Plastic Pipes

Amended Rules and Guidance

Rules for the Survey and Construction of Steel Ships Part D
Rules for Cargo Refrigerating Installations
Rules for High Speed Craft
Rules for the Survey and Construction of Passenger Ships
Rules for the Survey and Construction of Inland Waterway Ships
Guidance for the Survey and Construction of Steel Ships Parts D, and R
Guidance for High Speed Craft
Guidance for the Survey and Construction of Passenger Ships
Guidance for the Survey and Construction of Inland Waterway Ships
Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

Reason for Amendment

IACS Unified Requirement (UR) P4 specifies requirements related to the design, performance, location and approval of non-metallic pipes, and these requirements have already been incorporated into the NK Rules.

In February 2021, IACS adopted UR P4(Rev.6) to clarify the year of publication to be used with respect to the industry standards referenced in the UR.

Accordingly, relevant requirements were amended based on IACS UR P4(Rev.6). In addition, as a part of a comprehensive review of NK Rules, relevant provisions were transferred from Annex D12.1.6-2, Part D of the Guidance for the Survey and Construction of Steel Ships to Annex 12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships.

Outline of Amendment

The main contents of this amendment are as follows:

(1) Transferred the requirements related to plastic pipes from Annex D12.1.6-2, Part D of the Guidance for the Survey and Construction of Steel Ships to Annex 12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships.
(2) Aligned Annex 12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships and Table 6.6, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use with IACS UR P4(Rev.6) regarding the format of the year of publication to be used when referring to industry standards.

“Rules for the survey and construction of steel ships” has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

Chapter 12 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

12.1 General

Paragraph 12.1.6 has been amended as follows.

12.1.6 Use of Special Materials*

~~1~~ Notwithstanding the provisions in **12.1.5** above, special materials such as rubber hoses, plastic pipes~~,~~ (including vinyl pipes) complying with **Annex 12.1.6**, aluminum alloys, etc. may be used~~,~~ ~~after taking into account safety against fire and flooding as well as their service conditions,~~ in cases where approved by the Society in accordance with requirements specified otherwise after taking into account their safety against fire and flooding as well as their service conditions.

Annex 12.1.6 has been added as follows.

Annex 12.1.6 PLASTIC PIPES

1.1 Scope

1 This annex is to apply to the materials, construction, strength, application, assembly and tests of piping systems on ships, including pipe joints and fittings, made predominately of materials other than metal.

2 The annex is not applicable to use of mechanical joints and flexible couplings in metallic piping systems which are accepted for use in accordance with **12.3.3-1** or **12.3.4-2, Part D of the Rules**.

3 The specification of the pipes is to be in accordance with a recognised national or international standard acceptable to the Society and the following requirements. However, the requirements in **1.4** (except **1.4.1-2(2)**) and **1.5** (except **1.5.2**) need not apply to the pipes specified in **1.3-2.**

1.2 Terminology

Terms used in this annex are defined as follows:

(1) "Plastic" means both thermoplastic and thermosetting plastic materials with or without reinforcement, such as *PVC* and fibre reinforced plastics - FRP. Plastic includes synthetic rubber and materials of similar thermo /mechanical properties.

(2) "Pipe/piping Systems" means those made of plastic(s) and include pipes, fittings, system joints, methods of joining and any internal or external liners, coverings and coatings required to comply with this annex.

(3) "Joint" means the location at which two pieces of pipe or a pipe and a fitting are connected together. The joint may be made by adhesive bonding, laminating, welding, flanges etc.

(4) "Fittings" means bends, elbows, fabricated branch pieces, etc. of plastic materials.

(5) "Nominal pressure" means the maximum permissible working pressure which is to be determined in accordance with **1.4.1-2**.

(6) "Design pressure" means the maximum working pressure which is expected under operation conditions or the highest set pressure of any safety valve or pressure relief device on the system, if fitted.

(7) "Fire endurance" means the capability of piping to maintain its strength and integrity (i.e. capable of performing its intended function) for some predetermined period of time while exposed to fire.

(8) "*FTP* Code" means as defined in **3.2.23, Part R of the Rules**.

1.3 Materials

1 Plastic pipes are to be those approved by the Society in accordance with **12.1.6, Part D of the Rules** and adequate for their service conditions.

2 Notwithstanding the requirement in **-1** above, pipes which comply with recognised standards such as *JIS* or *JWWA*, comply with **1.4.1-2(2)** and **1.5.2** and are adequate for their service conditions may be used for the following **(1)** and **(2)**:

(1) Drinking water pipes, domestic water pipes (including hot water pipes) and sanitary pipes located within accommodation spaces and engine rooms as well as deck scuppers located

within spaces.

(2) Pipes used for the "Auxiliary machinery for specific use" and "Other auxiliary machinery" (except for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems, exhaust gas cleaning systems (EGCS), etc.) specified in **1.1.1-6, Part D of the Rules**.

1.4 Design Requirements

1.4.1 Strength

1 The strength of fittings and joints is to be not less than that of the pipes.

2 The nominal pressure is to be determined from the following **(1)** to **(3)**:

(1) Internal Pressure

In the case of internal pressure, the smaller of the following is to be taken:

$$P_{nint} \leq \frac{P_{sth}}{4} \text{ or } P_{nint} \leq \frac{P_{lth}}{2.5}$$

where

P_{sth} : Short-term hydrostatic test failure pressure

P_{lth} : Long-term hydrostatic test failure pessure (>100,000h)

(2) External Pressure (for any installation which may be subject to vacuum conditions inside the pipe or a head of liquid acting on the outside of the pipe or for any pipes that would allow progressive flooding to other compartments through damaged piping or through open ended pipes in the compartments)

External pressure is to comply with the following formula. Maximum working external pressure is the sum of the vacuum inside pipes and heads of liquid acting on the outside of pipes.

$$P_{next} \leq \frac{P_{col}}{3}$$

where

P_{col} : Pipe collapse pressure (However, in no instance is the pipe collapse pressure to be less than 0.3 MPa)

(3) Wall Thickness

Notwithstanding the requirements of **(1)** or **(2)** above as applicable, the pipe or pipe layer minimum wall thickness is to follow recognised standards. In the absence of standards for pipes not subject to external pressure, the requirements of **(2)** above are to be met.

