by the following basic formula (mm)

c = corrosion allowance (mm) (from Tables T.D3.202.1 and T.D3.202.2).

$$t = \frac{PD}{20\,Ke + P}$$

P = design pressure (bar) (see D3.700)
D = outside diameter (mm)
K = permissible stress (N/mm2) (from D3.500 and D3.600)
e = efficiency factor

e = 1 for seamless pipes and for welded pipes delivered by manufacturers approved for making welded pipes which are considered an equivalent to seamless pipes.

for other welded pipes the RBNA will consider an efficiency factor value depending upon the service and the welding procedure.

b = allowance for bending

The value for this allowance is to be chosen in such a way that the calculated stress in the bend, due to the internal pressure only, does not exceed the permissible stress.
When this allowance is not determined by a more accurate procedure, it is to be taken as no less than:

$$b = \frac{1}{2{,}5}\,\frac{D}{R}\,t_0$$

where

R = mean radius of the bend (mm)

300. Manufacturing tolerance

301. The value of t, calculated above, does not account for any negative manufacturing tolerance; therefore the said thickness shall be increased considering the negative manufacturing tolerance by means of the following formula:

$$t_1 = \frac{t}{1 - a/100}$$

where

t1 = minimum thickness in the case of negative tolerance (mm)

t = minimum thickness calculated by formula (1) (mm)

a = percentage negative manufacturing tolerance.

400. Minimum wall thickness

401. The minimum wall thickness is to be as indicated in Tables T.D3.401.1 to T.D3.401.4. For pipes subject also to Load Line Regulations see LL36.

TABLE T.D3.202.1 - CORROSION ALLOWANCE C FOR STEEL PIPES

Piping service	c (mm)
Superheated steam systems	0,3
Saturated steam systems	0,8
Steam coil systems in cargo tanks	2
Feed water for boilers in open circuit systems	1,5
Feed water for boilers in closed circuit systems	0,5
Blow down (for boilers) systems	1,5
Compressed air systems	1
Hydraulic oil systems	0,3
Lubricating oil systems	0,3
Fuel oil systems	1
Cargo oil systems	2
Refrigerating plants	0,3
Fresh water systems	0,8
Sea water systems in general	3

NOTE

1. For pipes passing through tanks an additional corrosion allowance is to be considered according to the figures given in the Table, and depending on the external medium, in order to account for the external corrosion.

2. The corrosion allowance may be reduced where pipes and any integral pipe joints are protected against corrosion by means of coating,, lining, etc.

3. In the case of use of special alloy steel with sufficient corrosion resistance, the corrosion allowance may be reduced to zero.

TABLE T.D3.202.2 - CORROSION ALLOWANCE C FOR NON-FERROUS METAL PIPES

Piping material	c (mm)
Copper, brass and similar alloys, copper-tin alloys except those with lead contents	0,8
Copper-nickel alloys (with Ni ≥ 10%)	0,5

NOTE

For media without corrosive action in respect of the material employed and in the case of special alloys with sufficient corrosion resistance the corrosion allowance may be reduced to zero

TABLES T.D3.401.1 - MINIMUM WALL THICKNESS FOR STEEL PIPES (all dimensions in mm)

Nominal Size	Outside Diameter	Wall thickness			
		A	B	C	D
6	10,2	1,6			
	12,0	1,6			
8	13,5,	1,8			
10	17,2	1,8			
	19,3	1,8			
	20,0	2			
15	21,3	2		3,2	
	25,0	2		3,2	
20	26,9	2		3,2	
25	33,7	2		3,2	
	38,0	2	4,5	3,,6	6,3
32	42,4	2	4,5	3,6	6,3
	44,5	2	4,5	3,6	6,3
40	48,3	2,3	4,5	3,6	6,3
	51,0	2,3	4,5	4,0	6,3
50	60,3	2,3	4,5	4,0	6,3
	63,5	2,3	4,5	4,0	6,3
65	70,0	2,6	4,5	4,0	6,3
	76,1	2,6	4,5	4,5	6,3
	82,5	2,6	4,5	4,5	6,3
80	88,9	2,9	4,5	4,5	7,1
90	101,6	2,9	4,5	4,5	7,1
	108,0	2,9	4,5	4,5	7,1
100	114,3	3,2	4,5	4,5	8,0
	127,0	3,2	4,5	4,5	8,0
	133,0	3,6	4,5	4,5	8,0
125	139,7	3,6	4,5	4,5	8,0
	152,4	4	4,5	4,5	8,8
150	168,3	4	4,5	4,5	8,8
	177,8	4,5	5,0	5,0	8,8
175	193,7	4,5	5,4	5,4	8,8
200	219,1	4,5	5,9	5,9	8,8
225	244,5	5	6,3	6,3	8,8
250	273,0	5	6,3	6,3	8,8
	298,5	5,6	6,3	6,3	8,8
300	323,9	5,6	6,3	6,3	8,8
350	355,6	5,6	6,3	6,3	8,8
	368,0	5,6	6,3	6,3	8,8
400	40,6,4	6,3	6,3	6,3	8,8
450	457,2	6,3	6,3	6,3	8,8

402. Notes of Table 3: Columns A, B, C and D in the table apply to the following services:

A Pipes in general

B Vent, overflow and sounding pipes for integral tanks

C Bilge, ballast and sea water pipes

D Bilge, ballast, vent, overflow and sounding pipes passing through fuel tank. Bilge, vent, overflow, sounding and fuel pipes passing through ballast tanks.

403. Notes:

a. The nominal sizes, pipe diameters and wall thicknesses given in the table are many of the common sizes based on international standards. Notwithstanding the requirements of Table 3, diameter and thickness according to other national or international standards may be accepted.

b. Where pipes and any integral pipe joints are protected against corrosion by means of coating, lining etc. at the discretion of RBNA, the thickness may be reduced by no more than 1 mm.

c. For sounding pipes, except those for flammable cargoes, the minimum wall thickness in column B

is intended to apply only to the part outside the tank.

d. The minimum thicknesses listed in this table are the nominal wall thickness. No allowance needs to be made for negative tolerance or for reduction in thickness due to bending.

e. For threaded pipes, where allowed, the minimum wall thickness is to be measured at the bottom of the thread.

f. The minimum wall thickness for bilge lines and ballast lines through deep tanks will be subject to special consideration by the RBNA. The minimum wall thickness for ballast lines through oil cargo tanks is not to be less than that specified by UR F15.

g. The minimum wall thickness for pipes larger than 450mm nominal size is to be in accordance with a national or international standard and in any case no less than the minimum wall thickness of the appropriate column indicated for 450 mm pipe size.

h. The minimum internal diameter for bilge, sounding, venting and overflow pipes shall be:

Bilge 50 mm bore

Sounding 32 mm bore

Venting and overflow 50 mm bore

i. Exhaust gas pipe minimum wall thickness will be subject to special consideration by RBNA.

j. The minimum wall thickness for cargo oil lines will be subject to special consideration by RBNA.

TABLES T.D3.401.2 MINIMUM WALL THICKNESS FOR AUSTENITIC STAINLESS STEEL PIPES

External diameter D (mm)	Minimum wall Thickness (mm)	External diameter D (mm)	Minimum wall Thickness (mm)
1,2 to 17,2	1,0	219,1	2,6
21,3 to 48,3	1,6	273,0	2,9
60,3 to 88,9	2,0	323,9 to 406,4	3,6
114,3 to 168,3	2,3	Over 406,4	4,0

Note: Diameters and thicknesses according to national or international standards may be accepted.

TABLES T.D3.401.3 MINIMUM WALL THICKNESS FOR STEEL PIPES FOR CO2 FIRE EXTINGUISHING

External diameter D (mm)	From bottles to distribution station	From distribution station to nozzles
21,3 - 26,9	3,2	2,6
30 - 48,3	4	3,2
51 - 60,3	4,5	3,6
63,5 - 76,1	5	3,6
82,5 - 88,9	5,6	4
101,6	6,3	4
108 - 114,3	7,1	4,5
127	8	4,5
133 - 139,7	8	5
152,4 - 168,3	8,8	5,6

NOTES
1. Pipes are to be galvanized at least inside,except those fitted in the engine room where galvanizing may not be required at the discretion of the Classification Society.
2. For threaded pipes, where allowed, the minimum wall thickness is to be measured at the bottom of the thread.
3. The external diameters and thicknesses have been selected from ISO Recommendations R336 for smooth welded and seamless steel pipes. Diameter and thickness according to other national or international standards may be accepted.
4. For larger diameters the minimum wall thickness will be subject to special consideration by the Classification Society.
5. In general the minimum thickness is the nominal wall thickness and no allowance need be made for negative tolerance or reduction in thickness due to bending.

TABLES T.D3.401.4 - MINIMUM WALL THICKNESS FOR COPPER AND COPPER ALLOY PIPES

External diameter D (mm)	Minimum wall thickness (mm)	
	Copper	Copper alloy
08-10	1,0	
12-20	1,2	
25-44,5	1,5	
50-76,1	2,0	
88,9-108	2,5	
133-159	3,0	
193,7-267	3,5	
273-457,2	4,0	
470	4,0	
508	4,5	
Note: Diameters and thicknesses according to national or international standards may be accepted.		

500. Permissible stress k for carbon steel and alloy steel pipes

501. The permissible stress for carbon steel and alloy steel pipes to be considered in formula (2) of D3.200 is to be chosen as the lowest of the following values:

$R_{20}/2,7$
$E_T/1,6$ up to $E_T/1,8$
$\sigma_{R/100\,000}/1,6$ up to $\sigma_{R/10\,000}/1,8$
$\sigma_{R/100\,000}/1$ accordingly.

where

R_{20} = specified minimum tensile strength (N/mm2) at room temperature, i.e. 20°C

E_T = specified minimum yield stress or 0,2% proof stress (N/mm2) at the design temperature (see D3.800)

$\sigma_R/100\,000$ = average stress (N/mm2) to produce rupture in 100 000 hours at the design temperature (see D3.800)

$\sigma_1/100\,000$ = average stress (N/mm2) to produce 1% creep in 100 000 hours at the design temperature (see D3.800)

502. NOTES

a. The values of yield stress or 0,2% proof stress given by national and international standards for steel pipes may be adopted.

b. The values in the range between 1,6 and 1,8 are to be chosen at the discretion of the RBNA.

c. The value of σ1/100 000/1 may be used at discretion of the RBNA on the basis of its reliability, and if deemed necessary.

600. Permissible stress K for copper and copper alloys

601. The permissible stress for copper and copper alloy pipes to be considered in formula (2) of D3.200 is to be taken from T.D3.601.1 depending upon design temperature (see D3.800).

TABLES T.D3.601.1 - PERMISSIBLE STRESS LIMITS K FOR COPPER AND COPPER ALLOYS

Pipe material		Copper	Aluminium brass	Copper nickel Cu Ni 5 Fe 1 Mn Cu Ni 10 Fe 1 Mn	Copper nickel Cu Ni 30
Material condition		Annealed	Annealed	Annealed	Annealed
Minimum tensile strength (N/mm^2)		215	325	275	365
Permissible stress K (N/mm^2)	50°C	41	78	68	81
	75°C	41	78	68	79
	100°C	40	78	67	77
	125°C	40	78	65,5	75
	150°C	34	78	64	73
	175°C	27,5	51	62	71
	200°C	18,5	24,5	59	69
	225°C	–	–	56	67
	250°C	–	–	52	65,5
	275°C	–	–	48	64
	300°C	–	–	44	62

NOTES
1. Intermediate values may be determined by linear interpolation.
2. For materials not included in the Table, the permissible stress shall be specially considered by the Classification Society.

700. Design pressure:
[P.1.2.7]

701. The design pressure P to be considered in formula (2) of D3.200 is the maximum working pressure and it is not to be less than the highest set pressure of any safety relief valve. For special cases, the design pressure will be specially considered. For pipes containing fuel oil, the design pressure is to be taken in accordance with Table T.D3.701.1.

TABLE T.D3.701.1 -.DEFINITION OF THE DESIGN PRESSURE FOR FUEL OIL SYSTEMS

Working temperature Woring pressure	**T ≤ 60°C**	**T > 60°**
P ≤ 7 bar	3 bar or max. woring pressure, whichever is greater	3 bar or max. woring pressure, whichever is greater
P > 7 bar	Max. working pressure	14 bar or max. woring pressure, whichever is greater

800. Design temperature:

801. The design temperature to be considered for determining the permissible stress in D3.500 and D3.600 is in general the maximum temperature of the medium inside the pipes. For special cases, the design temperature will be specially considered.

D4. DIMENSION OF VALVES AND FITTINGS

100. Flanges
[P1.3]

101. The dimensions of flanges and relative bolts are to be chosen in accordance with the national standards.

102. For special application the dimensions of flanges and relative bolts will be subject to special consideration*.

**For special applications, when the temperature, the pressure and the size of the flange have values above certain limits, to be fixed, the complete calculation of bolts and flanges is to be carried out.*

200. Valves and Fittings:
[P1.4]

201. Valves and fittings in piping systems are to be compatible with the pipes to which they are attached in

respect of their strength (see D3.700 for design pressure) and are to be suitable for effective operation at the maximum working pressure they will experience in service.

CHAPTER E
CARGO PIPING SYSTEMS

CHAPTER CONTENTS

E1. CARGO PIPING IN SPECIAL PURPOSE SHIPS

100. Liquid bulk vessels.

101. For special ships carrying bulk liquid refer to Part II, Titles 33 and 34 of the Rules.

E2. FUEL OIL CARGO IN NON-SPECIAL PURPOSE SHIPS

100. Fuel oil with flash point < 60° C

101. For non-special ships carrying fuel oil with a flash point below 60°C refer to Part II, Title 32 of the Rules.

CHAPTER F
HULL PIPING SYSTEM

CHAPTER CONTENTS

F1. BILGE WATER – DRAINAGE

100. Principles

101. All the vessels are to be fitted with pumping systems and piping lines capable of performing the drainage of any compartment. Where unmanned or with GT < 70, compartments that are permanently watertight may be waived of rhe requirement for fixed drainage system by consulting the RBNA, but are to have sounding pipes installed.

102. Compartments whose width is half breadth of the ship or more (as applicable) are to have at least 2 (two) side suctions. Compartments other than the above are to be fitted with at least one suction, conveniently located.

103. The bilge water main is to be totally independent from the piping systems intended for cargo and for fuel oil

104. Special care should be taken so that discharges outside the vessel will not pollute the waters. See Chapter H.

200. Arrangement

201. The arrangement of pipes and fittings is to avoid accidental communication between watertight compartments and the exterior of the vessel. For this purpose the branches of the various compartments are to be connected to the main pipeline system or to the bilge manifold by means of closing and one way valves.

202. The bilge piping is not to pass through lubricating oil tanks, drinking water tanks or feed watertanks for boilers.

203. Where bilge piping pass through a fuel oil tanks the pipies are to be of the reinforced material type and all connections inside the tank are to be welded with reinforced flanges. The number of connections inside the tanks is to be kept to a minimum.

204. Where there are no tunnels for the pipes, the branches are to be fitted with one way valves of approved type at the suction ends.

205. Longitudinal sections of pipes fixed on bulkheads or floors spaced for more than 0.1 x L apart are to have expansion curves or other approved device, sealing gaskets not being allowed to absorb expansion and contraction.

206. Bilge valves or draining are not allowed on the collision bulkhead. If otherwise impracticable, the passage of bilge or ballast piping is to be equipped with shut-off valve installed in the bulkhead, inside the collision tank with remote control operated from an accessible location above the bulkhead deck and a device for indication of open or closed position. Under special conditions RBNA may approve the installation of such valve by the external side, provided that it is in a position accessible under all service conditions and the space where it is located is other than of cargo or fuel oil.

207. All the bilge suctions are to be fitted with gratings, whose free perforated areas are to not be less than 3 times the cross sectional area of the suction pipe.

208. The sections of the piping comprised between the bilge suction manifold and the bilge pump are to be fitted with filters so as protect the pump.

