RULES

PUBLICATION 53/P

SHIP PLASTIC PIPING

December
2024

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków complete or extend the Rules and are mandatory where applicable.

GDAŃSK

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INTRODUCTION

This *Publication* has been developed based on the requirements/ recommendation of IACS UR P4/Rev.7, IACS Rec.86/Rev. 2 and guidelines given in IMO Res. A.753(18), as amended by Res. MSC.313(88) and MSC.399(95).

1 SCOPE

1.1 This *Publication* contains requirements for the manufacture, test methods, approval and installation of piping systems used on ships including pipe joints and fittings, made predominately of other material than metal.

1.2 The use of mechanical joints approved for the use in metallic piping systems only are not permitted.

1.3 Piping systems intended for non-essential services are to meet only the requirements of recognized standards and par. 3.1.3, 4.2, 5.2 to 5.7 and chapter 6 of this *Publication*.

2 DEFINITIONS

For the purposes of this *Publication*, the following definitions apply:

.1 ***Plastic(s)*** – means both thermoplastic and thermosetting plastic materials with or without reinforcement, such as polyvinyl chloride (PVC) and fiber reinforced plastics (FRP). Plastic also includes synthetic rubber and materials of similar thermo/ mechanical properties.

.2 ***Pipes/ Piping systems*** – means those made of plastic and include the pipes, fittings, piping system joints, method of joining and any internal or external liners, coverings and coatings required to comply with the performance criteria. For example, if the basic material needs a fire protective coating to comply with the fire endurance requirements then the piping should be manufactured and tested with both the basic material and coating attached and submitted for approval as a material system.

.3 ***Joint*** – means the location at which two pieces of pipe and a fitting are permanently connected together. The joint may be made by adhesive bonding, laminating, welding, flanges and mechanical joints according to Table 6 in IACS UR P2.7.4.

.4 ***Fittings*** – means bends, elbows, fabricated branch pieces etc. of plastic materials.

.5 ***Nominal pressure*** – means the maximum permissible working pressure which should be determined in accordance with the requirements given in 3.1.

.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 pipeline 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 ***Essential to the safety of ship*** – means all piping systems that in event of failure will pose a threat to personnel and the ship*.

.9 ***Essential services*** – are those services essential for propulsion and steering, and safety of the ship as specified in IACS UI SC134.

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* Examples for piping systems essential to the safety are provided by Table 1.

3 GENERAL REQUIREMENTS

The specification of piping is to be in accordance with a recognized national or international standard acceptable to the PRS. In addition, the following requirements apply.

3.1 Strength

3.1.1 The strength of the pipes is to be determined by a hydrostatic test failure pressure of a pipe test specimen under the standard conditions, i.e. atmospheric pressure equal to 100 kPa, relative humidity 30 %, environmental and carried fluid temperature 298 kPa (25°C).

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

3.1.3 The nominal pressure is to be determined from the following conditions:

.1 Internal pressure:

For an internal pressure the following is to be taken whichever is smaller:

$$P_{n\,int} \leq P_{sth}/4 \text{ or } P_{n\,int} \leq P_{lth}/2.5$$

where:

P_{sth} – short-term hydrostatic test pipe failure pressure;
P_{lth} – long-term hydrostatic test pipe failure pressure (> 100, 000 h).

.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; and for any pipe installation required to remain operational in case of flooding damage, as per SOLAS II-1/8-1, or for any pipes that would allow progressive flooding to other compartments through damaged piping or through open ended pipes in the compartments).

For an external pressure:

$$P_{n\,ext} \leq P_{col}/3$$

where:

P_{col} – pipe collapse pressure.

In no case is the pipe collapse pressure to be less than 3 bar.

The maximum working external pressure is a sum of the vacuum inside the pipe and a head of liquid acting on the outside of the pipe.

3.1.4 Notwithstanding the requirements of par. 3.1.3.1 or 3.1.3.2 above as applicable, the pipe or pipe layer minimum wall thickness is to follow recognized standards. In the absence of standards for pipes not subject to external pressure, the requirements of 3.1.3.2 are to be met.

3.1.5 The maximum permissible working pressure is to be specified with due regard for maximum possible working temperature in accordance with pipes Manufacturer's recommendations.