(4) Temperature

Nominal pressure is to be specified in accordance with the manufacturer's recommendations with due regard being given to the maximum possible working temperature.

3 Design temperature

(1) In this annex, design temperatures are to be the highest and lowest working temperatures of any liquid inside such pipes and atmospheric temperatures of the area where such pipes are arranged at the designed conditions. The design temperatures of ballast pipes are not to be less than 50 ºC for high temperature sides and are not to be more than 0 ºC for low temperature sides.

(2) The permissible working temperature depending on the working pressure is to be in accordance with manufacturer's recommendations, but in each case it is to be at least 20 ºC lower than the minimum heat distortion/deflection temperature of the pipe material, determined according to *ISO* 75-2:2013 method A, or equivalent e.g. *ASTM D648-18*. The minimum heat distortion/deflection temperature is to be not less than 80 ºC.

4 The sum of the longitudinal stresses due to pressure, weight and other loads is not to exceed the allowable stress in the longitudinal direction.

5 In the case of fibre reinforced plastic pipes, the sum of the longitudinal stresses is not to exceed half of the nominal circumferential stress derived from the nominal internal pressure condition according to -**2(1)** above.

6 Plastic pipes and joints are to have a minimum resistance to impact in accordance with recognised national or international standards, e.g. *ISO* 9854, *ISO* 9653, *ISO* 15493, *ASTM D2444* or their equivalent.

1.5 Requirements for Pipe/Piping Systems Depending On Service and/or Locations

1.5.1 Fire Endurance

1 Pipes and their associated fittings whose integrity is essential to the safety of ships are required to meet the minimum fire endurance requirements of *Appendix* 1 or 2, as applicable, of *IMO Res. A.*753(18) (including any amendments due to *IMO Res. MSC.*313(88) and *IMO Res. MSC.*399(95)).

2 Permitted use of piping depending on fire endurance, location and piping system is given in **Table 1.**

1.5.2 Flame Spread

1 All pipes, except those fitted on open decks and within tanks, cofferdams, pipe tunnels and ducts, if separated from accommodation, permanent manned areas and escape ways by means of an "*A*" class bulkhead, are to have low surface flame spread characteristics as determined by the test procedures given in *Appendix* 3 of *IMO Res. A.*753(18) (including any amendments due to *IMO Res. MSC.*313(88) and *IMO Res. MSC.*399(95)). Piping with both the total heat release (Q_t) of not more than 0.2 *MJ* and the peak heat release rate (Q_p) of not more than 1.0*kW* (both values determined in accordance with the requirements of "Test for Surface Flammability" specified in the *FTP* Code, *ANNEX* 1, *Part* 5) are considered to comply with the above requirements and may be exempted from testing in accordance to standard *ISO* 1716:2010 related to calorific value.

2 Surface flame spread characteristics are to be determined using the procedure given in the *FTP* Code, *ANNEX* 1, *Part* 5 with regard to the modifications due to the curvilinear pipe surfaces as also listed in *Appendix* 3 of *IMO Res. A.*753(18), as amended by *IMO Res. MSC.*313(88) and *IMO Res. MSC.* 399(95).

3 Surface flame spread characteristics may also be determined using the test procedures given in *ASTM D635-18*, or in other national equivalent standards. Under the procedure of *ASTM D635-18*, a maximum burning rate of 60 *mm/min* applies. In case of adoption of other national equivalent standards, the relevant acceptance criteria are to be defined.

1.5.3 Fire Protection Coatings

In cases where the fire protective coating of pipes and fittings is necessary for achieving required fire endurance levels, such coating is to meet the requirements in the following **(1)** to **(4)**:

(1) Pipes are generally to be delivered from the manufacturer with the protective coating already applied.

(2) The fire protection properties of such coatings are not to be diminished when exposed to salt water, oil or bilge slops. It is to be demonstrated that such coatings are resistant to those products that are likely to come into contact with the piping.

(3) When considering fire protection coatings, characteristics such as thermal expansion, resistance against vibrations, and elasticity are to be taken into account.

(4) Fire protection coatings are to have sufficient resistance to impact and be able to retain their integrity.

1.5.4 Electrical Conductivity

1 In cases where the piping systems for fluids with conductivity of less than 1,000 *pS/m* (*pico siemens per metre*), such as refined products and distillates, conductive pipes are to be used.

2 Regardless of the fluid being conveyed, plastic piping is to be electrically conductive if such piping passes through the hazardous areas specified in **4.3**, **Part H of the Rules**.

3 Pipes and fittings having conductive layers are to be protected against any possibility of spark damage to pipe walls.

4 In cases where electrical conductivity is to be ensured, the resistance of pipes and fittings is not to exceed 0.1 $M\Omega/m$.

1.5.5 Durability against Chemicals

Pipes are to be resistant to any chemical substances they might possibly come it to contact with during service.

1.5.6 Smoke Generation and Toxicity

Piping materials within the accommodation, service, and control spaces are to fulfill the requirements of *Appendix* 3 of *IMO Res*. *A*.753(18) (including any amendments due to *IMO Res*. *MSC*.313(88) and *IMO Res*. *MSC*.399(95)), on smoke and toxicity tests. Procedure modifications are necessary due to the curvilinear pipe surfaces listed in **Chapter 6, Part R of the Rules**.