209. The engine room is to have, at least, two bilge suctions. On passenger vessels with more than 20 GT and other types of ships with more than 50 GT flooding level alarms, audible and visual, are to be fitted. All bilge sumps are to be accessible and easy to clean. Bilge water must not flood areas where electrical equipment are located under any conditions of movement and inclination.

210. The Engine Room oily water bilge system is to be independent from the hull bilge system.

211. All the tanks used for ballast water, fuel oil or liquid cargo, including double bottom tanks, are to be fitted with bilge suctions at their aft ends, except in case of special geometries. Void spaces s and cofferdams are to be connected to the bilge system, except in special cases, e.g. small spaces permanently closed, without air pipes or overflow.

212. The bilge branch lines for dry cargo holds are to be fitted with one way valves and be separated from branches of ballast and de-ballast . Ships of a single cargo hold with compartment length greater than 30 (thirty) meters are to be fitted with bilge suctions one on each side of the ship , in the aft part of the hold and at one quarter of the cargo hold length, forward.

300. Bilge water system for vessels under 500 GT

301. All self-propelled vessels of Gross Tonnage equal to or greater than 100, but less than 500 GT trasnporting passengers, dangerous goods, tugs and pusher boats and other vessels are to have at least one non-manual(*) bilge water pump with flow rate of at least 15 m^3/h, which may be driven by the main engine.

(*)Guidance

A non-hand fire pump is a fixed pump, driven by a non hand power supply

End of guidance

302. The vessels which do not fit in the requirements of the preceding paragraph are to be fitted with at least, one bilge water pump with minimum flow rate 10 m^3/h, which may be manual.

303. When the propulsion power exceeds 224 kW (300 HP) with gross tonnage under 500 GT two non-manual pumps are to be installed each with a minimum flow rate of 15 m^3/h. The second pump is to be driven by a prime mover independent of the propulsion engine.

304. The minimum capacity of the bilge water pumps shall be obtained by the following formula:

$$Q = 0.00575 \times d^2$$

Where:

Q = pump capacity in m^3/h
D = required diameter of the main line, in mm.

305. The flow of independent driven pumps is to be such that the suction speed is at least 2 m/s when the bilge water is flowing simultaneously through two branches of main diameters that are connected to the pump.

306. The flow of bilge pumps driven by the main engine are to be not less than the flow of cooling water pumps driven by these engines. Lower flow may be accepted provided that the difference is offset by the outflow of the independent bilge water pump.

307. When centrifugal pumps for bilge water are used, they are to be self-primed or to be linked to a central system of priming.

308. When the bilge water pump is used in de-ballast, the main branch is to be connected to the suction line of the pump by mens of an one way valve to prevent the ballast water flowing into the bilge water system.

309. **Arrangement for sewage and hull drainages**

a. The hull discharges are to be below or at the vessel's load waterline.

b. Bilge or drains of spaces inside the hull will have valves operated from the external part of the hull. Other bilge or drains shall be fitted with a non-return and shut-off valve.

c. For drainage of accumulated water in spaces other than those of the interior of the hull scuppers are to be fitted in number and dimensions suitable to the location.

400. Bilge water system for cargo and passenger with gross tonnage equal to or greater than 500 GT

401. An efficient bilge pumping system shall be provided, capable of pumping from and draining any watertight compartment other than a space permanently appropriated for the carriage of:

a. fresh water,

b. water ballast,

c. oil fuel

d. liquid cargo

and for which other efficient means of pumping are provided, under all practical conditions. Efficient means shall be provided for draining water from insulated holds.

402. Sanitary, ballast and general service pumps may be accepted as independent power bilge pumps if fitted with the necessary connections to the bilge pumping system.

403. All bilge pipes used in or under fuel storage tanks or in boiler or machinery spaces, including spaces in which oil-settling tanks or oil fuel pumping units are situated, shall be of steel or other suitable material.

404. The arrangement of the bilge and ballast pumping system shall be such as to prevent the possibility of water passing from the sea and from water ballast spaces into the cargo and machinery spaces, or from one compartment to another. Provision shall be made to prevent any deep tank having bilge and ballast connections being inadvertently flooded from the sea when containing cargo, or being discharged through a bilge pump when containing water ballast.

405. All distribution boxes and manually operated valves in connection with the bilge pumping arrangements shall be in positions which are accessible under ordinary circumstances.

406. Provision shall be made for the drainage of enclosed cargo spaces situated on the bulkhead deck of a passenger ship and on the freeboard deck of a cargo ship, provided that RBNA may permit the means of drainage to be dispensed with in any particular compartment of any ship or class of ship if it is satisfied that by reason of size or internal subdivision of those spaces the safety of the ship is not thereby impaired.

407. Where the freeboard to the bulkhead deck or the freeboard deck, respectively, is such that the deck edge is immersed when the ship heels more than 5°:

a. in the case of a passenger ship, the drainage shall be by means of a sufficient number of scuppers of suitable size discharging directly overboard,

b. in the case of a cargo ship the requirements for scuppers, inlets and discharges of the International Convention on Load Lines in force.

408. Where the freeboard is such that the edge of the bulkhead deck or the edge of the freeboard deck, respectively, is immersed when the ship heels 5° or less, the drainage of the enclosed cargo spaces on the bulkhead deck or on the freeboard deck, respectively, shall be led to a suitable space, or spaces, of adequate capacity, having a high water level alarm and provided with suitable arrangements for discharge overboard. In addition it shall be ensured that:

a. the number, size and disposition of the scuppers are such as to prevent unreasonable accumulation of free water;

b. the pumping arrangements required by this regulation for passenger ships or cargo ships, as applicable, take account of the requirements for any fixed pressure water-spraying fire extinguishing system;

c. water contaminated with petrol or other dangerous substances is not drained to machinery spaces or other spaces where sources of ignition may be present; and

d. where the enclosed cargo space is protected by a carbon dioxide fire extinguishing system the deck

scuppers are fitted with means to prev e escape of the smothering gas.

500. Bilge water system for passenger ships with gross tonnage equal to or greater than 500 GT

501. The bilge pumping system required by F1.400 above shall be capable of operation under all practicable conditions after a casualty whether the ship is upright or listed

a. For this purpose wing suctions shall generally be fitted except in narrow compartments at the end of the ship, where one suction may be sufficient.

b. In compartments of unusual form, additional suctions may be required.

c. Arrangements shall be made whereby water in the compartment may find its way to the suction pipes.

d. Where, for particular compartments, RBNA is satisfied that the provision of drainage may be undesirable, such provision may be dispensed with if calculations made in accordance with the conditions laid down in Part II, Title 11, Section 1, Subchapter H.5 show that the survival capability of the ship will not be impaired.

502. At least three power pumps shall be fitted connected to the bilge main, one of which may be driven by the propulsion machinery.

503. Where the bilge pump numeral is 30 or more, one additional independent power pump shall be provided. The bilge pump numeral shall be calculated as follows:

when P1 is greater than P:

bilge pump numeral = 72 [(M+2P1) / (V + P1 - P)]

in other cases:

bilge pump numeral =72 [(M+2P1)/V]

where:

L = the length of the ship (metres),

M = the volume of the machinery space (cubic metres) that is below the bulkhead deck; with the addition thereto of the volume of any permanent oil fuel bunkers which may be situated above the inner bottom and forward of, or abaft, the machinery space;

P = the whole volume of the passenger and crew spaces below the bulkhead deck (cubic metres), which are provided for the accommodation and use of passengers and crew, excluding baggage, store, provision and mail rooms;

V = the whole volume of the ship below the bulkhead deck (cubic metres);

P1= KN,

where:

N = the number of passengers for which the ship is to be certified; and
K = 0.056L

504. However, where the value of KN is greater than the sum of P and the whole volume of the actual passenger spaces above the bulkhead deck, the figure to be taken as P1 is that sum or two-thirds KN, whichever is the greater.

505. Where practicable, the power bilge pumps shall be placed in separate watertight compartments and so arranged or situated that these compartments will not be flooded by the same damage.

a. If the main propulsion machinery, auxiliary machinery and boilers are in two or more watertight compartments, the pumps available for bilge service shall be distributed as far as is possible throughout these compartments.

506. On a ship of 91.5 m in length and upwards or having a bilge pump numeral, calculated in accordance with paragraph F1.504 above of 30 or more, the arrangements shall be such that at least one power bilge pump shall be available for use in all flooding conditions which the ship is required to withstand, as follows:

a. one of the required bilge pumps shall be an emergency pump of a reliable submersible type having a source of power situated above the bulkhead deck; or

b. the bilge pumps and their sources of power shall be so distributed throughout the length of the ship that at least one pump in an undamaged compartment will be available.

507. With the exception of additional pumps which may be provided for peak compartments only, each required bilge pump shall be so arranged as to draw water from any space required to be drained by paragraph F1.501 above.

508. Each power bilge pump shall be capable of pumping water through the required main bilge pipe at a speed of not less than 2 m/s.

509. Independent power bilge pumps situated in machinery spaces shall have direct suctions from these spaces, except that not more than two such suctions shall be required in any one space.

510. Where two or more such suctions are provided, there shall be at least one on each side of the ship. RBNA may require independent power bilge pumps situated in other spaces to have separate direct suctions.

511. Direct suctions shall be suitably arranged and those in a machinery space shall be of a diameter not less than that required for the bilge main.

512. In addition to the direct bilge suction or suctions required by paragraph F1.509 to F1.512, a direct suction from the main circulating pump leading to the drainage level of the machinery space and fitted with a non-return valve shall be provided in the machinery space. The diameter of this direct suction pipe shall be at least two thirds of the diameter of the pump inlet in the case of steamships, and of the same diameter as the pump inlet in the case of motorships.

513. Where in the opinion of RBNA the main circulating pump is not suitable for this purpose, a direct emergency bilge suction shall be led from the largest available independent power driven pump to the drainage level of the machinery space; the suction shall be of the same diameter as the main inlet of the pump used. The capacity of the pump so connected shall exceed that of a required bilge pump by an amount deemed satisfactory by RBNA.

514. The spindles of the sea inlet and direct suction valves shall extend well above the engine-room platform.

515. All bilge suction piping up to the connection to the pumps shall be independent of other piping.

516. Provision shall be made to prevent the compartment served by any bilge suction pipe being flooded in the event of the pipe being severed or otherwise damaged by collision or grounding in any other compartment.

a. For this purpose, where the pipe is at any part situated nearer the side of the ship than one fifth of the breadth of the ship (as defined in regulation 2 and measured at right angles to the centreline at the level of the deepest subdivision load line), or is in a duct keel, a non-return valve shall be fitted to the pipe in the compartment containing the open end.

517. Distribution boxes, cocks and valves in connection with the bilge pumping system shall be so arranged that, in the event of flooding, one of the bilge pumps may be operative on any compartment; in addition, damage to a pump or its pipe connecting to the bilge main outboard of a line drawn at one fifth of the breadth of the ship shall not put the bilge system out of action.

a. If there is only one system of pipes common to all the pumps, the necessary valves for controlling the bilge suctions must be capable of being operated from above the bulkhead deck.

518. Where in addition to the main bilge pumping system an emergency bilge pumping system is provided, it shall be independent of the main system and so arranged that a pump is capable of operating on any compartment under flooding condition as specified in paragraph F1.501 in that case only the valves necessary for the operation of the emergency system need be capable of being operated from above the bulkhead deck.

519. All cocks and valves referred to in paragraph F1.518 which can be operated from above the bulkhead deck shall have their controls at their place of operation clearly marked and shall be provided with means to indicate whether they are open or closed.

600. Bilge water system for cargo ships with gross tonnage equal to or greater than 500 GT

601. At least two power pumps connected to the main bilge system shall be provided, one of which may be driven by the propulsion machinery.

602. If the RBNA is satisfied that the safety of the ship is not impaired, bilge pumping arrangements may be dispensed with in particular compartments."

700. Diâmeter of the suction pipes (all ships)

701. The diameter **d** of the bilge main shall be calculated according to the following formula. However, the actual internal diameter of the bilge main may be rounded off to the nearest standard size acceptable to the RBNA:

$$d = 25 + 1.68*\sqrt{L * (B+D)}$$

where:

d is the internal diameter of the bilge main (millimetres);
L and B are the length and the breadth of the ship (metres) as defined in F1.400 above;

D is the moulded depth of the ship to the bulkhead deck (metres) provided that, in a ship having an enclosed cargo space on the bulkhead deck which is internally drained in accordance with the requirements of paragraph F1.408 above and which extends for the full length of the ship, D shall be measured to the next deck above the bulkhead deck.

a. Where the enclosed cargo spaces cover a lesser length, D shall be taken as the moulded depth to the bulkhead deck plus lh/L where l and h are the aggregate length and height respectively of the enclosed cargo spaces (metres). The diameter of the bilge branch pipes shall meet the requirements of the RBNA.

702. The diameter **d** of the bilge branch piping shall be calculated according to the following formula. However, the actual internal diameter of the bilge branch is not to be less than 50 mm:

$$d = 25 + 2.16 * \sqrt{lc * (B+D)}$$

where

lc: length of the compartment

B: extreme width from outside of frame to outside of frame at or below the deepest subdivision load line (m)

D: moulded depth of the ship (m)

F2. FIREFIGHTING PIPING SYSTEMS FOR VESSELS WITH GT < 500

Guidance

For vessels with AB ≥ 500, see Part II, Title 11, Section 3, Chapter E, E10.

End of guidance

100. Application

101. This Subchapter applies to all sefl-propelled vessels having GT < 500.

102. National requirements are to be taken into account. For Brazilian flag vessels, the requirements of are those of NORMAM 01.

103. This Subchapter contains requirements based on IACS Rec 99.

104. All the propelled and non-propelled vessels intended for the carriage of special products are to be provided with fire pumps, fire main, fire outlets and hoses in accordance with this Part of the Rules.

105. Plans in virtual files or in triplicate hard copies are to be submitted to the RBNA for approval, clearly indicating:

a. the details and particulars of the fire piping arrangement;

b. number and capacity of pumps;

c. means of access to each compartment and to the decks;

d. location of fire extinguishers, alarms, detectors; and

e. a list of fire fighting appliances, with the names of manufacturers, types, serial numbers and main particularities.

106. The plans of the fixed fire fighting installation for the machinery spaces and cargo holds, when required, are to also be submitted, including piping diagrams and significant details.

107. The calculations for the capacity of fixed installation of fire fighting are to be submitted for reference, when required.

108. The fixed foam systems, water spray and inert gas to the cargo spaces and pump rooms of tank vessels, oil carriers, liquefied gas, chemicals and dangerous cargo are to be installed in accordance with the requirements laid down in the international codes. In the case of vessels without propulsion and without crew on board, the requirements may be modified and be submitted to the consideration of the RBNA.

200. Fire pumps

201. **IACS Rec 99**The total capacity of the main fire pump(s) is not to be less than:

$$Q = [0{,}145 * \sqrt{L*(B+D)} + 2{,}170]^2$$

but need not exceed $25 m^3/h$

where

B = greatest moulded breadth of vessel, in metres

D = moulded depth to bulkhead deck, in metres

L = Freeboard Length, in metres

Q = total capacity, in m^3/h

300. Number and requirements for fire pumps

301. All self-propelled vessels having GT ≤ 300 shall be fitted with one non-hand fire pump with driver delievering a minimum flow of 10 m^3/h and suficiente pressure to throw a jet of water at a distance not less than 12 m when employing a nozzle of 12 mm. The manual pumps shall deliever a flow not less than 1,1 m^3/h.

Guidance

A non-hand fire pump is a fixed pump, driven by a non hand power supply

End of guidance

302. Self-propelled vessels having GT > 300 and/or tug boats and pussher boats employed in convoy operations shall be fitted with a non-hand fire pump delidering a flow not less than 15 m^3/h, which may be driven aby the Main Engine

303. Sanitary, ballast, bilge or general services pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil and that if they are occasionally subject to the funciton of transferring or pumping fuel oil are equipped with appropriate devices to perform the change of function.

304. In ships which have additional ICE class notation, the suction valves are to be equipped with ice-clearing devices.

305. Oil pumps are not to be conncected to and are not to be used in the fire system.

306. Where the design pressure of the fire pumps is lower than the design pressure of the service water piping

systems, a relief valve is to be fitted to the fire main to control the excess in pressure.