3.2 Axial strength

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

3.2.2 In the case of fiber reinforced plastic piping, the sum of the longitudinal stresses is not to exceed half of the nominal circumferential stress derived from the nominal internal pressure condition (see 3.1).

3.3 Impact resistance

3.3.1 Plastic pipes and joints are to have a minimum resistance to impact not less than specified in recognized national or international standards.

3.3.2 After the test the specimen is to be subjected to hydrostatic pressure equal to 2.5 times the design pressure for at least 1 hour

3.4 Temperature

3.4.1 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°C 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.

3.4.2 The minimum heat distortion/ deflection temperature is to be not less than 80°C.

3.5 Ageing

Before selection of a piping material, the manufacturer shall confirm that the environmental effects including but not limited to ultraviolet rays, saltwater exposure, oil and grease exposure, temperature, and humidity, will not degrade the mechanical and physical properties of the piping material below the values necessary to meet requirements of this *Publication*. The manufacturer should establish material ageing characteristics by subjecting samples of piping to an ageing test acceptable to PRS and then confirming its physical and mechanical properties by the performance criteria in this *Publication*. (Rez. A.753(18), p. 2.1.7.1)

3.6 Fatigue

3.6.1 In cases where design loadings incorporate a significant cyclic or fluctuating component, fatigue should be considered in the material selection process and taken into account in the installation design. (Rez. A.753(18), p. 2.1.8.1)

3.6.2 In addressing material fatigue, the designer may rely on experience with similar materials in similar service or on laboratory evaluation of mechanical test specimens. However, the designer is cautioned that small changes in the material composition may significantly affect fatigue behavior. This may require additional support of the piping systems. (Rez. A.753(18), p. 2.1.8.2)

3.7 Erosion resistance

In the cases where fluid in the system has high flow velocities, abrasive characteristics or where there are flow path discontinuities producing excessive turbulence the possible effect of erosion should be considered. If erosion cannot be avoided then adequate measures should be taken such as increased wall thickness, special liners, change of materials, etc. (Rez. A.753(18), p. 2.1.9.1)

3.8 Fluid absorption

3.8.1 Absorption of fluid by the piping material shall not cause a reduction of mechanical and physical properties of the material below that required by this *Publication*. (Rez. A.753(18), p. 2.1.10.1)

3.8.2 The fluid being carried or in which the pipe is immersed shall not permeate through the wall of the pipe. Testing for fluid absorption characteristics of the pipe material shall be to a recognized standard. (Rez. A.753(18), p. 2.1.10.2)

3.9 Material compatibility

The piping material shall be compatible with the fluid being carried or in which it is immersed such that its design strength does not degenerate below that recognized by these guidelines. Where the reaction between the pipe material and the fluid is unknown, the compatibility shall be demonstrated to the satisfaction of PRS. (Rez. A.753(18), p. 2.1.11.1)

4 REQUIREMENTS FOR PIPES/ PIPING SYSTEMS DEPENDING ON SERVICE AND/ OR LOCATIONS

4.1 Fire endurance

4.1.1 Pipes and their associated fittings whose functions or integrity are essential to the safety of ships are required to meet the minimum fire endurance requirements given in this subchapter. (Rez. A.753(18), p. 2.2.1.1)

4.1.2 The fire endurance of a piping system is the capability to maintain its strength and integrity (i.e. capable of performing its intended function) for some predetermined period of time, while exposed to fire that reflects anticipated conditions.
Three different levels of fire endurance for plastic are given. These levels consider the different severity of consequences resulting from the loss of system integrity for the various applications and locations.

.1 The highest fire endurance standard (level L1) will ensure the integrity of the system during a full scale hydrocarbon fire and is particularly applicable to systems where loss of integrity may cause outflow of flammable liquids or spread of fire through duct piping and worsen the fire situation.

.2 The intermediate fire endurance standard (level L2) intends to ensure the availability of systems essential to the safe operation of the ship, after a fire of short duration, allowing the system to be restored after the fire has been extinguished.