Table 1 Fire Endurance Requirements Matrix

N	Piping Systems	Location										
		A	B	C	D	E	F	G	H	I	J	K
CARGO (FLAMMABLE CARGO f.p.[11] ≦ 60 ℃)												
1	Cargo lines	—	—	L1	—	—	○	—	○[10]	○	—	L1[2]
2	Crude oil washing lines	—	—	L1	—	—	○	—	○[10]	○	—	L1[2]
3	Vent lines	—	—	—	—	—	○	—	○[10]	○	—	×
INERT GAS												
4	Water seal effluent lines	—	—	○[1]	—	—	○[1]	○[1]	○[1]	○[1]	—	○
5	Scrubber effluent lines	○[1]	○[1]	—	—	—	—	—	○[1]	○[1]	—	○
6	Main lines	○	○	L1	—	—	—	—	—	○	—	L1[6]
7	Distribution lines	—	—	L1	—	—	○	—	—	○	—	L1[2]
FLAMMABLE LIQUIDS (f.p.[11] ＞ 60 ℃)												
8	Cargo lines	×	×	L1	×	×	—[3]	○	○[10]	○	—	L1
9	Fuel oil	×	×	L1	×	×	—[3]	○	○	○	L1	L1
10	Lubricating	×	×	L1	×	×	—	—	—	○	L1	L1
11	Hydraulic oil	×	×	L1	×	×	○	○	○	○	L1	L1
SEAWATER[1]												
12	Bilge mains & branches	L1[7]	L1[7]	L1	×	×	—	○	○	○	—	L1
13	Fire mains & water sprays	L1	L1	L1	×	—	—	—	○	○	×	L1
14	Foam systems	L1W	L1W	L1W	—	—	—	—	—	○	L1W	L1W
15	Sprinkler systems	L1W	L1W	L3	×	—	—	—	○	○	L3	L3
16	Ballast	L3	L3	L3	L3	×	○[10]	○	○	○	L2W	L2W
17	Cooling water, essential services[12]	L3	L3	—	—	—	—	—	○	○	—	L2W
18	Tank cleaning services fixed machines	—	—	L3	—	—	○	—	○	○	—	L3[2]
19	Non-essential systems[13]	○	○	○	○	○	—	○	○	○	○	○
FRESHWATER												
20	Cooling water essential services[12]	L3	L3	—	—	—	—	○	○	○	L3	L3
21	Condensate returns	L3	L3	L3	○	○	—	—	—	○	○	○
22	Non-essential systems[13]	○	○	○	○	○	—	○	○	○	○	○
SANITARY/DRAINS/SCUPPERS												
23	Deck drains (internal)	L1W[4]	L1W[4]	—	L1W[4]	○	—	○	○	○	○	○
24	Sanitary drains (internal)	○	○	—	○	○	—	○	○	○	○	○
25	Scuppers and discharges (overboard)	○[1,8]	○[1,8]	○[1,8]	○[1,8]	○[1,8]	○	○	○	○	○[1,8]	○
SOUNDING/AIR												
26	Water tanks/dry spaces	○	○	○	○	○	○[10]	○	○	○	○	○
27	Oil tanks (f.p.[11] ＞ 60 ℃)	×	×	×	×	×	×[3]	○	○[10]	○	×	×

Table 1 Fire Endurance Requirements Matrix (continued)

N	Piping Systems	Location										
		A	B	C	D	E	F	G	H	I	J	K
MISCELLANEOUS												
28	Control air	L1[5]	L1[5]	L1[5]	L1[5]	L1[5]	—	○	○	○	L1[5]	L1[5]
29	Service air (non-essential)[13]	○	○	○	○	○	—	○	○	○	○	○
30	Brine	○	○	—	○	○	—	—	—	○	○	○
31	Auxiliary low pressure steam ($\leq$ 0.7*MPa*)	L2W	L2W	○[9]	○[9]	○[9]	○	○	○	○	○[9]	○[9]
32	Central vacuum cleaners	—	—	—	○	—	—	—	—	○	○	○
33	Exhaust gas cleaning system / Exhaust gas recirculation system effluent line	L3[1]	L3[1]	—	—	—	—	—	—	—	L3[1, 14] —	—
34	Reductant agent transfer / supply system (SCR installations)	L1[15]	L1[15]	—	—	—	—	—	—	○	L3[14] —	○

Notes:

(1) LOCATION

A : "Machinery spaces of category *A*": Machinery spaces of category *A* as defined in **2.1.32, Part A of the Rules**

B : "Other machinery spaces and pump rooms": Spaces, other than category *A* machinery spaces and cargo pump rooms, containing: propulsion machinery; boilers; fuel oil units; steam and internal combustion engines; generators and major electrical machinery; oil filling stations; refrigerating, stabilising, ventilation and air-conditioning machinery as well as similar spaces and trunks to such spaces.

C : "Cargo pump rooms": Spaces containing cargo pumps and entrances and trunks to such spaces.

D : "Ro-ro cargo holds": Ro-ro cargo holds are ro-ro cargo spaces and special category spaces as defined in **3.2.41, Part R of the Rules** and **2.1.38, Rules for High Speed Craft**

E : "Other dry cargo holds": All spaces other than ro-ro cargo holds used for non-liquid cargo and trunks to such spaces.

F : "Cargo tanks": All spaces used for liquid cargo and trunks to such spaces.

G : "Fuel oil tanks": All spaces used for fuel oil (excluding cargo tanks) and trunks to such spaces.

H : "Ballast water tanks": All spaces used for ballast water and trunks to such spaces.

I : "Cofferdams, voids, etc.": Cofferdams and voids are those empty spaces between two bulkheads separating two adjacent compartments.