307. Where centrifugal pumps are epmployed for fire pumps, they shall be of the self-priming type, or else they shall be connected to a central priming system. A one way valve with means of closing may be accepted.

308. The main fire pump shall be installed aft of the collision bulkhead, preferably in the Engine Room in a location of easy access.

400. Portable fire pumps

401. Portable fire pumps are to comply with the following:

a. The pump are to be self-priming.

b. The total suction head and the net positive suction head of the pump are to be determined taking account of actual operation, i.e. pump location when used.

c. The portable fire pump, when fitted with its length of discharge hose and nozzle are to be capable of maintaining a pressure sufficient to produce a jet throw of at least 12 m, or that required to enable a jet of water to be directed on any part of the engine room or the exterior boundary of the engine room and casing, whichever is the greater.

d. Except for electric pumps, the pump set is to have its own fuel tank of sufficient capacity to operate the pump for three hours. For electric pumps, their batteries are to have sufficient capacity for three hours.

e. Except for electric pumps, details of the fuel type and storage location are to be carefully considered. If the fuel type has a flashpoint below 60°C, further consideration to the fire safety aspects are to be given.

f. The pump set are to be stored in a secure, safe and enclosed space, accessible from open deck and clear of the Category 'A' machinery space.

g. The pump set is to be easily moved and operated by two persons and be readily available for immediate use.

h. Arrangements are to be provided to secure the pump at its anticipated operating position(s).

i. The overboard suction hose are to be non-collapsible and of sufficient length, to ensure suction under all operating conditions. A suitable strainer is to be fitted at the inlet end of the hose.

j. Any diesel-driven power source for the pump are to be capable of being readily started in its cold condition by hand (manual) cranking. If this is impracticable, consideration is to be given to the provision and maintenance of heating arrangements, so that readily starting can be ensured.

402. Alternatively to the Recommendations of F2.401 a fixed fire pump may be fitted, which are to comply with the following:

a. The pump, its source of power and sea connection are to be located in accessible positions, outside the compartment housing the main fire pump.

b. The sea valve are to be capable of being operated from a position near the pump.

c. The room where the fire pump prime mover is located are to be illuminated from the emergency source of electrical power, and are to be well ventilated.

d. Pump is required to supply water for a fixed fire-extinguishing system in the space where the main fire pump is situated; it are to be capable of simultaneously supplying water to this system and the fire main at the required rates.

e. The pump may also be used for other suitable purposes, subject to the approval in each case.

f. Pressure and quantity of water delivered by the pump being sufficient to produce a jet of water, at any nozzle, of not less than 12 m in length. For vessels of less than 150 GT, the jet of water may be specially considered.

403. For vessels less than 150 GT fitted with an approved fixed firefighting system in the engine room, portable pumps may be omitted.

404. Means to illuminate the stowage area of the portable pump and its necessary areas of operation are to be provided from the emergency source of electrical power.

500. Fire main and hydrants

501. The diameter of the fire main are to be based on the required capacity of the fixed main fire pump(s) and the diameter of the water service pipes are to be sufficient to ensure an adequate supply of water for the operation of two fire hoses throwingwater at a distance not less than 15 m. However, for cargo ships, the diameter may be such as to deliever a flow of 140 m^3/h.

502. Materials readily rendered ineffective by heat are to not be used for fire mains. Where steel pipes are used, they are to be galvanized internally and externally. Cast iron pipes are not acceptable.

503. The fire line and the fire hydrants shall be independent of other piping systems, protected from

damage from deck cargo and designed for easy connection of the hoses.

504. The wash deck line may be used as a fire main provided that the Recommendations of this sub-Section are satisfied.

505. All exposed water pipes for fire-extinguishing are to be provided with drain valves for use in frosty weather. The valves are to be located where they will not be damaged by cargo.

600. Pressure in the fire main

601. When the main fire pump is delivering the quantity of water required by F2.100, or the fire pump described in F2.402. above, through the fire main, fire hoses and nozzles, the pressure maintained at any hydrant are to be sufficient to produce a jet throw at any nozzle of no less than 12 m in length. (For vessels less than 150 GT, the jet of water may be specially considered).

700. Fire Hydrants and Fire stations

701. The number and position of hydrants are to be such that at least two jets of water not emanating from the same hydrant, one of which are to be from a single length of hose, may reach any part of the vessel normally accessible to the crew while the vessel is being navigated and any part of any cargo spaces when empty. Furthermore, such hydrants are to be positioned near the accesses to the protected spaces. Other Requirements specified by the RBNA may be considered.

702. The fire station must be so arranged that from each hydrant, at least one fire station must be clearly visible.

703. The pipes and hydrants are to be so placed that the fire-hoses may be easily coupled to them.

704. The arrangement of pipes and hydrants are to be such as to avoid the possibility of freezing.

705. In vessels where deck cargo may be carried, the positions of the hydrants are to be such that they are always readily accessible and the pipes are to be arranged, as far as practicable, to avoid risk of damage by such cargo.

706. There is to be complete interchangeability of hose couplings and nozzles.

707. A valve of at least 38 mm internal diameter is to be fitted at each fire hydrant so that any fire-hose may be removed while the fire pump is at work.

708. Where a fixed fire pump is fitted outside the engine room:

a. An isolating valve is to be fitted in the fire main so that all the hydrants in the vessel, except that or those in the Category 'A' machinery space, can be supplied with water.

b. The isolating valve is to be located in an easily accessible and tenable position outside the Category 'A' machinery space; and

c. The fire main is to not re-enter the machinery space downstream of the isolating valve.

709. Tug boats and pusher boats of GT > 20 employed in convoy operations are to be fitted with at least two hydrants and two fire stations complete with all accessories at the bow, positioned in such a way as to permit fire-fighting on the convoy.

710 At least one external hydrant and a complete fire station shall be fitted at the main entrance of the Engine Room.

711. The fire stations shall be fitted with nozzles, couplings, tightening tool and painted in red. The letter “F” and the number of the fire box shall be clearly visible. The front lid shall have a glass window.

712. The fire stations are to be used exclusively for the storage of the nozzles, hoses and accessories.

800. Fire hoses and nozzles

801. The fire hoses shall be manufactured from non-perishable materials approved by RBNA, with sections not less than 15 m length and 38 mm diameter. They shall be sufficient to deliever a water jet as per requirements of F2.500 above.

802. The number of hoses to be fitted on board in sets (each set comprising the hose, connections and nozzles) shall be one hose for each 30 m of the ship’s length plus a spare hose, but not less than three in total. The Engine Room hoses are not included in this total.

803. For ships under 100 GT, the minimum total may be two. Ships carryng dangerous products, however, shall be fitted with a minimum of 3 hoses and additional nozzles to the prescribed in F2.802 above.

804. Depending upon the availability, accessibility, and capability, the quantities required above may be increased as a function of the type of the vessel and the nature of the cargo.

900. Nozzles and connections

901. Qucik connections nozzles of the “Storz” type (bayonet connectins) shall be provided for the coupling of the hoses to the fire hydrant plugs.

902. The standard dimensions for the nozzles are 12 mm, 16 mm and 19 mm, or as near those dimensions as possible. Larger diameter nozzles may be accepted after analysis by RBNA.

903. In the machinery spaces and external areas, the dimension of the nozzles shall be such as to provide the

maximum discharge of two jets as prescribed in item F2.500 from the smallest fire pump, employing a nozzle with diameter not larger than 19 mm.

904. In the accommodation or servisse spaces nozzles of a diameter not lager than 12 mm may be accepted.

905. All nozzles shall be fitted with a closing device and be of an appoved type. For the machinery spaces, the nozzles are to be of the dual type, delivering solid and spray jets.

906. Oil or chemical tankers are to be fitted with an international shore connection in conformity with the IMO FSS Code

907. The international shore connection may be fitted either SB or PS.

TABLE T.F2.907.1 – INTERNATIONAL SHORE CONNECTION

Description	*Dimension*
Outside diameter	215 mm
Inner diameter	According to pipe outside diameter
Bolt circle diameter	183 mm
Slots in flange	6 holes 22 mm in diameter equidistantly placed on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 22 mm
Flange thickness	20 mm
Bolts and nuts:	6, each of 20 mm in diameter and of quantity, diameter suitable length
The flange is designed to accept pipes up to a maximum internal diameter of 125 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a gasket of oil-proof material, shall be suitable for a service pressure of 600 kPa.	

908. The international shore connection shall be manufactured from steel or oehter equivalente material to withstand 1,0 N/mm². The flanges shall have a flat surface in one side, and the other is to be permanently connected to the coupling to the hydrants of the ship. Sealing gaskets are to be stored together with the shore connection, manufactured from any material able to withstand 1,0 N/mm² and a set of four 16 mm bolts of 50 mm length each, four 16 mm nuts and eight washers.

F3. BALLAST

100. Application

101. The ballast system is to be totally independent of the piping systems dedicated to cargo and fuel oil.

102. Where the ballast piping passes through fuel oil tanks it shall be made of reinforced material and all the connections inside the tank are to be welded with reinforced flanges. The number of connections within the tanks is to be kept to a minimum.

F4. AIR VENTING AND OVERFLOW PIPES, SOUNDING/ULLAGE PIPES AND TANK LEVEL INDICATORS

100. Air venting and overflow pipes

101. Where pumping may occur in an empty compartment of tank, air venting and overflow pipes are to be fitted at the highest point. The end of such pipes is to be above the open deck giving to the open air as follows:

a. For ships of Brazilian flag under 500 GT, in conformity with the requirements of Chapter 7 Section I of NORMAM 01;

b. For ships of foreign flags, in conformity with National Administration requirements or, in absence of those, in conformity with the IMO ILLC Convention;

c. For ships of gross tonnage equal to or larger than 500, in conformity with the IMO ILLC Convention.

102. All air venitng pipes are to be fitted with a 180º curve or equivalent devices to prevent ingress of water. Ullage/sounding d devices are to be fitted with adequate closing caps.

103. When the tank or space has a relatively large surface two air venting pipes shall be fitted, arranged in such a way that any air or gas accumulated at the top can escape freely.

104. The cross sectional area of the air and overflow pipes and are to be at least 25% greater than the cross sectional area of the pumping pipe sections (filling up or suction inlet).

105. The air venting pipes cannot be used for filling up the tanks

200. Airventing and overflow pipes of fuel oil tanks

201. The inner diameter is to be no less than 60 mm.

202. **IACS UR F 35** Air venting pipes from fuel oil tanks should be led to a safe position on the open deck.

a. The free opening of the air venting pipes and overflow pipes is to be protected by a corrosion resistant flame screen.

b. The open areas of the screen are to be at least twice the internal cross sectional area of the pipe.

203. The open end of the air venting pipes should not be located where steam release may cause damage.

204. **IACS UR F 35** Any overflow pipe should have a sectional area of at least 1,25 times that of the filling pipe and should be led to an overflow tank of adequate capacity or to a storage tank having space reserved for overflow purposes.

205. **IACS UR F 35** An alarm device should be provided to give warning when the oil reaches a predetermined level in the tank, or alternatively, a sight glass should be provided in the overflow pipe to indicate when any tank is overflowing. Such sight glasses should be placed on vertical pipes only and in readily visible positions.

300. Air and overflow pipes of lubricating oil tanks

301. The inner diameter are to be no less than 60 mm.

302. **IACS UR F 35** Air pipes from lubricating oil storage tanks may end in the machinery space,provided that the open ends are so situated that any oil flow form them cannot come into contact with electrical equipment or heated surfaces.

400. Air and overflow pipes of potable water tanks

401. The inner diameter in potable water tanks shall be no less than 40 mm. The free end, which may be in the engine room, is to be fitted with a screen to prevent the ingress of insects.

500. Air and overflow pipes of ballast tanks

501. The inner diameter is to be no less than 50 mm.

600. Air pipe of sea chests

601. All the sea chests are to be fitted with air venting pipes fitted with a shut-off valve and ending above the open deck. The air pipe vents may be interconnected after the shut-off valves.

602. The inner diameter of each sea chest air venting pipe is to be no less than 40 mm and the diameter of pipe interconnections is to be no less than 50 mm.

700. Sounding/ullage air venting pipes and level indicators

701. All tanks, empty spaces or compartments not always accessible as well as bilge sumps are to be fitted with a sounding pipe, whose inner diameter is to be at least 40 mm. Such pipes are to be as straight as possible and their passages within cargo holds are to be protected against damages.

702. The sounding pipes are to extend up to the open deck, whenever possible. The sounding pipes of oil tanks are to be neither in accommodation and passenger spaces nor where there is a risk of ignition.

703. Where the ends of the sounding pipes are located below the vessel load line, these are to be fitted with closing appliances. For fuel oil tanks, automatic self-closing devices are to be fitted.

704. Adequate reinforcement plates are to be fitted under the sounding pipes to avoid damage to the bottom of the tanks or empty spaces during the sounding operations.

705. In open tanks or where there are adequate openings in the top, the volume of the liquid inside the tank may be measured by ullage.

706. Non-structural or structural tanks situated above the water line may be equipped with a level indicating devices, observing that:

a. Are to be of sturdy construction and be adequately protected;

b. Level valves are to not be used for fuel oil or lubricating oil tanks;

c. Can be isolated from the tank through valves, which will be of quick shut-off operation in case of fuel oil tanks; and

d. Transparent levels are to be constructed of flat glasses protected against impact and have self-closing valves in the connections with the tank.

800. Air Pipe Closing Devices [IACS UR P3.1 to P3.4]

801. **General requirements**: Where air pipes are required by the Rules or Load Line Convention, 1966 to be fitted with automatic closing devices, they are to comply with the following:

802. **Design**: Air pipe automatic closing devices shall be so designed that they will withstand both ambient and working conditions, and be suitable for use at inclinations up to and including $\pm 40^{o}$.

803. Air pipe automatic closing devices shall be constructed to allow inspection of the closure and the inside of the casing as well as changing the seals.

804. Efficient ball or float seating arrangements are to be provided for the closures.

a. Bars, cage or other devices are to be provided to prevent the ball or float from contacting the inner chamber in its normal state and made in such a way that the ball or float is not damaged when subjected to water impact due to a tank being overfilled.

805. Air pipe automatic closing devices are to be self-draining.

806. The clear area through an air pipe closing device in the open position shall be at least equal to the area of the inlet.

807. An automatic closing device is to:

a. Prevent the free ingress of water into the tanks,

b. Allow the passage of air or liquid to prevent excessive pressure or vacuum coming on the tank.

808. In the case of air pipe closing devices of the float type, suitable guides are to be provided to ensure unobstructed operation under all working conditions of heel and trim.

809. The maximum allowable tolerances for wall thickness of floats are to not exceed ± 10% of thickness.

810. The inner and the outer chambers of an automatic air pipe head is to be of a minimum thickness of 6 mm.

811. Materials

a. Casings of air pipe closing devices are to be of approved metallic materials adequately protected against corrosion.

b. For galvanised steel air pipe heads, the zinc coating is to be applied by the hot method and the thickness is to be 70 to 100 microns.

c. For areas of the head susceptible to erosion (e.g. those parts directly subjected to ballast water impact when the tank is being pressed up, for example the inner chamber area above the air pipe, plus an overlap of 10o or more either side) na additional harder coating are to be applied. This is to be an aluminium bearing epoxy, or other equivalent, coating, applied over the zinc.

d. Closures and seats made of non-metallic materials are to be compatible with the media intended to be carried in the tank and to seawater and suitable for operating at ambient temperatures between -25^{o}C and 85^{o}C.

F5. POTABLE WATER

100. Potable water tanks

101. Only potable water piping is allowed inside potable water tanks. The arrangement of potable water piping crossing tanks of any other liquids will be examined on a case-by-case by RBNA.

102. Air pipes and tanks of sounding of potable water are to be independent. The sounding outlet are to be at least 300 mm above the deck. Outlets of sounding or overflows are to have protection against ingress of insects or other impurities.