.3 The lowest level (level L3) is considered to provide the fire endurance necessary for a water filled piping system to survive a local fire of short duration. The system' s functions should be capable of being restored, after the fire has been extinguished. (Rez. A.753(18), p. 2.2.1.2)

4.1.3 Depending on the capability of a piping system to maintain its strength and integrity, there exist three different levels of fire endurance for piping systems:

.1 **Level 1 (L1)** – Piping systems essential to the safety of the ship and those systems outside machinery spaces where the loss of integrity may cause outflow of flammable fluid and worsen the fire situation shall be designed to endure a fully developed hydrocarbon fire for a long duration without loss of integrity, under dry conditions.

Piping having passed the fire endurance test specified in Appendix 1 of Res. A.753(18), as amended, for a duration of a minimum of one hour without loss of integrity in the **dry condition** is considered to meet level 1 fire endurance standard (L1).

Level 1W – Piping systems similar to Level 1 systems except these systems do not carry flammable fluid or any gas and a maximum 5% flow loss in the system after exposure is acceptable* (L1W).

* The flow loss must be taken into account when dimensioning the system.

.2 **Level 2 (L2)** – Piping systems essential to the safe operation of the ship shall be designed to endure a fire without loss of the capability to restore the system function after the fire has been extinguished.

Piping having passed the fire endurance test specified in Appendix 1 of Res. A.753(18), as amended, for a duration of a minimum of 30 minutes in the **dry condition** is considered to meet level 2 fire endurance standard (L2).

Level 2W – Piping systems similar to Level 2 systems except a maximum 5% flow loss in the system after exposure is acceptable* (L2W).

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* The flow loss must be taken into account when dimensioning the system.

.3 **Level 3 (L3)** – Piping systems essential to the safe operation of the ship shall be designed to endure a fire without loss of the capability to restore the system function after the fire has been extinguished.

Piping having passed the fire endurance test specified in Appendix 2 of Res. A.753(18) as amended, for a duration of a minimum of 30 minutes in the **wet condition** is considered to meet level 3 fire endurance standard (L3).

4.1.4 Pipes and their associated joints and fittings whose integrity is essential to the safety of ship, including plastic piping required by SOLAS II-2/21.4 to remain operational after a fire casualty, are required to meet the minimum fire endurance requirements of Appendix 1 or 2, as applicable, of Res. A.753(18), as amended.

4.1.5 Unless instructed otherwise by PRS, fire endurance tests are to be carried out with specimen representative for pipes, joints and fittings*, as follows:

.1 Pipes:
- for sizes with outer diameter < 200 mm the minimum outer diameter and wall thickness**;
- for sizes with outer diameter ≥ 200 mm one test specimen for each category of t/d (D = outer diameter, t = structural wall thickness). A scattering of ±10% for t/D is regarded as the same group. Minimum size approved is equal to the diameter of specimen successfully tested.

.2 Joints:
- each type of joint applicable for applied fire endurance level tested on pipe to pipe specimen.

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* *A test specimen incorporating several components of a piping system may be tested in a single test.*

** *Test conditions are most demanding for minimum wall thickness and thus larger wall thickness is covered. A key factor determining the fire performance of a pipe component variant is the thickness-to-diameter (t/D) ratio and whether it is larger or smaller than that of the variant which has been fire-tested.*
If fire-protective coatings or layers are included in the variant used in the fire test, only variants with the same or greater thickness of protection, regardless of the (t/D) ratio, shall be qualified by the fire test.

4.1.6 Means are to be provided to ensure a constant media pressure inside the test specimen during the fire test as specified in Appendix 1 or 2 of the Res. A.753(18), as amended. During the test it is not permitted to replace media drained by fresh water or nitrogen.

4.1.7 Permitted use of piping depending on fire endurance, location and piping system is given in Table 1 -Fire Endurance Requirements Matrix.

4.1.8 Where, according to the matrix, remotely closed valves are required when permitting the use of plastic piping, the remote operation system should be designed such that its function will not be inhibited after being exposed to an equivalent level L1 fire endurance test. Remote operation is defined as an accessible, safe location outside the space in which the valves are installed. In the case of valves on the main deck of a tanker, remote operation should be from outside the cargo block.

4.1.9 Where the matrix stipulates endurance level L2, pipes of endurance Level L1 may also be used. Similarly, where the matrix stipulates endurance Level L3, pipes of endurance level L2 and L1 may be used.