J : "Accommodation, service": Accommodation spaces, service spaces and control stations as defined in **2.1.36, 2.1.37, Part A of the Rules** and **9.2.3-2(1), Part R of the Rules**

K : "Open decks": Open deck spaces as defined in **9.2.4-2(10), Part R of the Rules** (excluding lifeboat and liferaft embarkation and lowering stations)

(2) ABBREVIATIONS

L1 : Pipes without leakage during pressure tests as a result of fire endurance tests (for more than one hour) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L1W : For piping systems which do not carry flammable fluid or any gas, pipes with negligible leakage (i.e. not exceeding 5 % flow loss) during pressure tests as a result of fire endurance tests (for more than one hour) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L2 : Pipes without leakage during pressure tests as a result of fire endurance tests (for more than 30 *minutes*) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L2W : Pipes with negligible leakage (i.e. not exceeding 5 % flow loss) during pressure tests as a result of fire endurance tests (for more than 30 *minutes*) and pressure tests (for more than 15 *minutes*) in dry conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

L3 : Pipes without significant leakage (i.e. not exceeding 0.2 *l/min*) during pressure tests as a result of fire endurance tests (for more than 30 *minutes*) and pressure tests (for more than 15 *minutes*) in wet conditions in accordance with *IMO Res. A*.753(18) *Appendix* 1 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res. MSC*.399(95))

○ : No fire endurance test required

– : Not applicable

× : Metallic materials having a melting point greater than 925 ºC

(3) FOOTNOTES

1 : In cases where non-metallic piping is used, remotely controlled valves are to be provided at ship's side (such valves are to be controlled from outside spaces).

2 : Remote closing valves are to be provided at cargo tanks.

3 : When cargo tanks contain flammable liquids with a f.p. (to be determined by an approved closed cup method) > 60 ºC, "○" may replace "–" or "×".

4 : In the case of drains serving only the space concerned, "○" may replace "L1W".

5 : When controlling functions are not required by statutory requirements or guidelines, "○" may replace "L1".

6 : In the case of pipes between machinery spaces and deck water seals, "○" may replace "L1".

7 : In the case of passenger vessels, "×" is to replace "L1".

8 : Scuppers serving open decks in positions I and II, as defined in **20.1.2, Part C of the Rules**, should be "×" throughout unless fitted at the upper end with the means of closing capable of being operated from a position above the freeboard deck in order to prevent downflooding.

9 : In the case of essential services, such as fuel oil tank heating and the ship's whistle, "×" is to replace "○".

10 : In the case of tankers where compliance with **3.2.4(1)(a)vi), Part 3 of the Rules for Marine Pollution Prevention Systems** is required, "–" is to replace "○".

11 : To be determined by an approved closed cup method.

12 : Pipe lines used for the "auxiliary machinery essential for main propulsion", "auxiliary machinery for the manoeuvring and safety" and "auxiliary machinery for cargo handling" specified in **1.1.1-6, Part D of the Rules**.

13 : Pipes specified in **1.3-2(1)** and **(2)**

14 : L3 in service spaces, NA in accommodation and control spaces.

15 :Type approved plastic piping without fire endurance test (○) is acceptable downstream of the tank valve, provided this valve is metal seated and arranged as fail-to-closed or with quick closing from a safe position outside the space in the event of fire.

1.6 Installation

1.6.1 Supports

1 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 that recommended the pipe manufacturer. The selection and spacing of pipe supports are to take into account pipe dimensions, length of the piping, mechanical and physical properties of pipe materials, mass of pipes and contained fluids, external pressures, operating temperatures, thermal expansion effects, loads due to external forces, thrust forces, water hammers, vibrations, fatigue and maximum accelerations to which such systems may be subjected. Combination of loads is to be considered.

2 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 minimise any wearing down of such pipes in the places where they come in contact with their supports.

3 Heavy components in piping systems, such as valves and expansion joints, are to be independently supported.

1.6.2 Expansion

1 Suitable provisions are to be made in pipelines to allow for relative movement between pipes made of plastic and steel structures, paying due regard to:

(1) The difference in the coefficients of thermal expansion.

(2) Deformations of the ship's hull and its structure.

2 When calculating the thermal expansions, system working temperatures as well as those

temperatures at which assembly is performed are to be taken into account.

1.6.3 External Loads

1 When installing piping, allowances are to be made for temporary point loads in cases 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.

2 Besides for providing adequate robustness for all piping including open-ended piping a minimum wall thickness, complying with **1.4.1-2**, may be increased taking into account the conditions encountered during service on board ships.

3 Pipes are to be protected from mechanical damage in cases where necessary.

1.6.4 Strength of Connections

1 The strength of connections is to be not less than that of the piping system in which they are installed.

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

3 Adhesives, when used for joint assembly, are to be suitable for providing permanent seals between pipes and fittings throughout the temperature and pressure ranges of their intended application.

4 All tightening of joints is to be performed in accordance with manufacturer instructions.

1.6.5 Installation of Conductive Pipes

1 In cases where pipes are required to be electrically conductive (as specified in **1.5.4**), sufficient consideration is to be given to electrical continuity.

2 Any resistance to earth from any points in such piping systems is not to exceed 1 $M\Omega$.

3 Earthing wires are to be accessible for inspection.

1.6.6 Application of Fire Protection Coatings

1 Fire protection coatings are to be applied on joints, in cases where such coatings are necessary for meeting the required fire endurance in accordance with **1.5.3**, after performing hydrostatic pressure tests of such piping systems.

2 Such fire protection coatings are to be applied in accordance with manufacturer recommendations, using procedures approved for each particular case.

3 Pipes are to be electrically conductive, even after being coated with fire protective coatings, in cases where it is necessary to coat conductive pipes.