F6. VENTILATION OF COMPARTMENTS

100. Installation

101. The hull accommodation and service spaces or lockers are to be fitted with means of ventilation.

102. The height of duct inlets above the deck are to meet the requirements of:

a. for vessels under the Brazilian flag with GT<500. NORMAM 01;

b. for vessels under the foreign flags with GT<500, National Regulations or, in the absence of those, IMO ILLC Convention regulation;

c. for vessels with AB ≥ 500, IMO ILLC Code.

103. The distribution of branches is to not compromise the subdivision of the hull.

104. The ventilation is to be fitted with openings for air inlet and exhaust.

105. The air suction and exhaust openings shall have means of closure, for damping in case of fire.

106. The dimensioning of the system is to be based upon the number of air exchanges exchanges for each compartment.

200. Natural ventilation

201. The dimensioning of natural ventilation ducts is to consider the speed of 5 m/s.

300. Mechanical ventilation

301. Mechanical ventilation is to be provided with quick stop devices for blowers and exhausters.

400. Ventilation of machinery spaces

401**.** The ventilation systems for machinery spaces shall be separate from the ventilation systems serving other spaces.

402. Machinery spaces of category A shall be so ventilated to ensure that an adequate supply of air is maintained for the safety and comfort of personnel and to all machinery and boilers required for safe operation of the vessel in all weather conditions

Guidance

See Part II, Title 11, Section 5, Chapter D1 for ambient temperature requirements for comfort of the crew and requirements for the design parameters of equipment.

End of guidance

403. Other machinery spaces shall be adequately ventilated appropriate for their purpose.

404. For ships with AB ≥ 500, the ventilation of machinery spaces shall be according to the principles laid down in SOLAS Regulation II-1/35 and supplied through suitably protected openings arranged in such a way that they can be used in all weather conditions, taking into account Reg.17(3) and Reg.19 of the 1966 Load Line Convention as amended by the Protocol of 1988. The machinery spaces are those defined in Part II, Title 11, Section 1, Chapter A, A.1 (*SOLAS Regulation II-1/3.16*).

405. For the determination of the ventilation capacity the heat radiation of the equipment in the space and the required combustion air according to the engine power are to be considered.

Guidance
Note

The capacity requirements mentioned in F6.405 above shall follow the requirements of the latest version of ISO Standard 8861 in.

End of guidance

406. Remote stop of the Engine Room and/or machinery spaces is to be fitted.

407. All ventilation inlets and outlets are to be fitted

408. Air ducts close to electrical switchboards must be so installed and fitted with drains to avoid condensed water dripping over the electrical installation.

500. Ventilation of paint stores and flammable liquid lockers

501. Paint stores and flammable liquid lockers are to be provided with ventilation arrangements separate from other ventilation systems.

502. The ventilation system shall be capable of effecting at least 10 changes of air per hour. The ducts arrangement is to be such as to remove all vapours.

503. Ventilation outlets or their duct openings shall lead to the open deck area and have means of closure (dampers) in case of fire.

504. Ventilators and their drives are to be installed external to the compartment, or alternatively be of the explosion proof type.

600. Ventilation of galleys

601. Where they pass through accommodation spaces the exhaust ducts from galley ranges shall be constructed of insulated "A" class divisions.

602. The exhaust ducts shall be fitted with a grease trap and a fire damper.

700. Ventilation of control stations

701. Control station ventilation is to be fitted with means to prevent smoke ingress from other compartments in case of fire. In case a control station is served by a common ventilation system, which serves also other spaces, effective local closing arrangements shall be provided.

Guidance

Effective local closing arrangements mean that the provided ventilation systems 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

702. And alternative ventilation system independent from other systems is to be provided. The arrangements shall be scuh as to prevent the risk of both sources of ventilation drawing smoke at the same time.

800. Ventilation of battery compartments

801. All battery-installations, except for gastight batteries, in rooms, cabinets and containers shall be fitted with adequate natural or mechanical ventilation to avoid the accumulation of gases. In case of mechanical ventilation, due attention should be paid that ventilators and their drives are installed externally to the compartment or alternatively be of the explosion proof type.

900. Emergency gewnerator and emergency fire pump rooms

901. Emergency generator rooms shall be fitted with natural or mechanical ventilation to ensure their normal operation.

902. Emergency fire pump rooms shall be designed to avoid ingress of smoke in case of a fire.

F7. HYDRAULIC POWER FOR THE HULL ESSENTIAL SERVICES

100. Maneuvering system drive

101. The system shall provide protection against overload, with safety valve including to prevent torque transmitted by grounding ,etc.

102. The pipes are to be kept away from the hull and are to not pass through cargo spaces.

200. Other hydraulic systems

201. The characteristics of these systems are to be submitted to the RBNA for approval.

F8. FIRE PUMPS AND FIREFIGHTING PIPING SYSTEM FOR SHIPS WITH GT ≥ 500

100. Scope

See Part II, Title 11, Section 3, Chapter E, Subchapter E10**.**

F9. FIXED FIRE EXTINGUISHING EQUIPMENT

100. General

101. The installation of fixed firefighting equipment for ships having GT equal to or largern than 500 is mandatory in the following locations:

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 Part II, Title 11, Section 3, Chapter E, 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. Cargo Pump Room located below the main deck;

c. Compartments bearing essential equipment such as Diesel generators, switchboards, compressors etc..;

d. Frigorific installation.

Guidance

For ships under 500 GT, the installation of fixed fire fighting equipment in the Engine Romm is recommended.

End of guidance

F10. FIXED GAS FIRE EXTINGUISHING [FSS CODE]

100. Application

101. This Subchapter details the specifications for fixed gas fire-extinguishing systems as required by Part II, Title 11, Section 3, Chapter E, Subchapter E10.400 of the Rules.

200. Fire-extinguishing medium

201. Where the quantity of the fire-extinguishing medium is required to protect more than one space, the quantity of medium available need not be more than the largest quantity required for any one space so protected. The system shall be fitted with normally closed control valves arranged to direct the agent into the appropriate space. Adjacent spaces with independent ventilation systems not separated by at least A-0 class divisions should be considered as the same space.

202. The volume of starting air receivers, converted to free air volume, shall be added to the gross volume of the machinery space when calculating the necessary quantity of the fire-extinguishing medium. Alternatively, a discharge pipe from the safety valves may be fitted and led directly to the open air.

203. Means shall be provided for the crew to safely check the quantity of the fire-extinguishing medium in the containers. It shall not be necessary to move the containers completely from their fixing position for this purpose. For carbon dioxide systems, hanging bars for a weighing device above each bottle row, or other means shall be provided. For other types of extinguishing media, suitable surface indicators may be used.

204. Containers for the storage of fire-extinguishing medium, piping and associated pressure components shall be designed to pressure codes of practice to the satisfaction of the RBNA having regard to their locations and

maximum ambient temperatures expected in service. specified elevated temperature properties.

300. Installation requirements

301. The piping for the distribution of fire-extinguishing medium shall be arranged and discharge nozzles so positioned that a uniform distribution of the medium is obtained. System flow calculations shall be performed using a calculation technique acceptable to the RBNA.

302. Except as otherwise permitted by the RBNA, pressure containers required for the storage of fire-extinguishing medium, other than steam, shall be located outside the protected spaces in accordance with Part II, Title 11, Section 3, Chapter E, Subchapter E10.400 (regulation II-2/10.4.3 of the Convention).

303. Spare parts for the system shall not be stored within spaces which may containe air/flammable gas mixtures.

304. In piping sections where valve arrangements introduce sections of closed piping, such sections shall be fitted with a pressure relief valve and the outlet of the valve shall be led to open deck.

305. All discharge piping, fittings and nozzles in the protected spaces shall be constructed of materials having a melting temperature which exceeds 925°C. The piping and associated equipment shall be adequately supported.

306. A fitting shall be installed in the discharge piping to permit the air testing as required by paragraph F9.209.a.

307. [**IACS UI SC200**] Agent containers stored in a protected space shall be distributed throughout the space with bottles or groups of bottles located in at least six separate locations.

a. Duplicate power release lines shall be arranged to release all bottles simultaneously.

b. The release lines shall be so arranged that in the event of damage to any power release line, five sixth of the fire extinguishing gas can still be discharged.

c. The bottle valves are considered to be part of the release lines and a single failure shall include also failure of the bottle valve.

d. For systems that need less than six cylinders (using the smallest bottles available), the total amount of extinguishing gas on the bottles shall be such that in the event of a single failure to one of the release lines (including bottle valve), five sixth of the fire extinguishing gas can still be discharged.

e. This may be achieved by for instance using more extinguishing gas than required so that if one bottle is not discharging due to a single fault, the remaining bottles will discharge the minimum five sixth of the required amount of gas.

f. This can be achieved with minimum two bottles. However, NOAEL values calculated at the highest expected engine room temperature are not to be exceeded when discharging the total amount of extinguishing gas simultaneously.

g. Systems that can not comply with the above, for instance systems using only one bottle located inside the protected space, can not be accepted. Such systems shall be designed with the bottle(s) located outside the protected space, in a dedicated room.

400. System control requirements

401. The necessary pipes for conveying fire-extinguishing medium into the protected spaces shall be provided with control valves so marked as to indicate clearly the spaces to which the pipes are led. Suitable provisions shall be made to prevent inadvertent release of the medium into the space. Where a cargo space fitted with a gas fire-extinguishing system is used as a passenger space, the gas connection shall be blanked during such use. T he pipes may pass through accommodations providing that they are of substantial thickness and that their tightness is verified with a pressure test, after their installation, at a pressure head not less than 5 N/mm². In addition, pipes passing through accommodation areas shall be joined only by welding and shall not be fitted with drains or other openings within such spaces. The pipes shall not pass through refrigerated spaces.

402. Means shall be provided for automatically giving audible and visual warning of the release of fire-extinguishing medium into any ro-ro spaces, container holds equipped with integral reefer containers, spaces accessible by doors or hatches, and other spaces in which personnel normally work or to which they have access. The audible alarms shall be located so as to be audible throughout the protected space with all machinery operating, and the alarms should be distinguished from other audible alarms by adjustment of sound pressure or sound patterns. The pre-discharge alarm shall be automatically activated (e.g., by opening of the release cabinet door). The alarm shall operate for the length of time needed to evacuate the space, but in no case less than 20 s before the medium is released. Conventional cargo spaces and small spaces (such as compressor rooms, paint lockers, etc.) with only a local release need not be provided with such an alarm.

403. Fire-extinguishing media protecting the cargo holds may be stored in a room located forward 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 should 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 should be included in the remote release arrangement. [**IACS UI SC204**].

404. Certain spaces for which the automatic warning of release of the extinguishing medium is required. Ordinary cargo holds need not comply with F10.203. However, ro-ro cargo spaces, holds in container ships equipped for integrated reefer containers and other spaces where personnel can be expected to enter and where the access is therefore facilitated by doors or manway hatches should comply with the above regulation.

405. The means of control of any fixed gas fire-extinguishing system shall be readily accessible, simple to operate and shall be grouped together in as few locations as possible at positions not likely to be cut off by a fire in a protected space. At each location there shall be clear instructions relating to the operation of the system having regard to the safety of personnel.

406. 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 of 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 should 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 should be included in the remote release arrangement. [**MSC.1/Circ. 1240]**

407. Automatic release of fire-extinguishing medium shall not be permitted, except as permitted by the RBNA.

500. Carbon dioxide systems

501. For cargo spaces, the quantity of carbon dioxide available shall, unless otherwise provided, be sufficient to give a minimum volume of free gas equal to 30% of the gross volume of the largest cargo space to be protected in the ship.

502. For vehicle spaces and ro-ro spaces which are not special category spaces, the quantity of carbon dioxide available shall be at least sufficient to give a minimum volume of free gas equal to 45% of the gross volume of the largest such cargo space which is capable of being sealed, and the arrangements shall be such as to ensure that at least two thirds of the gas required for the relevant space shall be introduced within 10 min. Carbon dioxide systems shall not be used for the protection of special category spaces.

503. For machinery spaces, the quantity of carbon dioxide carried shall be sufficient to give a minimum volume of free gas equal to the larger of the following volumes, either:

a. 40% of the gross volume of the largest machinery space so protected, the volume to exclude that part of the casing above the level at which the horizontal area of the casing is 40% or less of the horizontal area of the space concerned taken midway between the tank top and the lowest part of the casing; or

b. 35% of the gross volume of the largest machinery space protected, including the casing.

504. The percentages specified in F9.301.c above above may be reduced to 35% and 30%, respectively, for cargo ships of less than 2,000 gross tonnage where two or more machinery spaces, which are not entirely separate, are considered as forming one space.

505. For the purpose of this paragraph the volume of free carbon dioxide shall be calculated at 0.56 m3/kg.

506. For machinery spaces, the fixed piping system shall be such that 85% of the gas can be discharged into the space within 2 min.

507. For container and general cargo spaces (primarily intended to carry a variety of cargoes separately secured or packed) the fixed piping system shall be such that at least two thirds of the gas can be discharged into the space within 10 min. For solid bulk cargo spaces the fixed piping system shall be such that at least two thirds of the gas can be discharged into the space within 20 min. The system controls shall be arranged to allow one third, two thirds or the entire quantity of gas to be discharged based on the loading condition of the hold.

600. Controls

601. Carbon dioxide systems for the protection of ro-ro spaces, container holds equipped with integral reefer containers, spaces accessible by doors or hatches, and other spaces in which personnel normally work or to which they have access shall comply with the following requirements:

a. two separate controls shall be provided for releasing carbon dioxide into a protected space and to ensure the activation of the alarm. One control shall be used for opening the valve of the piping which conveys the gas into the protected space and a second control shall be used to discharge the gas from its storage containers. Positive means shall be provided so they can only be operated in that order; and

b. the two controls shall be located inside a release box clearly identified for the particular space. If the box containing the controls is to be locked, a key to the box shall be in a break-glass-type enclosure conspicuously located adjacent to the box.

602. The pre-discharge alarm may be activated before the two separate system release controls are operated (e.g. by a micro-switch that activates the pre-discharge alarm upon opening the release cabinet door. Therefore, the two

separate controls for releasing carbon dioxide into the protected space (i.e. one control to open the valve of the piping which conveys the gas into the protected space and a second control used to discharge the gas from its storage containers) can be independent of the control for activating the alarm. A single control for activation of the alarm is sufficient. The "positive means" for the correct sequential operation of the controls, is to be achieved by a mechanical and/or electrical interlock that does not depend on any operational procedure to achieve the correct sequence of operation.
[**UI SC25**].

700. Testing of the installation

701. When the system has been installed, pressure-tested and inspected, the following shall be carried out:

a. a test of the free air flow in all pipes and nozzles; and

b. a functional test of the alarm equipment.

800. Low-pressure CO2 system

801. Where a low pressure CO2 system is fitted to comply with this regulation, the following applies.

a. The system control devices and the refrigerating plants shall be located within the same room where the pressure vessels are stored.

b. The rated amount of liquid carbon dioxide shall be stored in vessel(s) under the working pressure in the range of 1.8 N/mm² to 2.2 N/mm². The normal liquid charge in the container shall be limited to provide sufficient vapour space to allow for expansion of the liquid under the maximum storage temperatures than can be obtained corresponding to the setting of the pressure relief valves but shall not exceed 95% of the volumetric capacity of the container.

802. Provision shall be made for:

a. pressure gauge;

b. high pressure alarm: not more than setting of the relief valve;

c. low pressure alarm: not less than 1.8 N/mm²;

d. branch pipes with stop valves for filling the vessel;

e. discharge pipes;

f. liquid CO2 level indicator, fitted on the vessel(s); and

g. two safety valves.

803. The two safety relief valves shall be arranged so that either valve can be shut off while the other is connected to the vessel. The setting of the relief valves shall not be less than 1.1 times working pressure. The capacity of each valve shall be such that the vapours generated under fire condition can be discharged with a pressure rise not more than 20% above the setting pressure. The discharge from the safety valves shall be led to the open.

804. The vessel(s) and outgoing pipes permanently filled with carbon dioxide shall have thermal insulation preventing the operation of the safety valve in 24 h after de-energizing the plant, at ambient temperature of 45°C and an initial pressure equal to the starting pressure of the refrigeration unit.