4.1.10 For safe return to port purposes (SOLAS II-2/21.4), plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.

Table 1
Fire Endurance Requirements Matrix

Piping Systems	LOCATION[13)]										
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
CARGO (FLAMMABLE CARGOES f.p. ≤ 60°C)											
1. Cargo lines	NA	NA	L1	NA	NA	0	NA	0[10)]	0	NA	L1[2)]
2. Crude oil washing lines	NA	NA	L1	NA	NA	0	NA	0[10)]	0	NA	L1[2)]
3. Vent lines	NA	NA	NA	NA	NA	0	NA	0[10)]	0	NA	X
INERT GAS											
4. Water seal effluent line	NA	NA	0[1)]	NA	NA	0[1)]	0[1)]	0[1)]	0[1)]	NA	0
5. Scrubber effluent line	0[1)]	0[1)]	NA	NA	NA	NA	NA	0[1)]	0[1)]	NA	0
6. Main line	0	0	L1	NA	NA	NA	NA	NA	0	NA	L1[6)]
7. Distribution lines	NA	NA	L1	NA	NA	0	NA	NA	0	NA	L1[2)]
FLAMMABLE LIQUIDS (f.p. > 60°C)											
8. Cargo lines	X	X	L1	X	X	NA[3)]	0	0[10)]	0	NA	L1
9. Fuel oil	X	X	L1	X	X	NA[3)]	0	0	0	L1	L1
10. Lubricating	X	X	L1	X	X	NA	NA	NA	0	L1	L1
11. Hydraulic oil	X	X	L1	X	X	0	0	0	0	L1	L1
SEAWATER[1)]											
12. Bilge main &branches	L1[7)]	L1[7)]	L1	X	X	NA	0	0	0	NA	L1
13. Fire main &water spray	L1	L1	L1	X	NA	NA	NA	0	0	X	L1
14. Foam system	L1W	L1W	L1W	NA	NA	NA	NA	NA	0	L1W	L1W
15. Sprinkler system	L1W	L1W	L3	X	NA	NA	NA	0	0	L3	L3
16. Ballast	L3	L3	L3	L3	X	0[10)]	0	0	0	L2W	L2W
17. Cooling water, essential services	L3	L3	NA	NA	NA	NA	NA	0	0	NA	L2W
18. Tank cleaning services fixed machines	NA	NA	L3	NA	NA	0	NA	0	0	NA	L3[2)]
19. Non-essential systems	0	0	0	0	0	NA	0	0	0	0	0

Piping Systems	LOCATION[13]										
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
FRESHWATER											
20. Cooling water essential services	L3	L3	NA	NA	NA	NA	0	0	0	L3	L3
21. Condensate return	L3	L3	L3	0	0	NA	NA	NA	0	0	0
22. Non-essential systems	0	0	0	0	0	NA	0	0	0	0	0
SANITARY/ DRAINS/ SCUPPERS											
23. Decks drains (internal)	L1W [4]	L1W [4]	NA	L1W [4]	0	NA	0	0	0	0	0
24. Sanitary drains (internal)	0	0	NA	0	0	NA	0	0	0	0	0
25. Scuppers and discharges (overboard)	0[1) 8)]	0[1) 8)]	0[1) 8)]	0[1); 8)]	0[1); 8)]	0	0	0	0	0[1) 8)]	0
SOUNDING/ AIR											
26. Water tanks/ dry spaces	0	0	0	0	0	0[10)]	0	0	0	0	0
27. Oil tanks (f.p. > 60 °C)	X	X	X	X	X	X[3)]	0	0[10)]	0	X	X
MISCELLANEOUS											
28. Control air	L1[5)]	L1[5)]	L1[5)]	L1[5)]	L1[5)]	NA	0	0	0	L1[5)]	L1[5)]
29. Service air (non-essential)	0	0	0	0	0	NA	0	0	0	0	0
30. Brine	0	0	NA	0	0	NA	NA	NA	0	0	0
31. Auxiliary low pressure steam (≤ 7 bar)	L2W	L2W	0[9)]	0[9)]	0[9)]	0	0	0	0	0[9)]	0[9)]
32. Central vacuum cleaners	NA	NA	NA	0	NA	NA	NA	NA	0	0	0
33. Exhaust gas cleaning system effluent line	L3[1)]	L3[1)]	NA	NA	NA	NA	NA	NA	0	L3 [1), 11)] NA	0
34. Urea transfer/supply system (SCR installations)	L1[12)]	L1[12)]	NA	NA	NA	NA	NA	NA	0	L3[11)] NA	0