1.6.7 Penetration of Divisions

1 Where plastic pipes pass through "*A*" or "*B*" class divisions, arrangements are to be made to ensure that their fire endurance is not impaired in accordance with **9.3, Part R of the Rules**.

2 When plastic pipes pass through oiltight and watertight bulkheads or decks, the watertight or oiltight integrity of the bulkhead or deck is to be maintained, and such penetrations are to be of steel. Steel penetration may also be required for other steel divisions in cases where deemed necessary. For pipes not able to satisfy the requirements in **1.4.1-2(2)**, a metallic shut-off valve operable from above the freeboard deck is to be fitted at the bulkhead or deck.

3 If bulkheads or decks are also fire divisions and destruction by fire of any plastic pipes may cause the inflow of liquid from tanks, metallic shut-off valves operable from above freeboard decks should be fitted at such bulkheads or decks.

1.6.8 Control During Installation

1 Pipes are to be properly protected from any damage caused by sparks from things such as welding and cutting as well as from any mechanical impact with heavy objects during assembling.

2 Installation is to be in accordance with manufacturer guidelines.

3 Sufficient consideration is to be given to fire protection and safety of life in cases where

adhesives are being used as well as in cases of cutting or grinding pipes.

4 Methods for connecting pipes are to be approved by the Society before such work is started.

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

6 All personnel involved in either connecting or bonding plastic pipes by welding, lamination or similar methods are to be properly qualified. Records for each person, including the bonding procedure with dates as well as the results of any qualification testing are to be shown to the Surveyor if necessary.

1.6.9 Bonding Procedure Quality Testing

1 Procedures for making bonds are to include:

(1) materials used,

(2) tools and fixtures,

(3) joint preparation requirements,

(4) cure temperatures,

(5) dimensional requirements and tolerances, and

(6) test acceptance criteria upon completion of assembly.

2 Test assemblies are to be fabricated in accordance with procedures in order to be qualified and such assemblies are to consist of at least one pipe-to-pipe joint and one pipe-to-fitting joint.

3 In cases where such test assemblies have been cured, they are to be subjected to hydrostatic test pressures at safety factors 2.5 *times* the design pressures of such test assemblies for not less than one *hour*. No leakages or separation of joints are allowed. Such tests are to be conducted so that joints are loaded in both longitudinal and circumferential directions.

4 Selection of pipes used for test assemblies is to be in accordance with the following:

(1) In cases where the largest size to be joined has a nominal outside diameter that is 200 *mm* or smaller, test assemblies are to be the largest piping size to be joined.

(2) In cases where the largest size to be joined has a nominal outside diameter that is greater than 200 *mm*, 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.

5 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 in **-4.**

6 Any change in the bonding procedure which will affect the physical and mechanical properties of the joint is to be approved by the Society.

1.6.10 Miscellaneous

1 Sufficient consideration is to be given to any wearing down caused by materials such as sand and sludge.

2 In cases where *GRP* pipes are used as drain pipes from scrubbers and blower casings of inert gas systems, the requirements specified in **35.2.2-1(3), Part R of the Rules** are also to be applied.

3 In cases where plastic pipes are to be installed in external areas, such pipes are to either be specifically approved for external use or be protected against ultraviolet radiation.

4 After installation on board, plastic pipes are to be easily distinguishable from pipes made of other materials.

1.7 Tests

1.7.1 Shop Tests

1 Plastic pipes, except for those piping systems specified in **1.3-2**, are to be subjected to the following tests and measurements of dimension after they have been manufactured. The number of test specimens, testing procedures, results, procedures of measurement of dimension and tolerance

are to comply with the internal standards of manufacturers that have been approved by the Society.

(1) Tensile tests

(2) Hydrostatic tests (Hydrostatic pressures are not to be less than 1.5 *times* nominal pressure. Alternatively, for pipes and fittings not employing hand lay-up techniques, the hydrostatic pressure test may be carried out in accordance with the hydrostatic testing requirements stipulated in the recognised national or international standard to which the pipe or fittings are manufactured, provided that there is an effective quality system in place.)

(3) Outside diameter and wall thickness measurements

(4) Ascertainment of uniform quality and the presence of no harmful defects

(5) Electric conductivity test (only for those pipes which require electric conductivity in accordance with **1.5.4** above)

2 For tests and measurements specified in **-1** above, in cases where the manufacture has been assessed in accordance with the **Rules for Approval of Manufacturers and Service Suppliers**, the requirements that items be tested in the presence of the Surveyor may be reduced. In such cases, the Society's Surveyor may require submission of all relevant test results instead.

3 The plastic pipes specified in **1.3-2** are to be subjected to the tests specified in **-1(2)** and **1.5.2** above for every batch of pipes. Those tests are to be conducted in the presence of the Surveyor. In cases where the manufacturer has been assessed in accordance with the **Rules for Approval of Manufacturers and Service Suppliers** or the manufacturer has a quality system that meets *ISO* 9001:2015 standards or their equivalent, the tests are to be conducted by the manufacturer at the frequency specified in the quality system. In such cases, the Society may require submission of all relevant test results instead. The quality system is to consist of elements necessary to ensure that pipes and fittings are produced with consistent and uniform mechanical and physical properties.

4 Plastic pipes which have been connected by adhesive bonding, laminating, welding, etc. are to be subjected to hydrostatic tests after completion of all fabrication processes at pressures of 1.5 *times* design pressure. (See **1.1.4, Part D of the Rules**) These tests may be carried out after installation on board.

5 Notwithstanding the requirements specified in **-1** above, the Society may request hydrostatic tests for all plastic pipes at a hydrostatic pressure not less than 1.5 *times* the nominal pressure taking into consideration the pipe service conditions.

1.7.2 On board Tests and Inspection

After installed on board, in addition to those tests and inspections specified in **2.1.4-1(8), Part B of the Rules**, the following tests and inspections are to be carried out.