805. The vessel(s) shall be serviced by two automated completely independent refrigerating units solely intended for this purpose, each comprising a compressor and the relevant prime mover, evaporator and condenser.

806. The refrigerating capacity and the automatic control of each unit shall be so as to maintain the required temperature under conditions of continuous operation during 24 h at sea temperatures up to 32°C and ambient air temperatures up to 45°C.

807. Each electric refrigerating unit shall be supplied from the main switchboard busbars by a separate feeder.

808. Cooling water supply to the refrigerating plant (where required) shall be provided from at least two circulating pumps one of which being used as a stand-by. The stand-by pump may be a pump used for other services so long as its use for cooling would not interfere with any other essential service of the ship. Cooling water shall be taken from not less than two sea connections, preferably one port and one starboard.

809. Safety relief devices shall be provided in each section of pipe that may be isolated by block valves and in which there could be a build-up of pressure in excess of the design pressure of any of the components.

a. The piping system should be designed in such a way that the CO2 pressure at the nozzles should not be less than 1 N/mm2.

810. Audible and visual alarms shall be given in a central control station or, in accordance with regulation II-1/51, where a central control station is not provided, when:

a. the pressure in the vessel(s) reaches the low and high values according to paragraph F9.209.b

b. any one of the refrigerating units fails to operate; or

c. the lowest permissible level of the liquid in the vessels is reached.

d. If the system serves more than one space, means for control of discharge quantities of CO2 shall be

provided, e.g. automatic timer or accurate level indicators located at the control position(s).

e. If a device is provided which automatically regulates the discharge of the rated quantity of carbon dioxide into the protected spaces, it shall be also possible to regulate the discharge manually.

900. Equivalent fixed gas fire-extinguishing systems for machinery spaces and cargo pump-rooms:

901. Fixed gas fire-extinguishing systems equivalent to those specified in paragraphs 2.2 and 2.3 shall be approved by the RBNA based on the guidelines developed by the Organization.

IACS Unified Interpretation SC200 *(June 2005): Container storage arrangement for equivalent fixed gas fire extinguishing systems:*

F11. FIXED FOAM FIRE EXTINGUISHING SYSTEMS FOR SHIPS BUILT FROM 01.01.2014 [FSS CODE]

100. General

101. This chapter details the specifications for fixed foam fire-extinguishing systems for the protection of:

a. machinery spaces in accordance with Part II, Title 11, Section 3, Chapter E, E.10.400 (regulation II-2/10.4.1.1.2 of the Convention),

b. cargo spaces in accordance with regulation Part II, Title 11, Section 3, Chapter E, E10.700 (II-2/10.7.1.1),

c. cargo pump-rooms in accordance with Part II, Title 11, Section 3, Chapter E, E10.700 regulation II-2/10.9.1.2 and

d. vehicle, special category and ro-ro spaces in accordance with Part II, Title 11, Section 3, Chapter E, E10.600 (regulation II-2/20.6.1.3).

102. This chapter does not apply to cargo pump-rooms of chemical tankers carrying liquid cargoes referred to in regulation II-2/1.6.2 of the Convention, unless the RBNA specifically accepts the use of these systems based on additional tests with alcohol-based fuel and alcohol resistant foam.

103. Unless expressly provided otherwise, the requirements of this Subchapter shall apply to ships constructed on or after 1 January 2014.

200. Definitions

201. **Design filling rate** is at least the minimum nominal filling rate used during the approval tests.

202. **Foam** is the extinguishing medium produced when foam solution passes through a foam generator and is mixed with air.

203. **Foam solution** is a solution of foam concentrate and water.

204. **Foam concentrate** is a liquid which, when mixed with water in the appropriate concentration forms a foam solution.

205. **Foam delivery ducts** are supply ducts for introducing high-expansion foam into the protected space from foam generators located outside the protected space.

206. **Foam mixing ratio** is the percentage of foam concentrate mixed with water forming the foam solution.

207. **Foam generators** are discharge devices or assemblies through which high-expansion foam solution is aerated to form foam that is discharged into the protected space. Foam generators using inside air typically consist of a nozzle or set of nozzles and a casing. The casing is typically made of perforated steel/stainless steel plates shaped into a box that enclose the nozzle(s). Foam generators using outside air typically consist of nozzles enclosed within a casing that spray onto a screen. An electric, hydraulic or pneumatically driven fan is provided to aerate the solution.

208. **High-expansion foam fire-extinguishing systems** are fixed total flooding extinguishing systems that use either inside air or outside air for aeration of the foam solution. A high-expansion foam system consists of both the foam generators and the dedicated foam concentrate approved during the fire testing.

209. **Inside air foam system** is a fixed high-expansion foam fire-extinguishing system with foam generators located inside the protected space and drawing air from that space.

210. **Nominal flow rate** is the foam solution flow rate expressed in **l**/min.

211. **Nominal application rate** is the nominal flow rate per area expressed in **l**/min/m2.

212. **Nominal foam expansion ratio** is the ratio of the volume of foam to the volume of foam solution from which it was made, under non-fire conditions, and at an ambient temperature of e.g. around 20ºC.

213. **Nominal foam production** is the volume of foam produced per time unit, i.e. nominal flow rate times nominal foam expansion ratio, expressed in m3/min.

214. **Nominal filling rate** is the ratio of nominal foam production to the area, i.e. expressed in m2/min.

215. **Nominal filling time** is the ratio of the height of the protected space to the nominal filling rate, i.e. expressed in minutes.

216. **Outside air foam system** is a fixed high-expansion foam system with foam generators installed outside the protected space that are directly supplied with fresh air.

300. Fixed high-expansion foam fire-extinguishing systems

301. The system shall be capable of manual release, and shall be designed to produce foam at the required application rate within 1 minute of release. Automatic release of the system shall not be permitted unless appropriate operational measures or interlocks are provided to prevent any local application systems required by Part II, Title 11, Section 3, Chapter E, E.10 (regulation II-2/10.5.6 of the Convention) from interfering with the effectiveness of the system.

302. The foam concentrates shall be approved by the RBNA based on the guidelines developed by the "*Guidelines for the performance and testing criteria and surveys of high-expansion foam concentrates for fixed fire-extinguishing systems (MSC/Circ.670")*. Different foam concentrate types shall not be mixed in a high-expansion foam system.

303. The system and its components shall be suitably designed to withstand ambient temperature changes, vibration, humidity, shock, clogging and corrosion normally encountered on ships. Piping, fittings and related components inside the protected spaces (except gaskets) shall be designed to withstand 925°C.

304. System piping, foam concentrate storage tanks, components and pipe fittings in contact with the foam concentrate shall be compatible with the foam concentrate and be constructed of corrosion resistant materials such as stainless steel, or equivalent. Other system piping and foam generators shall be full galvanized steel or equivalent. Distribution pipework shall have self-draining capability.

305. Means for testing the operation of the system and assuring the required pressure and flow shall be provided by pressure gauges at both inlets (water and foam concentrate supply) and at the outlet of the foam proportioner. A test valve shall be installed on the distribution piping downstream of the foam proportioner, along with orifices which reflect the calculated pressure drop of the system. All sections of piping shall be provided with connections for flushing, draining and purging with air. All nozzles shall be able to be removed for inspection in order to prove clear of debris.

306. Means shall be provided for the crew to safely check the quantity of foam concentrate and take periodic control samples for foam quality.

307. Operating instructions for the system shall be displayed at each operating position.

308. Spare parts shall be provided based on the manufacturer's instruction.

309. If an internal combustion engine is used as a prime mover for the seawater pump for the system, the fuel oil tank to the prime mover shall contain sufficient fuel to enable the pump to run on full load for at least 3 h and sufficient reserves of fuel shall be available outside the machinery space of category A to enable the pump to be run on full load for an additional 15 h. If the fuel tank serves other internal combustion engines simultaneously, the total fuel tank capacity shall be adequate for all connected engines.

310. The arrangement of foam generators and piping in the protected space shall not interfere with access to the installed machinery for routine maintenance activities.

311. The system source of power supply, foam concentrate supply and means of controlling the system shall be readily accessible and simple to operate, and shall be arranged at positions outside the protected space not likely to be cut off by a fire in the protected space. All electrical components directly connected to the foam generators shall have at least an IP 54 rating.

312. The piping system shall be sized in accordance with a hydraulic calculation technique to ensure availability of flows and pressures required for correct performance of the system.

G*uidance*

Where the Hazen-Williams method is used, the following values of the friction factor ***C*** *for different pipe types which may be considered should apply:*

Pipe type C	
Black or galvanized mild steel	*100*
Copper or copper alloys	*150*
Stainless steel	*150*

End of guidance

313. The arrangement of the protected spaces shall be such that they may be ventilated as the space is being filled with foam. Procedures shall be provided to ensure that upper level dampers, doors and other suitable openings are kept open in case of a fire. For inside air foam systems, spaces below 500 m3 need not comply with this requirement.

314. Onboard procedures shall be established to require personnel re-entering the protected space after a system discharge to wear breathing apparatus to protect them from oxygen deficient air and products of combustion entrained in the foam blanket.

315. Installation plans and operating manuals shall be supplied to the ship and be readily available on board. A

list or plan shall be displayed showing spaces covered and the location of the zone in respect of each section. Instructions for testing and maintenance shall be available on board.

316. All installation, operation and maintenance instructions/plans for the system shall be in the working language of the ship. If the working language of the ship is not English, French, nor Spanish, a translation into one of these languages shall be included.

317. The foam generator room shall be ventilated to protect against overpressure, and shall be heated to avoid the possibility of freezing.

318. The quantity of foam concentrate available shall be sufficient to produce a volume of foam equal to at least five times the volume of the largest protected space enclosed by steel bulkheads, at the nominal expansion ratio, or enough for 30 min of full operation for the largest protected space, whichever is greater.

319. Machinery spaces, cargo pump-rooms, vehicle spaces, ro-ro spaces and special category spaces shall be provided with audible and visual alarms within the protected space warning of the release of the system. The alarms shall operate for the length of time needed to evacuate the space, but in no case less than 20 s.

400. Inside air foam systems

401. Systems for the protection of machinery spaces and cargo pump-rooms

402. The system shall be supplied by both main and emergency sources of power. The emergency power supply shall be provided from outside the protected space.

403. Sufficient foam-generating capacity shall be provided to ensure the minimum design filling rate for the system is met and in addition shall be adequate to completely fill the largest protected space within 10 min.

404. The arrangement of foam generators shall in general be designed based on the approval test results. A minimum of two generators shall be installed in every space containing combustion engines, boilers, purifiers, and similar equipment. Small workshops and similar spaces may be covered with only one foam generator.

405. Foam generators shall be uniformly distributed under the uppermost ceiling in the protected spaces including the engine casing. The number and location of foam generators shall be adequate to ensure all high risk areas are protected in all parts and at all levels of the spaces. Extra foam generators may be required in obstructed locations. The foam generators shall be arranged with at least 1 m free space in front of the foam outlets, unless tested with less clearance. The generators shall be located behind main structures, and above and away from engines and boilers in positions where damage from an explosion is unlikely.

406. Systems for the protection of vehicle, ro-ro, special category and cargo spaces

407. The system shall be supplied by the ship's main power source. An emergency power supply is not required.

408. Sufficient foam-generating capacity shall be provided to ensure the minimum design filling rate for the system is met and in addition shall be adequate to completely fill the largest protected space within 10 min. However, for systems protecting vehicle and ro-ro spaces and special category spaces, with decks that are reasonably gas-tight and that have a deck height of 3 m or less, the filling rate shall be not less than two thirds of the design filling rate and in addition sufficient to fill the largest protected space within 10 min.

409. The system may be divided into sections, however, the capacity and design of the system shall be based on the protected space demanding the greatest volume of foam. Adjacent protected spaces need not be served simultaneously if the boundaries between the spaces are "A" class divisions.

410. The arrangement of foam generators shall in general be designed based on the approval test results. The number of generators may be different, but the minimum design filling rate determined during approval testing shall be provided by the system. A minimum of two generators shall be installed in every space. The foam generators shall be arranged to uniformly distribute foam in the protected spaces, and the layout shall take into consideration obstructions that can be expected when cargo is loaded on board. As a minimum, generators shall be located on every second deck, including movable decks. The horizontal spacing of the generators shall ensure rapid supply of foam to all parts of the protected space. This shall be established on the basis of full scale tests.

411. The foam generators shall be arranged with at least 1 m free space in front of the foam outlets, unless tested with less clearance.

500. Outside air foam systems: Systems for the protection of machinery spaces and cargo pump-rooms

501. The system shall be supplied by both main and emergency sources of power. The emergency power supply shall be provided from outside the protected machinery space.

502. Sufficient foam-generating capacity shall be provided to ensure the minimum design filling rate for the system is met and in addition shall be adequate to completely fill the largest protected space within 10 min.

503. The arrangement of foam delivery ducts shall in general be designed based on the approval test results. The number of ducts may be different, but the minimum design filling rate determined during approval testing shall be provided by the system. A minimum of two ducts shall be installed in every space containing combustion engines,

boilers, purifiers, and similar equipment. Small workshops and similar spaces may be covered with only one duct.

504. Foam delivery ducts shall be uniformly distributed under the uppermost ceiling in the protected spaces including the engine casing. The number and location of ducts shall be adequate to ensure all high risk areas are protected in all parts and at all levels of the spaces. Extra ducts may be required in obstructed locations. The ducts shall be arranged with at least 1 m free space in front of the foam delivery ducts, unless tested with less clearance. The ducts shall be located behind main structures, and above and away from engines and boilers in positions where damage from an explosion is unlikely.

505. The arrangement of the foam delivery ducts shall be such that a fire in the protected space will not affect the foam-generating equipment. If the foam generators are located adjacent to the protected space, foam delivery ducts shall be installed to allow at least 450 mm of separation between the generators and the protected space, and the separating divisions shall be class "A-60" rated. Foam delivery ducts shall be constructed of steel having a thickness of not less than 5 mm. In addition, stainless steel dampers (single or multi-bladed) with a thickness of not less than 3 mm shall be installed at the openings in the boundary bulkheads or decks between the foam generators and the protected space. The dampers shall be automatically operated (electrically, pneumatically or hydraulically) by means of remote control of the foam generator related to them, and arranged to remain closed until the foam generators begin operating.

506. The foam generators shall be located where an adequate fresh air supply can be arranged.

600. Systems for the protection of vehicle and ro-ro spaces and special category and cargo spaces

601. The system shall be supplied by the ship's main power source. An emergency power supply is not required.

602. Sufficient foam-generating capacity shall be provided to ensure the minimum design filling rate for the system is met and in addition shall be adequate to completely fill the largest protected space within 10 min. However, for systems protecting vehicle and ro-ro spaces and special category spaces, with decks that are reasonably gas-tight and that have a deck height of 3 m or less, the filling rate shall be not less than two thirds of the design filling rate and in addition sufficient to fill the largest protected space within 10 min.

603. The system may be divided into sections, however, the capacity and design of the system shall be based on the protected space demanding the greatest volume of foam. Adjacent protected spaces need not be served simultaneously if the boundaries between the spaces are "A" class divisions.

604. The arrangement of foam delivery ducts shall in general be designed based on the approval test results. The number of ducts may be different, but the minimum design filling rate determined during approval testing shall be provided by the system. A minimum of two ducts shall be installed in every space. The foam generators shall be arranged to uniformly distribute foam in the protected spaces, and the layout shall take into consideration obstructions that can be expected when cargo is loaded on board. As a minimum, ducts shall be led to every second deck, including movable decks. The horizontal spacing of the ducts shall ensure rapid supply of foam to all parts of the protected space. This shall be established on the basis of full scale tests.

605. The system shall be arranged with at least 1 m free space in front of the foam outlets, unless tested with less clearance.