Abbreviations:

L1 – Fire endurance test (Appendix 1 of Res. A.753(18), as amended) in dry conditions, 60 min.
L1W – Fire endurance test (par. 4.1.5).
L2 – Fire endurance test (Appendix 1 of Res. A.753(18), as amended) in dry conditions, 30 min.
L2W – Fire endurance test (par. 4.1.5).
L3 – Fire endurance test (Appendix 2 of Res. A.753(18), as amended), in wet conditions, 30 min.
0 – No fire endurance test required.
NA – Not applicable.
X – Metallic materials having a melting point greater than 925°C.

FOOTNOTES:

1) Where non-metallic piping is used, remotely controlled valves to be provided at ship's side (valve is to be controlled from outside space).

2) Remote closing valves to be provided at the cargo tanks.
3) When cargo tanks contain flammable liquids tanks with f.p. > 60°C, "0" may replace "NA" or "X".
4) For drains serving only the space concerned, "0" may replace "L1W".
5) When controlling functions are not required by applicable rules, "0" may replace "L1".
6) For pipe between machinery space and deck water seal, "0" may replace "L1".
7) For passenger vessels, "X" is to replace "L1".
8) Scuppers serving open decks in positions 1 and 2 as defined in Regulation 13 of Protocol of 1988 relating to the International Convention on Load Lines, 1966 should be "X" 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) For essential services, such as fuel oil tank heating and ship's whistle, "X" is to replace "0".
10) For tankers where compliance with paragraph 3.6 of Regulation 19 of MARPOL Annex I is required, "NA" is to replace "0".
11) L3 in service spaces, NA in accommodation and control spaces.
12) Type approval plastic piping without fire endurance test (0) is acceptable downstream of the tank valve, provided this valve is metal seated and arranged as fail-to closed or with quick closing from the safe position outside the space in the event of fire.
13) For passenger ships subject to SOLAS, II-2/21.4 (Safe return to port), plastic pipes for services required to remain operative in the part of the ship not affected by casualty thresholds, such as systems intended to support safe areas, are to be considered essential services. In accordance with 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.

LOCATION DEFINITIONS:

Location	Definition
A – Machinery spaces of category A	Machinery spaces of category A as defined in SOLAS II-2/3.31.
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, stabilizing, ventilation and air-conditioning machinery, and 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 and ro-ro cargo spaces and special category spaces as defined in SOLAS II-2/3.41 and SOLAS II-2/3.46.
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, void spaces, etc.	Cofferdams and void are those empty spaces between two bulkheads separating two adjacent compartments.
J – Accommodation, service	Accommodation spaces, service spaces and control stations as defined in SOLAS II-2/3.1, SOLAS II-2/3.45 and SOLAS II-2/3.18.
K – Open decks	Open deck spaces as defined in SOLAS II-2/9.2.2.3.2(5).

4.2 Flame spread

4.2.1 All pipes, except those fitted on open decks and within tanks, cofferdams, void spaces, pipeline 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 not exceeding average values, listed in Appendix 3 of Res. A.753(18), as amended.

4.2.2 Piping materials giving average values for all of the surface flammability criteria not exceeding the values listed in appendix 3 are considered to meet the requirements for low flame spread in accommodation, service and control spaces. In other areas or where the quantity of pipes is small, PRS may allow equivalent acceptance criteria. (Rez. A.753(18), p. 2.2.2.3)

4.2.3 Surface flame spread characteristics are to be determined using the procedure given in the 2010 FTP Code, Annex 1, Part 5 with regard to the modifications due to the curvilinear pipe surfaces as also listed in Appendix 3 of Res. A.753(18), as amended.

4.2.4 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.