(1) Hydrostatic tests at pressures 1.5 *times* design pressure or 0.4 *MPa*, whichever is greater, used for "auxiliary machinery essential for main propulsion", "auxiliary machinery for the manoeuvring and the safety" and "auxiliary machinery for cargo handling" specified in **1.1.6-1, Part D of the Rules** and for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems and exhaust gas cleaning systems (EGCS), etc.

(2) Leakage tests at service conditions, used for other than auxiliary machinery specified in **(1)** above.

(3) Sufficient earthing to hulls for those pipes required to be electrically conductive in accordance with **1.5.4** above.

(4) Safe support of pipes and no harmful defects on their external surface.

“Rules for cargo refrigerating installations” has been partly amended as follows:

Chapter 3 REFRIGERATING MACHINERY

3.1 General

3.1.3 Materials and Welding*

Sub-paragraph -6 has been amended as follows.

6 ~~Refrigerating machinery using specific~~ Special materials such as rubber hoses, plastic tubes~~,~~ (including vinyl pipes), ~~etc., or~~ aluminium alloys, etc. used for refrigerating machinery is to be approved or accepted by the Society~~, considering~~ in consideration of the refrigerant used or service conditions.

“Rules for high speed craft” has been partly amended as follows:

Part 9 MACHINERY INSTALLATIONS

Chapter 7 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

7.1 General

7.1.2 Materials*

Sub-paragraph -5 has been amended as follows.

5 ~~Such s~~Special materials such as rubber hoses, plastic pipes~~,~~ (including vinyl pipes) complying with **Annex 12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships**, aluminium alloys, etc., (notwithstanding **-3** above)~~,~~ may be used in cases where approved by the Society in accordance with requirements specified otherwise after taking into account their safety against fire and flooding as well as their service conditions.

“Rules for the survey and construction of passenger ships” has been partly amended as follows:

Part 5 MACHINERY INSTALLATIONS

Chapter 1 GENERAL

1.1 General

1.1.1 Scope*

Sub-paragraph -4 has been added as follows.

4 In cases where plastic pipes (including vinyl pipes) are used when applying **Chapter 12, Part D of Rules for the Survey and Construction of Steel Ships** in accordance with **-1(3)**, the following **(1)** to **(3)** are to be complied with:

(1) In applying **12.1.6, Part D of Rules for the Survey and Construction of Steel Ships** and **Annex 12.1.6, Part D of Rules for the Survey and Construction of Steel Ships**, the requirements regarding external pressures specified in **1.4.1-2(2) of the Annex** are to be applied to any pipe installation required to remain operational in the case of flooding damage in accordance with **2.5.1, Part 4 of the Rules.**

(2) In applying **12.1.6, Part D of Rules for the Survey and Construction of Steel Ships** and **Annex 12.1.6, Part D of Rules for the Survey and Construction of Steel Ships**, the requirements regarding fire endurance specified in **1.5.1-1 of the Annex** are to be applied to any pipe installation used for Safe Return to Port purposes (*SOLAS* II-2, Reg.21.4). Such installations can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.

(3) In applying **12.1.6, Part D of Rules for the Survey and Construction of Steel Ships** and **Annex 12.1.6, Part D of Rules for the Survey and Construction of Steel Ships**, the following note is added to **Table 1 of the Annex** and is to be considered in the application of the table:

For passenger ships subject to Reg. 21.4 (Safe Return to Port) of *SOLAS* II-2, plastic pipes for services required to remain operative in the part of the ship not affected by the casualty thresholds (such as systems intended to support safe areas) are to be considered essential services. In accordance with MSC Circular *MSC*.1/*Circ*.1369 (interpretation 12), plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard for Safe Return to Port purposes.

“Rules for the survey and construction of inland waterway ships” has been partly amended as follows:

Part 7 MACHINERY INSTALLATIONS

Chapter 10 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

10.1 General

Paragraph 10.1.6 has been amended as follows.

10.1.6 Use of Special Materials*

Notwithstanding the provisions in **10.1.5** above, special materials such as rubber hoses, plastic pipes~~,~~ (including vinyl pipes) complying with **Annex 12.1.6, Part D of the Rules for the Survey and Construction of Steel Ships**, aluminum alloys, etc. may be used~~, after taking into account safety against fire and flooding as well as their service conditions,~~ in cases where approved by the Society in accordance with provisions specified otherwise after taking into account their safety against fire and flooding as well as their service conditions.

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

D12 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

D12.1 General

Paragraph D12.1.6 has been amended as follows.

D12.1.6 Use of Special Materials

1 The wording "requirements specified otherwise" in **12.16, Part D of the Rules** means as follows.

(1) In cases where rubber hoses, Teflon hoses or nylon hoses are used for the following pipes~~;~~ ~~those~~, materials approved ~~under the requirements of the~~ in accordance with ~~"~~**Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**~~"~~ are to be used~~:~~.

(~~1~~a) Pipes of Group I or Group II

(~~2~~b) Pipes likely to cause fire or flooding in cases where they rupture

~~**2**~~(2) ~~In cases where~~ Only plastic pipes (including vinyl pipes) approved by the Society in accordance with **Chapter 6, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** are to be used~~, the requirements specified in the Annex D12.1.6-2 "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF PLASTIC PIPES" are to be complied with~~.

~~**3**~~(3) In cases where aluminum alloy pipes are used; the following requirements are to be complied with:

(~~1~~a) As a rule, aluminum alloy pipes are to be in accordance with the requirements of the code deemed appropriate by the Society, and are to be of seamless drawn pipes or seamless extruded pipes.

(~~2~~b) Aluminum alloy pipes are not to be used for any of the following applications:

(~~a~~i) As a rule, pipes with a design temperature exceeding 150 °C.