606. The arrangement of the foam delivery ducts shall be such that a fire in the protected space will not affect the foam-generating equipment. If the foam generators are located adjacent to the protected space, foam delivery ducts shall be installed to allow at least 450 mm of separation between the generators and the protected space, and the separating divisions shall be class "A-60" rated. Foam delivery ducts shall be constructed of steel having a thickness of not less than 5 mm. In addition, stainless steel dampers (single or multi-bladed) with a thickness of not less than 3 mm shall be installed at the openings in the boundary bulkheads or decks between the foam generators and the protected space. The dampers shall be automatically operated (electrically, pneumatically or hydraulically) by means of remote control of the foam generator related to them, and arranged to remain closed until the foam generators begin operating.

607. The foam generators shall be located where an adequate fresh air supply can be arranged.

700. Installation testing requirements

701. After installation, the pipes, valves, fittings and assembled systems shall be tested to the satisfaction of the RBNA, including functional testing of the power and control systems, water pumps, foam pumps, valves, remote and local release stations and alarms. Flow at the required pressure shall be verified for the system using orifices fitted to the test line. In addition, all distribution piping shall be flushed with freshwater and blown through with air to ensure that the piping is free of obstructions.

702. Functional tests of all foam proportioners or other foam mixing devices shall be carried out to confirm that the mixing ratio tolerance is within +30 to -0% of the nominal mixing ratio defined by the system approval. For foam proportioners using foam concentrates of Newtonian type with kinematic viscosity equal to or less than 100 cSt at 0ºC and density equal to or less than 1,100 kg/m3, this test can be performed with water instead of foam concentrate. Other arrangements shall be tested with the actual foam concentrate.

800. Systems using outside air with generators installed inside the protected space

801. Systems using outside air but with generators located inside the protected space and supplied by fresh air ducts may be accepted by the RBNA provided that these systems have been shown to have performance and reliability equivalent to systems defined in 3.3. For acceptance, the RBNA should consider the following minimum design features:

a. lower and upper acceptable air pressure and flow rate in supply ducts;

b. function and reliability of damper arrangements;

c. arrangements and distribution of air delivery ducts including foam outlets; and

d. separation of air delivery ducts from the protected space.

900. Fixed low-expansion foam fire-extinguishing systems

901. The foam concentrates of low-expansion foam fire-extinguishing systems shall be approved by the RBNA based on the "*Revised Guidelines for the performance and testing criteria and surveys of low expansion foam concentrates for fixed fire-extinguishing systems (MSC.1/Circ.1312)".*. Different foam concentrate types shall not be mixed in a low-expansion foam system. Foam concentrates of the same type from different manufacturers shall not be mixed unless they are approved for compatibility.

902. The system shall be capable of discharging through fixed discharge outlets, in no more than 5 min, a quantity of foam sufficient to produce an effective foam blanket over the largest single area over which oil fuel is liable to spread.

903. **Installation requirements**

a. Means shall be provided for effective distribution of the foam through a permanent system of piping and control valves or cocks to suitable discharge outlets, and for the foam to be effectively directed by fixed sprayers onto other main fire hazards in the protected space. The means for effective distribution of the foam shall be proven acceptable to the RBNA through calculation or by testing.

b. The means of control of any such systems shall be readily accessible and simple to operate and shall be grouped together in as few locations as possible at positions not likely to be cut off by a fire in the protected space.

F12. REQUIREMENTS FOR EXPANSION FOAM FIRE-EXTINGUISHING SYSTEMS APPLICABLE BEFORE 01.01.2014 [FSS CODE]

100. General

101. Fixed foam fire-extinguishing systems shall be capable of generating foam suitable for extinguishing oil fires.

200. Fixed high-expansion foam fire-extinguishing systems

201. The foam concentrates of high-expansion foam fire-extinguishing systems shall be approved by the RBNAn based on the "*Guidelines for performance and testing criteria and surveys of high expansion foam concentrates for fire- extinguishing systems (MSC/Circ.670)".*

202. Any required fixed high-expansion foam system in machinery spaces shall be capable of rapidly discharging through fixed discharge outlets a quantity of foam sufficient to fill the greatest space to be protected at a rate of at least 1 m in depth per minute. The quantity of foam-forming liquid available shall be sufficient to produce a volume of foam equal to five times the volume of the largest space to be protected. The expansion ratio of the foam shall not exceed 1,000 to 1.

203. The Administration may permit alternative arrangements and discharge rates provided that it is satisfied that equivalent protection is achieved.

204. Supply ducts for delivering foam, air intakes to the foam generator and the number of foam-producing units shall in the opinion of the Administration be such as will provide effective foam production and distribution.

205. The arrangement of the foam generator delivery ducting shall be such that a fire in the protected space will not affect the foam generating equipment. If the foam generators are located adjacent to the protected space, foam delivery ducts shall be installed to allow at least 450 mm of separation between the generators and the protected space. The foam delivery ducts shall be constructed of steel having a thickness of not less than 5 mm. In addition, stainless steel dampers (single or multi-bladed) with a thickness of not less than 3 mm shall be installed at the openings in the boundary bulkheads or decks between the foam generators and the protected space. The dampers shall be automatically operated (electrically, pneumatically or hydraulically) by means of remote control of the foam generator related to them.

206. The foam generator, its sources of power supply, foam-forming liquid and means of controlling the system shall be readily accessible and simple to operate and shall be grouped in as few locations as possible at positions not likely to be cut off by a fire in the protected space.

300. Fixed low-expansion foam fire-extinguishing systems

301. The foam concentrates of low-expansion foam fire-extinguishing systems shall be approved by the RBNA based on the "*Guidelines for performance and testing criteria and surveys of low expansion foam concentrates for fire-extinguishing systems (MSC/Circ.582 and Corr.1)".*

302. The system shall be capable of discharging through fixed discharge outlets in no more than 5 min, a quantity of foam sufficient to produce an effective foam blanket over the largest single area over which oil fuel is liable to spread.

303. Means shall be provided for the effective distribution of the foam through a permanent system of piping and control valves or cocks to suitable discharge outlets, and for the foam to be effectively directed by fixed sprayers on other main fire hazards in the protected space. The means for effective distribution of the foam shall be proven acceptable to the Administration through calculation or by testing.

304. The means of control of any such systems shall be readily accessible and simple to operate and shall be grouped together in as few locations as possible at positions not likely to be cut off by a fire in the protected space.

Guidance

(2.2) IACS Unified Interpretation SC32 (Rev.1 2001) (Rev.2 Nov 2005):

Fixed high expansion foam fire-extinguishing system:
When such a system is to be fitted in any other space than a machinery space, this regulation applies.

Reference is made to MSC/Circ. 670 - Guidelines for the performance and testing criteria and surveys of high-expansion foam concentrates for fixed fire-extinguishing systems.

End of guidance

F13. FIXED PRESSURE WATER SPRAYING AND WATER-MIST FIRE-EXTINGUISHING SYSTEMS [FSS CODE]

100 Application

101. This Subchapter details the specifications for fixed pressure water- spraying and water-mist fire-extinguishing systems as required by chapter II-2 of the Convention.

200. Engineering specifications

201. Fixed-pressure water-spraying fire-extinguishing systems for machinery spaces and cargo pump-rooms shall be approved by the RBNA based on the Revised "*Guidelines for the approval of equivalent water-based fire-extinguishing systems for machinery spaces and cargo pump-rooms (MSC/Circ.1165)."*

202. **Equivalent water-mist fire-extinguishing systems:** Water-mist fire-extinguishing systems for machinery spaces and cargo pump-rooms shall be approved by the RBNA.

203. Fixed pressure water-spraying fire-extinguishing systems for cabin balconies shall be approved by the RBNA.

204. (**Applicable from 01.01. 2014)** Fixed water-based fire-fighting systems for ro-ro spaces, vehicle spaces and special category spaces shall be approved by the RBNA based on the "*Revised guidelines for approval of fixed water-based fire-fighting systems for ro-ro spaces and special category spaces(MSC.1/Circ.1430)."*

Guidance

From SOLAS Interpretations as approved by IMO 2008-10-30, also issued as MSC/Circ.1120 of 2 June 2004:

Areas for increased application rates
An indication of areas for which increased application rates may be required is given below:

Protected area
Boiler fronts or roof, firing areas, oil fuel units, centrifugal separators (not oily water separators), oil purifiers, and clarifiers.

Application rate
*20 **l**/min/m2*

Protected area
Hot oil fuel pipes near exhausts or similar heated surfaces on main or auxiliary diesel engines.

Application rate
*10 **l**/min/m2*

End of guidance

F14. AUTOMATIC SPRINKLER, FIRE DETECTION AND FIRE ALARM SYSTEMS [FSS CODE]

100. Application

101. This chapter details the specifications for automatic sprinkler, fire detection and fire alarm systems as required by chapter II-2 of the SOLAS Convention.

200. Engineering specifications

201. Type of sprinkler systems: the automatic sprinkler systems shall be of the wet pipe type, but small exposed sections may be of the dry pipe type where in the opinion of the Administration this is a necessary precaution. Control stations, where water may cause damage to essential equipment, may be fitted with a dry pipe system or a pre-action system. Saunas shall be fitted with a dry pipe system, with sprinkler heads having an operating temperature up to 140 degrees C.

300. Sources of power supply

301. **Passenger ships**

There shall be not less than two sources of power supply for the sea water pump and automatic alarm and detection system. Where the sources of power for the pump are electrical, these shall be a main generator and an emergency source of power. One supply for the pump shall be taken from the main switchboard, and one from the emergency switchboard by separate feeders reserved solely for that purpose. The feeders shall be so arranged as to avoid galleys, machinery spaces and other enclosed spaces of high fire risk except in so far as it is necessary to reach the appropriate switchboards, and shall be run to an automatic changeover switch situated near the sprinkler pump. This switch shall permit the supply of power from the main switchboard so long as a supply is available therefrom, and be so designed that upon failure of that supply it will automatically change over to the supply from the emergency switchboard. The switches on the main switchboard and the emergency switchboard shall be clearly labelled and normally kept closed. No other switch shall be permitted in the feeders concerned. One of the sources of power supply for the alarm and detection system shall be an emergency source. Where one of the sources of power for the pump is an internal combustion engine it shall, in addition to complying with the provisions of paragraph 2.4.3, be so situated that a fire in any protected space will not affect the air supply to the machinery.

302. Cargo ships

There shall not be less than two sources of power supply for the sea water pump and automatic alarm and detection system. If the pump is electrically driven it shall be connected to the main source of electrical power, which shall be capable of being supplied by at least two generators. The feeders shall be so arranged as to avoid galleys, machinery spaces and other enclosed spaces of high fire risk except in so far as it is necessary to reach the appropriate switchboards. One of the sources of power supply for the alarm and detection system shall be an emergency source. Where one of the sources of power for the pump is an internal combustion engine it shall, in addition to complying with the provisions of paragraph 2.4.3, be so situated that a fire in any protected space will not affect the air supply to the machinery.

400. Component requirements

401. **Sprinklers**

a. The sprinklers shall be resistant to corrosion by marine atmosphere. In accommodation and service spaces the sprinklers shall come into operation within the temperature range from 68 degrees C to 79 degrees C, except that in locations such as drying rooms, where high ambient temperatures might be expected, the operating temperature may be increased by not more than 30 degrees C above the maximum deckhead temperature.

b. A quantity of spare sprinkler heads shall be provided for all types and ratings installed on the ship as follows:

Total number of heads	**Required number of spares**
< 300	6
300 to 1000	12
> 1000	24

The number of spare sprinkler heads of any type need not exceed the total number of heads installed of that type.

402. **Pressure tanks**

a. A pressure tank having a volume equal to at least twice that of the charge of water specified in this paragraph shall be provided. The tank shall contain a standing charge of fresh water, equivalent to the amount of water which would be discharged in one minute by the pump referred to in paragraph 2.3.3.2, and the arrangements shall provide for maintaining an air pressure in the tank such as to ensure that where the standing charge of fresh water in the tank has been used the pressure will be not less than the working pressure of the sprinkler, plus the pressure exerted by a head of water measured from the bottom of the tank to the highest sprinkler in the system. Suitable means of replenishing the air under pressure and of replenishing the fresh water charge in the tank shall be provided. A glass gauge shall be provided to indicate the correct level of the water in the tank.

b. Means shall be provided to prevent the passage of sea water into the tank.

403. **Sprinkler pumps**

a. An independent power pump shall be provided solely for the purpose of continuing automatically the discharge of water from the sprinklers. The pump shall be brought into action automatically by the pressure drop in the system before the standing

fresh water charge in the pressure tank is completely exhausted.

b. The pump and the piping system shall be capable of maintaining the necessary pressure at the level of the highest sprinkler to ensure a continuous output of water sufficient for the simultaneous coverage of a minimum area of 280 m² at the application rate specified in paragraph 2.5.2.3. The hydraulic capability of the system shall be confirmed by the review of hydraulic calculations, followed by a test of the system, if deemed necessary by the Administration.

c. The pump shall have fitted on the delivery side a test valve with a short open-ended discharge pipe. The effective area through the valve and pipe shall be adequate to permit the release of the required pump output while maintaining the pressure in the system specified in paragraph 2.3.2.1.

500. Installation requirements

501. **General**

Any parts of the system which may be subjected to freezing temperatures in service shall be suitably protected against freezing.

502. **Piping arrangements**

a. Sprinklers shall be grouped into separate sections, each of which shall contain not more than 200 sprinklers. In passenger ships any section of sprinklers shall not serve more than two decks and shall not be situated in more than one main vertical zone. However, the Administration may permit such a section of sprinklers to serve more than two decks or be situated in more than one main vertical zone, if it is satisfied that the protection of the ship against fire will not thereby be reduced.

b. Each section of sprinklers shall be capable of being isolated by one stop valve only. The stop valve in each section shall be readily accessible in a location outside of the associated section or in cabinets within stairway enclosures. The valve's location shall be clearly and permanently indicated. Means shall be provided to prevent the operation of the stop valves by any unauthorized person.

c. A test valve shall be provided for testing the automatic alarm for each section of sprinklers by a discharge of water equivalent to the operation of one sprinkler. The test valve for each section shall be situated near the stop valve for that section.

d. The sprinkler system shall have a connection from the ship' s fire main by way of a lockable screw-down non-return valve at the connection which will prevent a backflow from the sprinkler system to the fire main.

e. A gauge indicating the pressure in the system shall be provided at each section stop valve and at a central station.

f. The sea inlet to the pump shall wherever possible be in the space containing the pump and shall be so arranged that when the ship is afloat it will not be necessary to shut off the supply of sea water to the pump for any purpose other than the inspection or repair of the pump.

503. **Location of systems**

The sprinkler pump and tank shall be situated in a position reasonably remote from any machinery space of category A and shall not be situated in any space required to be protected by the sprinkler system.

600. System control requirements

601. **Ready availability**

a. Any required automatic sprinkler, fire detection and fire alarm system shall be capable of immediate operation at all times and no action by the crew shall be necessary to set it in operation.

b. The automatic sprinkler system shall be kept charged at the necessary pressure and shall have provision for a continuous supply of water as required in this chapter.

602. **Alarm and indication**

a. Each section of sprinklers shall include means for giving a visual and audible alarm signal automatically at one or more indicating units whenever any sprinkler comes into operation. Such alarm systems shall be such as to indicate if any fault occurs in the system. Such units shall indicate in which section served by the system a fire has occurred and shall be centralised on the navigating bridge or in the continuously manned central control station and, in addition, visible and audible alarms from the unit shall also be placed in a position other than on the aforementioned spaces to ensure that the indication of fire is immediately received by the crew.

b. Switches shall be provided at one of the indicating positions referred to in paragraph 2.5.2.1 which will enable the alarm and the indicators for each section of sprinklers to be tested.

c. Sprinklers shall be placed in an overhead position and spaced in a suitable pattern to maintain an average application rate of not less than 5 l/m²/min over the nominal area covered by the sprinklers. For this purpose, nominal area shall be taken as the gross horizontal projection of the area to be covered. However, RBNA may permit the use of sprinklers providing such an alternative amount of water suitably distributed as has been shown to the satisfaction of RBNA to be not less effective.

d. A list or plan shall be displayed at each indicating unit showing the spaces covered and the location of the zone in respect of each section. Suitable instructions for testing and maintenance shall be available.