4.3 Smoke generation, containment and toxicity

4.3.1 Criteria for smoke production need only be applied to pipes within the accommodation, service, and control spaces. SOLAS regulation II-2/6 is applicable to exposed interior surfaces which are interpreted as including the surface finish of piping systems. (Rez. A.753(18), p. 2.2.3.1)

4.3.2 Piping materials shall fulfil the requirements of the *2010 FTP Code*, Annex 1, Part 2, on smoke and toxicity test. Procedure modifications are necessary due to the curvilinear pipe surfaces. These procedure modifications are listed in appendix 3 of Rez. A.753(18), as amended. (Rez. A.753(18), p. 2.2.3.2)

4.4 Fire protection coatings

4.4.1 Where a fire protective coating of pipes and fittings is necessary for achieving the fire endurance level required, it is to meet the following requirements:

- **.1** the pipes are generally to be delivered from the manufacturer with the protective coating on;
- **.2** the fire protection properties of the coating are not to be diminished when exposed to sea water, oil or bilge slops. It is to be demonstrated that the coating is resistant to products likely to come into contact with the piping;
- **.3** in considering fire protection coatings, such characteristics as thermal expansion, resistance against vibrations, and elasticity are to be taken into account;
- **.4** the fire protection coatings are to have sufficient resistance to impact to retain their integrity.

4.4.2 Additional special testing such as adhesion, ageing, etc. may be required as part of the approval procedure for protective coatings. (Rez. A.753(18), p. 2.2.5.2)

4.5 Electrical conductivity

4.5.1 Electrostatic charges can be generated on the inside and outside of plastic pipes. The resulting sparks can create punctures through pipe walls leading to leakage of pipe contents, or can ignite surrounding explosive atmospheres. PRS shall consider these hazards when approving

plastic piping systems carrying fluids capable of generating electrostatic charges (static accumulators) inside the pipe, and when approving plastic piping systems in hazardous areas (i.e. areas that could, either in normal or fault conditions, contain an explosive atmosphere), for the possibility of electrostatic charges outside the pipe. (Rez. A.753(18), p. 2.2.4.1)

4.5.2 Where electrical conductivity is to be ensured, the resistance of the pipes and fittings is not to exceed 1 x 10^5 Ohm/m.

5 MATERIAL APPROVAL AND QUALITY CONTROL DURING MANUFACTURE

5.1 Except as required in par 1.3 prototypes of pipes and fitting are to be tested to determine short-term and long-term design strength, fire endurance and low surface flame spread characteristics (if applicable), electrical resistance (for electrically conductive pipes) and impact resistance in accordance with requirements of this *Publication*.

5.2 For prototype testing representative samples of pipe and fittings are to be selected to the satisfaction of PRS.

5.3 The Manufacturer is to have quality system that meets ISO 9001:2015 or equivalent. The quality system is to consistent of elements necessary to ensure that pipes and fittings are produced with consistent and uniform mechanical and physical properties.

5.4 Each pipe and fitting is to be tested by the Manufacturer at a hydrostatic pressure not less than 1.5 times the 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.

5.5 Piping and fittings are to be permanently marked with identification. Identification is to include pressure ratings, the design standards that the pipe or fitting is manufactured in accordance with, and the material of which the pipe or fitting is made.

5.6 In case the Manufacturer does not have an approved quality management system complying with ISO 9001:2015 or equivalent, pipes and fittings are to be tested in accordance with this *Publication* to the satisfaction of PRS surveyors for every batch of pipes.

5.7 Depending upon the intended application PRS may require the pressure testing of each pipe and/or fitting.

6 INSTALLATION

6.1 Supports

6.1.1 Selection and spacing of pipe supports 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, length of the piping, 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 piping system may be subjected. Combination of loads is to be considered.

6.1.2 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 minimize wear of the pipes where they contact the supports.

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

6.2 Expansion

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

.1 the differencies in the coefficients of thermal expansion;

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

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

6.3 External loads

6.3.1 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.

6.3.2 Besides for providing adequate robustness for all piping including open-ended piping a minimum wall thickness, complying with par. 3.1, may be increased taking into account the conditions encountered during service on board ships.

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

6.4 Strength of connections

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

6.4.2 Pipes may be assembled using adhesive-bonding, welding, flanged or other joints.

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

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

6.5 Installation of Conductive Pipes

6.5.1 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.

6.5.2 Regardless of the fluid being conveyed, 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 1×10^6 Ohm. It is preferred that pipes and 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.

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

6.6 Application of fire protection coatings

6.6.1 Fire protection coatings are to be applied on the joints, where necessary for meeting the required fire endurance as for subchapter 4.4, after performing hydrostatic pressure tests of the piping system.