(~~b~~ii) Any pipes which penetrates either an "*A*-Class division" or a "*B*-Class division."

(~~c~~iii) Piping in which the use of copper alloy pipes is prohibited by **Table D12.2, Part D of the Rules**.

(~~3~~c) The required thickness of aluminum alloy pipes subject to internal pressure are to be in accordance with the following requirements:

Pipe thickness is to be determined using the formula in **12.2.1-1, Part D of the Rules**. In this case, allowable stress (*f*) is to be the smallest of the following values. However, in cases where the design temperature is not in the creep region of the material, no consideration needs to be given to the value of f_3.

$$f_1 = \frac{R_{20}}{4.0},\ f_2 = \frac{R_t}{1.5},\ f_3 = \frac{S_R}{1.6}$$

where

R_{20} : ~~Rule required~~Specified minimum tensile strength (N/mm^2) of the material at room temperature (less than 50 °C)

R_t : 0.2 % proof stress (N/mm^2) of the material at design temperature

S_R : Mean value of creep breaking stress (N/mm^2) of the material after 100,000 *hours* at design temperature

~~**4**~~**2** (Omitted)

Annex D12.1.6-2 has been deleted.

~~**Annex D12.1.6-2　　GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF PLASTIC PIPES**~~

~~**(Omitted)**~~

Part R FIRE PROTECTION, DETECTION AND EXTINCTION

R35 INERT GAS SYSTEMS

R35.2 Engineering Specifications

R35.2.2 Requirements for All Systems

Sub-paragraph -1 has been amended as follows.

1 In cases where plastic pipes are used for the drainage piping from the scrubbers and blower fan casings specified in **35.2.2-1(3), Part R of the Rules**, the following requirements are to be complied with:

(1) The materials, design requirements, piping arrangements, connections of pipes, tests and inspections are to be as specified in **Annex ~~D~~12.1.6~~-2"GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF PLASTIC PIPES"~~, Part D of the Rules**.

(2) (Omitted)

"Guidance for high speed craft" has been partly amended as follows:

Part 9 MACHINERY INSTALLATIONS

Chapter 7 PIPES, VALVES PIPE FITTINGS AND AUXILIARIES

7.1 General

Paragraph 7.1.2 has been amended as follows.

7.1.2 Materials

~~1~~ The wording "requirements ~~where approved by the Society~~ specified otherwise" in **7.1.2, Part 9 of the Rules** means as follows~~:~~.

(1) In ~~the~~ cases where rubber hoses, ~~t~~Teflon hoses or nylon hoses are used for the following pipes, ~~those~~only materials approved ~~under the requirements of~~ in accordance with the **Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** are to be used~~:~~.

(a) Pipes of Group I or Group II

(b) Pipes likely to cause fire or flooding in case of their fracture

(2) ~~In the case where~~ Only plastics pipes (including vinyl pipes) approved by the Society in accordance with **Chapter 6, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** are to be used~~, the requirements specified in the Annex D12.1.6-2 "Guidance for the Survey and Construction of Plastic Pipes" are to be complied with~~.

(3) When aluminium alloy pipes are used, the following requirements are to be complied with:

(a) (Omitted)

(b) (Omitted)

(c) The required thickness of aluminium alloy pipes subject to an internal pressure is to be determined using the formula in **12.2.1-1, Part D of the Rules for the Survey and Construction of Steel Ships**. In this case, allowable stress (f) is to be of the minimum value of the following values. However, when the design temperature is not in the creep region of the material, no consideration may be required for the value of f_3.

$$f_1 = \frac{R_{20}}{4.0},\ f_2 = \frac{E_t}{1.5},\ f_3 = \frac{S_R}{1.6}$$

where:

R_{20} : Specified minimum tensile strength (N/mm^2) of the material at room temperature (less than 50°C)

E_t : 0.2% proof stress (N/mm^2) of the material at the design temperature

S_R : Mean value of creep breaking stress (N/mm^2) of the material after 100,000 hours at the design temperature

(4) (Omitted)

“Guidance for the survey and construction of passenger ships” has been partly amended as follows:

Part 5 MACHINERY INSTALLATIONS

Chapter 1 GENERAL

1.1 General

1.1.1 Scope

Sub-paragraphs -3 to -5 have been deleted.

~~**3** In applying **12.1.6, Part D of Rules for the Survey and Construction of Steel Ships** and **Annex D12.1.6-2, Part D of Guidance for the Survey and Construction of Steel Ships**, as required by **1.1.1-3(12), Part 5 of the Rules**, the requirements regarding external pressures specified in **1.4.1-2(2) of the Annex** are to be applied to any pipe installation required to remain operational in the case of flooding damage, as per **2.5.1, Part 4 of the Rules**.~~

~~**4** In applying **12.1.6, Part D of Rules for the Survey and Construction of Steel Ships** and **Annex D12.1.6-2, Part D of Guidance for the Survey and Construction of Steel Ships**, as required by **1.1.1-3(12), Part 5 of the Rules**, the requirements regarding fire endurance specified in **1.5.1-1 of the Annex** are to be applied to any pipe installation used for Safe Return to Port purposes (*SOLAS* II-2, Reg.21.4). Such installations can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.~~

~~**5** In applying **12.1.6, Part D of Rules for the Survey and Construction of Steel Ships** and **Annex D12.1.6-2, Part D of Guidance for the Survey and Construction of Steel Ships**, as required by **1.1.1-3(12), Part 5 of the Rules**, the following note is added to **Table 1 of the Annex** and is to be considered in addition to the rest of **Table 1:**~~

~~For Passenger Ships subject to *SOLAS* II-2, Reg.21.4 (Safe Return to Port), plastic pipes for services required to remain operative in the part of the ship not affected by the casualty thresholds, such as systems intended to support safe areas, are to be considered essential services. In accordance with MSC Circular *MSC*.1/*Circ*.1369, interpretation 12, for Safe Return to Port purposes, plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.~~

"Guidance for the survey and construction of inland waterway ships" has been partly amended as follows:

Part 7 MACHINERY INSTALLATIONS

Chapter 10 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES

10.1 General

Paragraph 10.1.6 has been amended as follows.