603. **Testing:** Means shall be provided for testing the automatic operation of the pump on reduction of pressure in the system.

700. Spray system on deck

701. Where required by the type of cargo to be carried, a water spray system shall be installed on the deck to cause a precipitation of gas emissions arised from the loading or to cool down the entire surface of the top of the cargo tanks in order to avoid the opening of the safety valve ejector of 50 kPa.

702. The precipitation system is to have standard flange shore connection, and the nozzles are to be distributed in such a way that the gas precipitation is carried out in a safe manner. The sprinklers are to be fitted to reach the total area of the deck of the cargo tanks.

703. The system is to have the controls on the bridge and on the deck. Its flow rate at plain operation is to be 50 liters per square metre of deck per hour. Its capacity is to be designed so that in case of operation of all the sprinklers the flow is at least 50 litres per square metre of deck area per hour.

704. Immediate availability of water supply for ships AB > 500:

the devices to allow the supply of water to be quickly available are to:

a. On passenger ships:

a.1. Of gross tonnage of 1000 or greater, be such that has to be at least one suitable water jet immediately available in any fire outlet existing in an inner spot, and such as to ensure the continuity of the flow of water through the automatic starting of a required fire pump;

a.2. Of gross tonnage of 1,000 or less, consists in the automatic starting of at least one fire pump, or at the startup by bridge remote control of at least one fire pump. If the pump start up automatically, or if the bottom valve cannot be opened from the spot where is triggered the pump by remote control, the bottom valve are to be maintained always open; and

a.3. If the ship is equipped with machinery compartments that are temporarily unattended, the Classification are to establish the requirements for fixed devices for fire water for these locations, which are equivalent to those of machinery compartments normally manned;

b. in cargo ships:

b.1. Be approved by the classifier; and

b.2. Equipped with machinery space that is periodically unattended, or when is required only one person on duty, there are to be the immediate discharge of water coming from the fire main system, with a suitable pressure, either by remote starting of one of the main fire pumps with remote starting control installed on the bridge and fire control station, if any, or keeping the fire main piping system permanently pressurised through one of the main fire pumps, being that the Classifier may waive this requirement for cargo ships of less than 1,600 gross tonnage if the starting control of fire pump is arranged so in the machinery space that is easily accessible.

CHAPTER G
MACHINERY PIPING

CHAPTER CONTENTS

G1. FUEL OIL

100. Piping arrangement

101. The pumping systems for fuel oil transfer are to be, as far as possible, independent of any other pumping system.

102. The interconnections of this system with another, if any, are to ensure that no accidental connection could be performed when the system is in operation.

103. The fuel oil pipes shall not pass through potable water, boiler feed water and cargo tanks.

104. In a ship in which fuel oil is used, the arrangements for the storage, distribution and utilization of the fuel oil shall be such as to ensure the safety of the ship and persons on board and shall at least comply with the following provisions.

105. **Location of fuel oil systems**. As far as practicable, parts of the fuel oil system containing heated oil under pressure exceeding 0.18 N/mm² shall not be placed in a concealed position such that defects and leakage cannot readily be observed. The machinery spaces in way of such parts of the fuel oil system shall be adequately illuminated.

200. Prevention of overpressure

201. Provisions shall be made to prevent overpressure in any oil tank or in any part of the fuel oil system, including the filling pipes served by pumps on board. Air and overflow pipes and relief valves shall discharge to a position where there is no risk of fire or explosion from the emergence of oils and vapour and shall not lead into crew spaces, passenger spaces nor into special category spaces, closed ro-ro cargo spaces, machinery spaces or similar spaces.

300. Fuel oil piping

301. Fuel oil pipes and their valves and fittings shall be of steel or other approved material, except that restricted use of flexible pipes shall be permissible in positions where the RBNA is satisfied that they are necessary. Such flexible pipes and end attachments shall be of approved fire-resisting materials of adequate strength and shall be constructed to the satisfaction of the RBNA. For valves, fitted to fuel oil tanks and which are under static pressure, steel or spheroidal-graphite cast iron may be accepted. However, ordinary cast iron valves may be used in piping systems where the design pressure is lower than 7 bar and the design temperature is below 60ºC.

302. **IACS UR F 35** Hose clamps and similar types of attachments for flexible pipes should not be permitted.

303. 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 jacketed pipe incorporates an outer pipe into which the high-pressure fuel pipe is placed, forming a permanent assembly. The jacketed piping system shall include a means for collection of leakages and arrangements shall be provided with an alarm in case of a fuel line failure.

304. The system of shielded high pressure pipe is to include means to collect the leaks and is to be equipped with means to which an alarm is triggered in the event of a failure of the main line.

305. When hoses are used as external pipe shielding, these shall be submitted to the approval of the RBNA.

306. When the peak values of the pulse in the low pressure return line fuel oil reach are greater than 2 MPa, the return line must also be reinforced as in item 802 above.

307. For vessels classified for restricted navigation the regulations above can be attenuated at the discretion of the RBNA.

308. **IACS UR F** Fuel oil in storage tanks should not to be heated to temperatures within 10°C below the flash point of the fuel oil, except that where fuel oil in service tanks, settling tanks and any other tanks in supply system is heated the following arrangements should be provided*:*

a. the length of the vent pipes from such tanks and/or a cooling device is sufficient for cooling the vapours to below 60°C, or the outlet of the vent pipes is located 3m away from a source of ignition;

b. the vent pipes are fitted with flame screens;

c. there are no openings from the vapour space of the fuel tanks into machinery spaces (bolted manholes are acceptable) ;

d. enclosed spaces are not located directly over such fuel tanks, except for vented cofferdams ;

e. electrical equipment is not fitted in the vapour space of the tanks, unless it is certified to be intrinsically safe.

309. Fuel oil lines shall not be located immediately above or near units of high temperature including boilers, steam pipelines, exhaust manifolds, silencers or other equipment required to be insulated. . As far as practicable, fuel oil 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.

310. Fuel oil pipes, which, if damaged, would allow oil to escape from a storage, settling or daily service tank having a capacity of 500 l and above situated above the double bottom, shall be fitted with a cock or valve directly on the tank capable of being closed from a safe position outside the space concerned in the event of a fire occurring in the space in which such tanks are situated. In the special case of deep tanks situated in any shaft or pipe tunnel or similar space, valves on the tank shall be fitted, but control in the event of fire may be effected by means of an additional valve on the pipe or pipes outside the tunnel or similar space. If such an additional valve is fitted in the machinery space it shall be operated from a position outside this space. The controls for remote operation of the valve for the emergency generator fuel tank shall be in a separate location from the controls for remote operation of other valves for tanks located in machinery spaces.

311. Safe and efficient means of ascertaining the amount of fuel oil contained in any fuel oil tank shall be provided.

312. Where sounding pipes are used, they shall not terminate in any space where the risk of ignition of spillage from the sounding pipe might arise. In particular, they shall not terminate in passenger or crew spaces. As a general rule, they shall not terminate in machinery spaces.

313. **: IACS UR F 35** Short sounding pipes may be used for tanks other than double bottom tanks without the additional closed level gauge provided an overflow system is fitted

314. Components of a diesel engine fuel system shall be designed considering the maximum peak pressure which will be experienced in service, including any high pressure pulses which are generated and transmitted back into the fuel supply and spill lines by the action of fuel injection pumps. Connections within the fuel supply and spill lines shall be constructed having regard to their ability to prevent pressurized fuel oil leaks while in service and after maintenance.

315. In multi-engine installations which are supplied from the same fuel source, means of isolating the fuel supply and spill piping to individual engines, shall be provided. T he means of isolation shall not affect the operation of the other engines and shall be operable from a position not rendered inaccessible by a fire on any of the engines.

316 Where the RBNA may permit the conveying of oil and combustible liquids through accommodation and service spaces, the pipes conveying oil or combustible liquids shall be of a material approved by the RBNA having regard to the fire risk.

400. Valves

401. The suction of each tank is to be fitted with a valve easily accessible from the compartment where the tank is located.

402. Where tanks are not located at the double bottom, this valve is to be installed directly in the tank's plating.

403. Where the suction of double bottom tanks is controlled by a valve located on the engine room, this valve is to be fitted as far as possible, next to the engine room bulkhead.

404. Where a pipe fed by an oil tank can be subject to static pressure, a positive shut-off valve must be fitted at the outlet of the tank or at the inlet of the piping in the engine room.

405. The filling pipes of tanks shall be fitted close to the top of the tank. When this is not possible, a non-return valve is to be fitted to the tank.

406. On vessels with installed power greater than 373 kW (500 HP) the valves of service tanks shall be fitted to the tank bulkhead and provided with a quick shut-off system controlled from outside the compartment.

500. Drains and oil collection trays

501. The daily fuel oil tanks shall be provided with drains, to enable the removal of water and impurities that accumulate at the bottom.

502. For tanks located in the engine room these drains must be equipped with self-closing valves fitted to the tank.

503. Trays shall be installed under pumps, valves, filters and other accessories of fuel oil piping, as well as under the non-structural tanks. Trays are to discharge to a collecting oil tank, which will be drained by the oily water bilge pump.

600. Fuel oil pumps

601. The fuel oil pumps are not to be used for pumping other liquids.

602. Positive displacement type pumps are to be provided with a safety relief valve fitted at the discharge, leading to the pump suction or another convenient location.

700. Fuel oil tanks

701. The fuel oil tanks shall be in number sufficient to ensure that, in the event of damage, the fuel oil is not all lost.

702. They are to be separated from potable water tanks, boiler feed water, and other spaces of the vessel where the temperature is high and precautions are to be taken so that they are not subjected to the flame.

703. The fuel oil tanks shall not be located above boilers or in locations subject to high temperatures.

704. For daily tanks with volume up to 50 l and installed in remotely controlled Diesel engines the installation of shut-off valve to the the suction of the tank is not required.

705. Fuel oil, lubrication oil and other flammable oils shall not be carried in forepeak tanks.

706. As far as practicable, fuel oil tanks shall be part of the ships structure and shall be located outside machinery spaces of category A.

707. Where fuel oil tanks, other than double bottom tanks, are necessarily located adjacent to or within machinery spaces of category A, at least one of their vertical sides shall be contiguous to the machinery space boundaries, and shall preferably have a common boundary with the double bottom tanks, and the area of the tank boundary common with the machinery spaces shall be kept to a minimum.

708. Where such tanks are situated within the boundaries of machinery spaces of category A they shall not contain fuel oil having a flashpoint of less than 60°C. In general, the use of free- standing fuel oil tanks shall be avoided.

709. When such tanks are employed their use shall be prohibited in category A machinery spaces on passenger ships.

710. Where permitted, they shall be placed in an oil-tight spill tray of ample size having a suitable drain pipe leading to a suitably sized spill oil tank.

711. No fuel oil tank shall be situated where spillage or leakage therefrom can constitute a fire or explosion hazard by falling on heated surfaces.

712. However, where the RBNA considers that these latter requirements are impracticable, it may permit termination of sounding pipes in machinery spaces on condition that all of the following requirements are met:

a. an oil-level gauge is provided meeting the requirements of item E2.202.c7 below;

b. the sounding pipes terminate in locations remote from ignition hazards unless precautions are taken, such as the fitting of effective screens, to prevent the fuel oil in the case of spillage through the terminations of the sounding pipes from coming into contact with a source of ignition; and

c. the termination of sounding pipes are fitted with self- closing blanking devices and with a small-diameter self- closing control cock located below the blanking device for the purpose of ascertaining before the blanking device is opened that fuel oil is not present. Provisions shall be made so as to ensure that any spillage of fuel oil through the control cock involves no ignition hazard.

713. Other oil-level gauges may be used in place of sounding pipes subject to the following conditions:

a. in passenger ships, such gauges shall not require penetration below the top of the tank and their failure or overfilling of the tanks shall not permit release of fuel; and

b. in cargo ships, the failure of such gauges or overfilling of the tank shall not permit release of fuel into the space. The use of cylindrical gauge glasses is prohibited. The RBNA may permit the use of oil-level gauges with flat glasses and self-closing valves between the gauges and fuel tanks.

714. The means prescribed in item E2.202.c7 above which are acceptable to the RBNA shall be maintained in the proper condition to ensure their continued accurate functioning in service.

715. **IACS UR F 35** Level switches may be used below the tank top provided they are contained in a steel enclosure or other enclosures not capable of being destroyed by fire.

800. Suction and feed piping

801. The suction pipes of fuel oil daily tanks are to be installed at a height from the bottom such as to avoid the suction of water or decanted impurities.

802. At the feed piping of propulsion engines a double filter or similar device is to be fitted, so that the cleaning of the filters can be performed with the engine running. The use of bypass pipe is not allowed.

900. Special fuel oil

901. The use of Diesel fuel with a flash point below 55^{o} will have special RBNA examination.

902. In gasoline systems the daily tanks are to be located at a height which allows the flow by gravity to the carburetor or fuel pump. In these tanks a glass level indicator cannot be installed.

903. The whole gasoline system is to be in open environment or have means of ventilation approved by RBNA.

904. The following limitations shall apply to the use of oil as fuel:

905. Except as otherwise permitted by this paragraph, no fuel oil with a flashpoint of less than 60°C shall be used;

906. In emergency generators fuel oil with a flashpoint of not less than 43°C may be used;

907. The use of fuel oil having a flashpoint of less than 60°C but not less than 43°C may be permitted (e.g., for feeding the emergency fire pump' s engines and the auxiliary machines which are not located in the machinery spaces of category A) subject to the following:

a. fuel oil tanks except those arranged in double bottom compartments shall be located outside of machinery spaces of category A;

b. provisions for the measurement of oil temperature are provided on the suction pipe of the fuel oil pump;

c. stop valves and/or cocks are provided on the inlet side and outlet side of the fuel oil strainers; and

d. pipe joints of welded construction or of circular cone type or spherical type union joint are applied as much as possible; and

e. in cargo ships the use of fuel having a lower flashpoint than otherwise specified in E1.201.b above, for example crude oil, may be permitted provided that such fuel is not stored in any machinery space and subject to the approval by the RBNA of the complete installation.

908. Requirements concerning use of crude oil or slop as fuel for tanker boilers **IACS UR M 24**

a. Use of fuel oil having a flashpoint of 43°C or less and crude oil or slop for tanker boilers

b. Machineries and piping systems for the usage of fuel oil having a flashpoint of 43°C or less should comply with the following:

c. provisions for the measurement of oil temperature should be provided on the suction pipe of fuel oil pump;

d. stop valves and/or cocks should be provided to the inlet side and outlet side of the fuel oil strainers; and

e. pipe joints of welded construction or of circular cone type or spherical type union joint should be applied as much as possible.

909. Gas turbine systems will be object of special analysis by RBNA.

G2. LUBRICATING OIL

100. Arrangement

101. The lubricating oil system is to be independent of any other piping system.

102. An alarm to indicate low lube oil pressure is to be fitted to the propulsion engines.

200. Arrangements for lubricating oil

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

201. The arrangements for the storage, distribution and utilization of oil used in pressure lubrication systems shall be such as to ensure the safety of the ship and persons on board. This does not preclude the use of sight-flow glasses in lubricating systems provided that they are shown by testing to have a suitable degree of fire resistance; and sounding pipes may be authorized in machinery spaces; however, the requirements of items E2.202.c6(i) and E2.202.c6(iii) need not be applied on condition that the sounding pipes are fitted with appropriate means of closure.

202. The provisions of item E2.203.c4 **4** shall also apply to lubricating oil tanks except those having a capacity less than 500 l, storage tanks on which valves are closed during the normal operation mode of the ship, or where it is determined that an unintended operation of a quick closing valve on the oil lubricating tank would endanger the safe operation of the main propulsion and essential auxiliary machinery.

300. Lubricating oil pumps

301. In systems of forced lubrication the pumps may be independent or driven by the motors to which they serve. Satisfactory engine lubrication is to be ensured during the start up.

302. For propulsion engines with a power greater than 373 kW (500 BHP), it is recommended to install two lube oil pumps, so that when one is broken, the lubrication is maintained for the engine at reduced power.