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

6.7 Penetrations of divisions

6.7.1 Where plastic pipes pass through "A" or "B" class division, 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 specified in Part 3 of Annex 1 to 2010 *FTP Code*.

6.7.2 Where plastic pipes pass through watertight bulkheads or decks, the watertight integrity of the bulkhead or deck is to be maintained. For pipes not able to satisfy the requirements in 3.1.3.2, a metallic shut-off valve operable from above the freeboard deck should be fitted at the bulkhead or deck.

6.7.3 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 should be fitted at the bulkhead or deck.

6.8 Control during installation

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

6.8.2 Prior to commencing the work, joining techniques are to be approved by PRS.

6.8.3 The tests and explanations specified in this *Publication* are to be completed before shipboard piping installation commences.

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

6.8.5 The procedure of making bonds is to include:
- **.1** materials used,
- **.2** tools and fixtures,
- **.3** joint preparation requirements,
- **.4** cure temperature,
- **.5** dimensional requirements and tolerances, and
- **.6** test acceptance criteria upon completion of the assembly.

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

6.9 Bonding procedure quality testing

6.9.1 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 test joint.

6.9.2 When the test assembly has been cured, it is to be subjected to a hydraulic test pressure at a safety factor 2.5 times the design pressure of test assembly, for not less than one hour. No leakage or separation of joint is allowed. The test is to be conducted so that the joint is loaded in both longitudinal and circumferential directions.

6.9.3 Selection of the pipes used for test assembly, is to be in accordance with the following:
- **.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;

.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.

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

6.10 Testing after installation on board

6.10.1 Piping systems for essential services are to be subjected to a test pressure not less than 1.5 times the design pressure or 4 bar whichever is greater. Notwithstanding the requirement above, the requirement in par 6.10.2 may be applied to open ended pipes (drains, effluent, etc.).

6.10.2 Piping systems for non-essential services are to be checked for leakage under operational conditions.

6.10.3 For piping required to be electrically conductive, earthing continuity is to be checked, and random resistance testing is to be conducted.

6.11 Type-approval procedure for plastic pipes

6.11.1 Scope

This subchapter contains requirements for the Type Approval of plastic pipes. It is applicable to piping systems, including pipe joints and fittings, made predominately of other material than metal.

6.11.2 Documentation

The following information for plastic pipes, fittings and joints is to be submitted for consideration and approval:

I. General information:
- **.1** pipe and fitting dimensions,
- **.2** maximum internal and external working pressure,
- **.3** working temperature range,
- **.4** intended services and installation locations,
- **.5** the level of fire endurance,
- **.6** electrical conductivity,
- **.7** intended fluids,
- **.8** limits of flow rates,
- **.9** serviceable life,
- **.10** installation instructions,
- **.11** details of marking;

II. Drawings and supporting documentation:
- **.1** certificates and reports for relevant tests previously carried out,
- **.2** details of relevant standards,
- **.3** all relevant design drawings, catalogues, data sheets, calculations and functional descriptions,
- **.4** fully detailed sectional assembly drawings showing pipe, fittings and pipe connections;

III. Materials (as applicable):
- **.1** resin type,
- **.2** catalyst and accelerator types, and concentration employed in the case of reinforced polyester resin pipes, or hardeners where epoxide resins are applied,

.3 a statement of all reinforcements employed; where the reference number does not identify the mass per unit area or the tex number of a roving used in a filament winding process, these are to be detailed,

.4 full information regarding the type of gel-coat or thermoplastic liner employed during construction, as appropriate,

.5 cure/post-cure conditions. The cure and post-cure temperatures and times employed as well as resin/reinforcement ratio,

.6 winding and reinforcement orientation,

.7 joint bonding procedures and qualification tests results, see par. 6.8.5.

6.11.3 Testing

Testing is to demonstrate compliance of the pipes, fittings and joints for which Type Approval is sought with the requirements specified in this *Publication*.

Pipes, joints and fittings are to be tested for compliance with the requirements of standards acceptable to PRS. The list of recommended standards for specific types of tests, based on IACS Rec.86/Rev.2, is given in Tables 2 and 3 below.