10.1.6 Use of Special Materials

1 The wording "requirements specified otherwise" in **10.1.6-1, Part 7 of the Rules** means as follows.

(1) In cases where rubber hoses, Teflon hoses or nylon hoses are used for the following pipes~~;~~ ~~those~~, only materials approved ~~under the requirements of~~ in accordance with the ~~"~~**Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**~~"~~ are to be used~~:~~.

(~~1~~a) Pipes of Group I or Group II

(~~2~~b) Pipes likely to cause fire or flooding in cases where they rupture

~~**2**~~(2) ~~In cases where~~ Only plastic pipes (including vinyl pipes) approved by the Society in accordance with **Chapter 6, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** are to be used~~, the requirements specified in **Annex D12.1.6-2 "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF PLASTIC PIPES", Part D of the Guidance for the Survey and Construction of Steel Ships** are to be complied with~~.

~~**3**~~(3) In cases where aluminum alloy pipes are used; the following requirements are to be complied with:

(~~1~~a) As a rule, aluminum alloy pipes are to be in accordance with the requirements of the code deemed appropriate by the Society, and are to be of seamless drawn pipes or seamless extruded pipes.

(~~2~~b) Aluminum alloy pipes are not to be used for any of the following applications:

(~~a~~i) As a rule, pipes with a design temperature exceeding 150 °C.

(~~b~~ii) Any pipes which penetrates either an "*A*-Class division" or a "*B*-Class division."

(~~c~~iii) Piping in which the use of copper alloy pipes is prohibited by **Table 7.10.2, Part 7 of the Rules**.

(~~3~~c) The required thickness of aluminum alloy pipes subject to internal pressure are to be in accordance with the following requirements:

Pipe thickness is to be determined using the formula in **10.2.1-1, Part 7 of the Rules**. In this case, allowable stress (*f*) is to be the smallest of the following values. However, in cases where the design temperature is not in the creep region of the material, no consideration needs to be given to the value of f_3.

$$f_1 = \frac{R_{20}}{4.0},\ f_2 = \frac{E_t}{1.5},\ f_3 = \frac{S_R}{1.6}$$

where

R_{20}: ~~Rule required~~Specified minimum tensile strength (N/mm^2) of the material at room temperature (less than 50 °C)

E_t: 0.2 % proof stress (N/mm^2) of the material at design temperature

S_R: Mean value of creep breaking stress (N/mm^2) of the material after 100,000 *hours* at

design temperature

“Guidance for the approval and type approval of materials and equipment for marine use” has been partly amended as follows:

Part 6 MACHINERY

Chapter 2 TYPE APPROVAL OF USE OF MACHINERY AND EQUIPMENT

2.1 General

Paragraph 2.1.1 has been amended as follows.

2.1.1 Scope

The requirements of this chapter deal with the tests and inspection relating to the approval of the machinery and equipment listed for which approval of the Society is to be obtained in advance before they are used in ships as required by **the Rules for the Survey and Construction of Steel Ships** (hereinafter referred to as “the Rules”).

(1) (Omitted)
(2) (Omitted)
(3) (Omitted)
(4) (Omitted)
(5) (Omitted)
(6) (Omitted)
(7) Pipes of special materials (**12.1.6~~-1~~, Part D of the Rules**)
(8) (Omitted)
(9) (Omitted)
(10) (Omitted)
(11) (Omitted)
(12) (Omitted)
(13) (Omitted)

Chapter 6 APPROVAL OF USE OF PLASTIC PIPES

6.9 Testing Procedures and Criteria

Paragraph 6.9.1 has been amended as follows.

6.9.1 Criteria for Approval Test for Process of Manufacture

The requirements and the criteria for the approval tests are, in principle, referred to **Table 6.6**. For application of the tables, see below:

(1) (Omitted)
(2) (Omitted)
(3) (Omitted)
(4) (Omitted)
(5) The ~~F~~flame spread and surface flammability, fire endurance, durability against chemicals, smoke generation and toxicity tests specified in **Table 6.6** are to be carried out~~,~~ in cases where ~~they are~~ required ~~in~~by the **Annex ~~D~~12.1.6~~-2~~, Part D of the ~~Guidance~~Rules for the Survey and Construction of Steel Ships**.
(6) (Omitted)
(7) (Omitted)

Table 6.6 Requirements and Criteria of Approval Test for Process of Manufacture of Plastic ~~p~~Pipes

Test item	Testing method	Criteria
(Omitted)		
Heat dependence of material	*ISO* 75-2:2013 Method A (*JIS K* 7191 Method A), *ISO* 306 (*JIS K* 7206), *ISO* 2507 *ASTM D*648-18	Minimum heat distortion/deflection temperature ≥ 80 °C Permissible working temperature depending on the working pressure ≤（Minimum heat distortion/deflection temperature -20 °C）
(Omitted)		
Flame spread and surface flammability	*IMO Res. A.*753(18) Appendix 3 (including any amendments due to *IMO Res. MSC*.313(88) and *IMO Res*. *MSC*.399(95))	Comply with the criteria stipulated by *IMO Res. A*.753(18) *Appendix* 3 (including any amendments due to *IMO Res*. *MSC*.313(88) and *IMO Res*. *MSC*.399(95))
	ASTM D 635-18	HB Maximum burning rate < 60 *mm/min*
(Omitted)		