400. Lubricating oil filters

401. At the inlet piping of lubricating oil in continuous service engines a double filter or a similar device must be installed, so that the cleaning of the filters can be performed with the motor running. The use of a bypass is not allowed.

402. In the engines where the casing serves as a lubricatingt oil tank devices must be installed to allow the determination of the level of oil, the filling, draining or pumping, when the engine is running.

500. Shut-off device

501. A visual and audible alarm must be fitted, sounding in the engine room and on the bridge, when the lubricating oil pressure falls below the minimum specified.

502 A shut-off device must be installed which shuts off the engine if the oil pressure becomes excessively low.

G3. MACHINERY COOLING

100. Suction of raw water (sea water or river)

101. At least two inlets of independent sea chests for cooling of the main engines are to be fitted.

102. These inlets shall be located so as to prevent the ingress of air in the suction line.

103. The sea chests are to have a removable grid with a free area of at least 2 (two) times the area of the suction pipe.

200. Sea water filters

201. Double filters or similar devices are to be installed at the suction of the cooling pumps of the main and auxiliary engines intended for essential service that are directly cooled by sea water, in such a manner as to allow the cleaning of the filter while the engine is running.

300. Sea water cooling pumps

301. The pumps may be independent or driven by the motors to which they serve.

302. Satisfactory engine cooling is to be assured during the start up.

400. Pumps of freshwater for cooling

401. See item 300 above.

500. Fresh water expansion tanks

501. The expansion tanks are to be installed in sufficiently high positions. They are to be equipped with filling devices, aeration and deaeration devices, drains, air pipes and level indicator.

502. Expansion tanks opeating under pressure, without air pipes, are to be equipped with a safety valve.

600. Air pipe drains

601. Drains are to be fitted at the highest points of the piping to remove gases and air that may have accumulated.

700. Heat exchangers

701. Where the heat exchangers are an integral part of the vessel's hull, venting devices shall be provided which ensure adequate ventilation.

800. Thermometers

801. Thermometers are to be installed, with indication at the engine operation site, to indicate the temperature of the cooling water outlet.

G4. EXHAUST GASES

100. Arrangement

101. The exhaust gas pipes of engines and boilers are to discharge to open areas in locations where the ingress of gases into the accommodations can be avoided.

102. When the exhaust pipe leads the gases near the water line, the arrangement should be so as to avoid the ingress of the water.

103. Whenever possible, the exhaust pipes of every engine or boiler are to be lead separately to an external area. When they are interconnected, provisions are to be made for devices that prevent the return of gas engines or boilers out of service.

104. Drains are to be installed in the exhaust gas pipes.

105. In vessels employed in the support of platforms or in oil areas, gas exhaust piping must be equipped with spark suppression devices.

200. Fire protection

201. Exhaust gas pipes that pass through areas where there is wood, flammable materials or where high ambient temperature may dangerously occur, are to be properly cooled or insulated. The vicinity to fuel oil pipes is to be avoided.

300. Silencers

301. Silencers are recommended at the engine exhaust piping arranged so as to permit easier drainage and accesses for cleaning and maintenance.

400. Thermal insulation

401. Exhaust pipes are to be insulated and installed so that no flammable material could ignite by contact with the installation and the maximum ambient temperature of the machinery space is according the Rules.

402. The insulation materials are to be non-flammable. Where there is the possibility of oil leaks or moisture leak or spray over the insulation, the piping is to be adequately protected by metallic plates.

G5. COMPRESSED AIR IACS UR M61

100. Princíples

101. The compressed air starting system of propulsion engines and auxiliaries to essential services is to ensure the possibility of the initial filling of the reservoirs.

102. The compressed air system for starting the main and auxiliary engines is to be arranged so that the necessary initial charge of starting air can be developed on board ship without external aid. .

103. If, for this purpose, an emergency air compressor or an electric generator is required, these units are to be powered by a hand-starting oil engine or a hand-operated compressor.

104. When the compressed air system is required to restore the propulsion, the arrangements for bringing main and auxiliary machinery into operation are to have capacity such that the starting energy and any power supplies for engine operation are available within 30 minutes of a dead ship condition.

105. The procedure for such a condition and the required calculations are to be submitted to the approval of RBNA.

106. Where the compressed air is necessary for the air whistle or other safety services, it is to be available from two compressed air receivers. At least one of them is to be starting air receiver for main engines. The separate connection, dedicated for this purpose, is to be provided directly from the compressed air main.

107. A separate connection to that end are to be installed directly from the main line of compressed air.

200. Starting air receiver

201. The total capacity of the tanks for propulsion engines shall be necessary to provide, for each engine and without replenishment, not less than 12 starts of the reversible motors or 6 starts of the non-reversible motors.

Where the main engine is arranged for starting by compressed air, at least two starting air receivers of about equal capacity are to be fitted which may be used independently.

a. The total capacity of air receivers is to be sufficient to provide, without their being replenished, no less than 12 consecutive starts alternating between Ahead and Astern of each main engine of the reversible type, and no less than six starts of each main non-reversible type engine connected to a controllable pitch propeller or other device enabling the start without opposite torque. The number of starts refers to engine in cold and ready to start conditions.

b. Additional number of starts may be required when the engine is in the warm running condition.

c. When other consumers such as auxiliary engines starting systems, control systems, whistle, etc., are to be connected to starting air receivers, their air consumption is also to be taken into account.

d. Regardless of the above, for multi-engine installations the number of starts required for each engine may be reduced upon the agreement with the RBNA depending upon the arrangement of the engines and the transmission of their output to the propellers.

202. For mulit-enigne propulsion plants, the capacity of receivers shall be sufficient to ensure at least 3 consecutive starts per motor. However, the total capacity is not to be less than 12 starts and need not exceed 18 starts.

203. The total capacity of the receivers is to be sufficient to provide without replenishementthe number of start-ups specified in items G5.202 and G5.201 above.

204. When other users such as compressed starting air systems for the auxiliary motors, control systems, whistle or similar is being fed by air cylinders, their air consumption is additionally to be taken into account.

205. Other types of equipment or systems with high air consumption than those described in item G5.204 above cannot be connected to the main starting air system, and are to be provided with separate sources.

.206. Any installations other than those dealt within items G5.201 to G5.205 above shall be submitted to the approval of the RBNA.

300. Air compressors

301. At least two air compressors, one of which is to be driven independently, are to be installed for filling of the receivers intended for the starting of the motors.

a. Where the main engine is arranged for starting by compressed air, two or more air compressors are to be fitted. At least one of the compressors is to be driven independent of the main propulsion unit and is to have the capacity no less than 50 % of the total required.

b. The total capacity of air compressors is to be sufficient to supply within one hour the quantity of air needed to meet G5.201.b)5 by charging the receivers from atmospheric pressure. The capacity is to be approximately equally divided between the number of compressors fitted, excluding an emergency compressor which may be installed to meet G5.1011.

302. When propulsion engines have power greater than 149 kW (200 BHP) the compressors are to be electrically driven.

303. Manual starting installations or independent batteries for electric starting can be accepted.

304. In the case of small installations, a manual compressor of an approved capacity can be accepted

305. The air compressors are to have capacity to fill the receivers of starting air within one hour.

306. This capacity should be distributed equally between the two compressors, excluding the emergency compressor when installed.

307. At least one of the compressors described above G5.301 must be independent of motors for supplying starting the air, and must be capable of not less than 50% to the total required item G5.301 above.

308. The air compressors shall be designed in such a way that the air discharge temperature does not exceed 95° C.

309. To this end, there should be adequate facilities for cooling and fuse devices or alarms set at a temperature no greater than 120° C.

310. The compressors shall be fitted with safety valve.

311. Devices to prevent over-pressure should be fitted wherever sleeves or carcasses of air compressors could be subjected to dangerous pressures due to air leakage of pressurized parts.

312. Compressors with a crankcase volume of 0.6 cubic metres or greater shall be fitted with safety valves against crankcase explosion.

313. The air compressors are to be equipped with a drain valve.

400. Accessories

401. The air receivers, compressors, pipes and other accessories are to be fitted with suitable devices to prevent over-pressure greater than 10% anywhere in the system.

402. Measures are to be adopted to reduce to a minimum the ingress of oil in compressed air systems.

403. The compressed air system is to be be provided with oil and water separators or filters on the compressors discharge outlet, and drains are to be installed in compressed air line where considered necessary.

404. All the pipe lines between the starting air compressors shall be conducted directly to the starting air cylinders, and all lines of the starting air pipe coming out of the cylinders must be totally independent of the discharge pipe system of the compressor.

405. Alarms and security devices must be installed on starting air systems according to table T. G 5.405.1 below.

406. However, some exemptions may be granted for vessels with notation O1.

Table T. G 5.405.1-alarms and SECURITY DEVICES

Symbology H = High HH = In excess of the high L = low LL = lower than the low R remote	**Monitoramento**	
Parameter identification	**Alarm**	**Indication**
Pressure of compressor lubricating oil (except when lubricated by "scoop")	L	-
Air pressure after the reducing valves	L+H	Local
Starting air pressure before the shut-off valve	L	Local + R (1)
Air cylinder pressure	L	-

(1) Remote indication is required if the starting air compressor is fitted with remote control.

500. Air control systems.

501. The air control and monitoring supply for essential services is to be available from two sources of sufficient capacity to allow for normal operation with one source out of service.

502. At least one compressed air cylinder fitted with non-return valve is to be provided in the air control and monitoring system.

503. The pressure reduction units used in the control and monitoring systems for essential equipment are to be duplicated, unless an alternative source of air is installed.

504. A failure in the air control system is to not to cause any sudden change in the controlled equipment that could be detrimental to the safety of the ship.

505. The system is to be fitted with pressure controllers maintain parameters that ensure proper operation of the installation.

506. Devices to cool, filter and dry the air before its introduction into the monitoring and control circuits are to be fitted.

G6. HEATING SYSTEMS, STEAM, FEED WATER AND CONDENSATE

100. Application

101. The characteristics of these systems are to be submitted to the RBNA for approval.

G7. THERMAL OIL

100. Pipes

101. The pipes are to be, preferably, welded, and with the least number of parts.

102. Gaskets shall be compatible with the nature and temperature of the thermal oil.

103. The arrangement of pipes is to provide freedom for thermal expansion. The pipes shall not pass through accommodation, service and passenger spaces. If they pass through cargo spaces, protection is to be be provided. Passage through bulkheads and decks shall have thermal insulation.

104. The overflow outlet of this system is to reach the location where no hazards are created.

200. Valves

201. The valves will be of ductile material for rated pressure of 16 bar.

202. At the pressure line check valves will be installed in the return line and the valves will have a device to keep the open position.

300. Pumps

301. There should be two independent circulating pumps.

302 There should be one pump for the expansion tank feeding.

G8. HYDRAULIC POWER TO MACHINERY ESSENTIAL SERVICES.

100. Application

101. The characteristics of these systems are to be submitted to the RBNA for approval.

G9. USE OF AMMONIA AS A REFRIGERANT [IACS M69]

100. Use of Ammonia as a refrigerant

101. Ammonia refrigerating machinery shall be installed in dedicated gastight compartments. Except for small compartments, at least two access doors are to be provided.

102. Compartments containing ammonia machinery (including process vessels) are to be fitted with :

a. a negative ventilation system independent of ventilation systems serving other ship spaces and having a capacity no less than 30 changes per hour based upon the total volume of the space; other suitable arrangements which ensure an equivalent effectiveness may be considered;

b. a fixed ammonia detector system with alarms inside and outside the compartment;

c. water screens above all access doors, operable manually from outside the compartment;

d. an independent bilge system.

103. At least two sets of breathing apparatus and protective clothings are to be available.

104. Ammonia piping is not to pass through accommodation spaces.

105. In case of ammonia plants of fishing vessels under 55 m in length or other ammonia plants with a quantity of ammonia no greater than 25 kg said plants are allowed to be located in the machinery space.

106. The area where the ammonia machinery is installed is to be served by a hood with a negative ventilation system, so as not to permit any leakage of ammonia from dissipating into other areas in the space.

107. A water spray system is to be provided for the said area.
In addition previous items G9.102 b), G9.103 and G9.104 apply.

CHAPTER H
POLLUTION PREVENTION PIPING

CHAPTER CONTENTS

H1. SEWAGE AND WASTEWATER

100. Arrangement

101. The Brazilian flag ships sailing under its jurisdiction will keep the Law 9966 of 04/28/00 and regulations of the Agency of Sanitary Vigilance – ANVISA and its Resolution - RDC N°17, of 01/12/01. Other vessels are to comply with MARPOL or national legislation.

H2. OILY WATER

100. Arrangement

101. The Brazilian flag vessels sailing under their jurisdiction will keep the Law 9966 of 04/28/00 and regulations of the Agency of Sanitary Vigilance – ANVISA and its Resolution - RDC N°17, of 01/12/01. Other vessels are to comply with MARPOL or national legislation.

CHAPTER T
TESTS

CHAPTER CONTENTS

T1. APPROACH (Pressure tests of piping after assembly on board [IACS UR P2.9]

100. Application to all systems

101. The piping systems, equipments and accessories are to be hydrostatically tested periodically after assembly at a hydraulic pressure equal to 1.5 times the working pressure.

102. Before entering into operation, the piping systems are to be subjected to flushing by circulation through single filters until there is evidence of cleaning.

103. Pressure tests of piping after assembly on board **IACS UR P2.9**

104. After assembly on board, the following tightness tests are to be carried out in the presence of the Surveyor.

105. In general, all the piping systems covered by these requirements are to be checked for leakage under operational conditions and, if necessary, using special techniques other than hydrostatic testing. In particular, heating coils in tanks and liquid or gas fuel lines are to be tested to no less than 1,5P but in no case less than 4 bar.

T2. PIPING SYSTEMS

100. Piping systems with working pressure above 10 bar (10.2 Kgf/cm^2)

101. The pipes for such systems are to be tested in the workshop after manufacture.

102. After installed on board, they should be tested with all the accessories, at a pressure no less than the given below:

a. 1.25 times the design pressure, if there is any welded joint on board; and

b. The opening pressure of the over-pressure protection devices, in the other cases or when the

welded joints on board have been subjected to non-destructive testing.

200. Cargo or fuel oil piping system

201. After installation on board, the system shall be tested at a pressure of 1.5 times the working pressure, but no less than 4 bar (4.07 kgf/cm^2).

300. Steam coils

301. After their installation on board, the steam coils shall be tested with a pressure equal to twice the working pressure.

400. Low pressure piping systems

401. Bilge pipes, ballast, and other low pressure service are to be tested, after their installation on board, at least, with a hydraulic pressure at least equal to the maximum service.

500. Fire testing of flexible pipes
[IACS URF 42 SFL]

501. 1. Flexible pipes with end attachments which are required to be of fire-resisting materials shall be subject to a fire for 30 minutes at a temperature of 800^{o}C, while water at the maximum service pressure is circulated inside the pipe. The temperature of the water at the outlet shall no be less than 80^{o}C. No leak should be recorded during or after the test.

502. 2. An alternative is to fire test the flexible pipe with flowing water at a pressure of at least 5 bar and subsequent pressure test to twice the design pressure.

T3. EQUIPMENT

100. Pumps, compressors, heat exchangers etc.

101. Equipment are to be tested with a hydraulic pressure no less than 1.5 times their working pressure.

T4. ACCESSORIES

100. Hydrostatic tests of valves and fittings
[UR P2.10]

101. Valves and fittings non-integral with the piping system, intended for Classes I and II, are to be tested in accordance with recognized standards, but to no less than 1,5 times the design pressure.

102. Valves and cocks intended to be fitted on the ship side below the load waterline are to be tested by hydraulic pressure no less than 5 bar.

200. Steel pressure vessels

201. All boilers and other pressure vessels including their associated fittings which are under internal pressure are to be subjected to appropriate tests including a pressure test before being put into service for the first time. (See Part III, Title 62, Section 6, Subchapter T.8).

202. Pumps, compressors, heat exchangers, etc. are to be tested at a hydraulic pressure not less than 1,5 times the operating pressure.

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