Table 2
Typical requirements for all systems

Item	Test	Typical Standard	Notes
1	Internal pressure[1)]	paragraph 3.1.3.1, ASTM D 1599, ASTM D 2992, ISO 15493 or equivalent	Top, middle, bottom (of range). Tests are to be carried out on pipe spools made of different pipe sizes, fittings and pipe connections.
2	External pressure[1)]	paragraph 3.1.3.2, ISO 15493 or equivalent	As above, for straight pipes only.
3	Axial strength	paragraph 3.2	As above.
4	Load deformation	ASTM D 2412 or equivalent	Top, middle, bottom (of each pressure range).
5	Temperature limitations	ISO 75 Method A GRP piping system: HDT test on each type of resin acc. to ISO 75 method A Thermoplastic piping systems: ISO 75 Method A ISO 306 Plastics - Thermoplastic materials - Determination of Vicat softening temperature (VST) VICAT test according to ISO 2507 Polyesters with an HDT below 80°C should not be used.	Each type of resin
6	Impact resistance	ISO 9854, ISO 9653, ISO 15493, ASTM D 2444 or equivalent	Representative sample of each type of construction
7	Ageing	Manufacturer's standard ISO 9142	Each type of construction
8	Fatigue	Manufacturer's standard or service experience	Each type of construction
9	Fluid absorption	ISO 8361	
10	Material compatibility[2)]	ASTM C581, Manufacturer's standard	

Table 3
Typical additional requirements depending on service and/or locations of piping

Item	Test	Typical Standard	Notes
1	Fire endurance[1), 2)]	Res. A.753 (18), as amended, Appendix 1, 2	Representative sample of each type of construction and type of pipe connection
2	Flame spread[1), 2)]	Res. A.753(18), as amended, Appendix 3	Representative sample of each type of construction
3	Smoke generation[2)]	Res. A.753(18), as amended, Appendix 3	Representative sample of each type of construction
4	Toxicity[2)]	Res. A.753(18), as amended, Appendix 3	Representative sample of each type of construction
5	Electrical conductivity[1), 2)]	ASTM F1173-95 or ASTM D 257, NS 6126 para. 11.2 or equivalent	Representative sample of each type of construction

Footnotes:

1) Test to be witnessed by PRS Surveyor.
2) If applicable.

Note: Tests of Table 3 are optional, if not carried out, the range of approved applications for the pipes will be limited accordingly (see Chapter 4 of this *Publication*).

List of IMO reference documents

1. A.753(18): GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS.
   - Appendix 1 – TEST METHOD FOR FIRE ENDURANCE TESTING OF PLASTIC PIPING IN THE DRY CONDITION.
   - Appendix 2 – TEST METHOD FOR FIRE ENDURANCE TESTING OF WATER-FILLED PLASTIC PIPING.
   - Appendix 3 – TEST METHODS AND CRITERIA FOR FLAME SPREAD, SMOKE GENERATION AND TOXICITY OF PLASTIC PIPING.
2. MSC.313(88): AMENDMENTS TO THE GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS (RESOLUTION A.753(18)).
3. MSC.399(95): AMENDMENTS TO THE GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS (RESOLUTION A.753(18)), AS AMENDED BY RESOLUTION MSC.313(88).

List of amendments effective from December 1, 2024

Item	*Title/Subject*	*Source*
Chapter 1, 2, 3, 4, 5 and 6	Content and order/numbering of subchapters/items, have been updated, in accordance with IACS UR 4/Rev.7	PRS
Chapter 1, 2, 3, 4, 5 and 6	Content of subchapters/items have been added and updated, in accordance with Res. A.753(18), as amended	PRS
Table 2 and 3	Tables for application of standards have been updated, in accordance with IACS Rec. 86/Rev.2	PRS
Chapter 7	Content of the chapter has been deleted, in subchapter 4.1 reference is given to Appendixes 1 and 2 of Res. A.753(18), which provide requirements for fire tests of pipes	PRS
Chapter 8	Content of the chapter has been deleted, in subchapter 4.2 reference is given to Appendix 3 of Res. A.753(18), which provides methods and criteria for testing flame spread, smoke generation and toxicity of pipelines	PRS
Chapter 9	Chapter has been removed, Tables 2 and 3 are included in chapter 6	PRS
Last page	List of IMO reference documents has been added	PRS