

EU RO Mutual Recognition Technical Requirements

PLASTIC PIPING SYSTEMS (COMPONENTS)	Version	0.4
	Adoption Date	1 January 2023
	Application Date	1 July 2023
	Tier	2
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1. PRODUCT DESCRIPTION

1.a General description of the product and definitions

- a) Plastic(s) means both thermoplastic and thermosetting plastic materials with or without reinforcement, such as PVC and FRP (fiber reinforced plastics);
- b) Plastic includes synthetic rubber and materials of similar thermomechanical properties;
- c) Plastic piping systems means those made of plastic and include the straight pipes, fittings, joints, and any internal or external liners, coverings and coatings required to comply with the performance criteria;
- d) Joint means joining pipes by adhesive bonding, laminating, welding, etc.;
- e) Fittings include bends, elbows, fabricated branch pieces, etc. made of plastic materials;
- f) Nominal pressure is the maximum permissible working pressure which shall be determined in accordance with 2.a.i.2 below;
- g) Design pressure is 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;
- h) Fire endurance is the capability of the piping system to perform its intended function, i.e. maintain its strength and integrity, for some predicted period of time while exposed to fire.

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1.b Application limitations†

- a) These requirements are applicable to all piping systems consisting of components made of rigid plastic. The certification shall include all components that are intended to be used for assembling the piping systems, i.e. straight lengths of pipes and their fittings (curves, tees, elbows, reductions, etc.). Therefore, the certification of straight pipes alone is not within the scope of these Technical Requirements;
- b) Piping systems made of thermoplastic materials, such as polyethylene (PE), polypropylene (PP), and polybutylene (PB), and intended for non-essential services shall meet the requirements of recognised standards as well as the following paragraphs of these Technical Requirements;
- c) These requirements are not applicable to flexible pipes and hoses and mechanical couplings used in metallic piping systems.

† The EU MR type approved product is generally not used as a stand-alone product, but integrated as component in a sub-system or system. When a product is presented with an EU RO MR Type Approval Certificate for given application, its acceptability with regards to conditions defined in 1b, 1c and 1d of this Technical Requirement will be evaluated by the EU RO in charge of classing the ship or being in charge of the unit/system certification.

1.c Intended use

- a) Plastics may be used for piping systems belonging to class III according to IACS Unified Requirement P2;
- b) The use of plastics for other systems or in other conditions will be given special consideration by the EU RO classifying the ship.

1.d Arrangement and installation

- a) Plastic piping systems shall be installed in accordance with the manufacturer's instructions;
- b) Requirements relevant to the items listed below shall be in compliance with Rules of the EU RO classifying the ship:
 - I. Supports;

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- II. Expansion;
- III. External loads;
- IV. Strength of connections;
- V. Earthing;
- VI. Application of fire protection coatings;
- VII. Penetration of fire divisions and watertight bulkheads or decks;
- VIII. Systems connected to the hull.

Testing activities after installation on board shall be in compliance with Rules of the EU RO classifying the ship.

2. DESIGN EVALUATION

2.a Engineering evaluation requirements

2.a.i. Technical Requirements

The specification of piping shall be in accordance with a recognised national or international standard acceptable to the EU RO. In addition, the following requirements apply.

2.a.i.1 General

- a) The piping shall have sufficient strength to take account of the most severe concomitant conditions of pressure, temperature, the weight of the piping itself and any static and dynamic loads imposed by the design or environment;
- b) The nominal pressure shall be specified with due regard to the maximum possible working temperature in accordance with manufacturer's recommendations;
- c) The strength of fittings and joints shall be not less than that of the pipes.

2.a.i.2 Nominal pressure

Piping systems shall be designed for a nominal pressure determined from the following conditions:

a) Internal pressure

The nominal internal pressure shall not exceed the smaller of:

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Psth/4*

Plth/2,5

where:

Psth: Short-term hydrostatic test failure pressure

Plth: Long-term hydrostatic test failure pressure (>100 000 hours) **.

*) Safety factor 4 is applicable to thermosetting plastic piping system whereas for thermoplastic pipes the safety factor specified in the relevant recognized standard applies.

**) Testing may be carried out over a reduced period of time using suitable standard, such as ASTM D2837 and D1598.

b) External pressure

The nominal external pressure shall not exceed $P_{col}/3$, where:

P_{col} : Collapse pressure

The external pressure is the sum of the vacuum inside the pipe and the static pressure head outside the pipe.

c) The collapse pressure shall not be less than 0.3 MPa. This requirement is applicable to all piping systems regardless of their intended use.

2.a.i.3 Permissible temperature

- In general, plastic pipes shall not be used for media with a temperature above 60°C or below 0°C, unless satisfactory justification is provided to the EU RO;
- The permissible working temperature range depends on the working pressure and shall be in accordance with manufacturer's recommendations;
- The maximum permissible working temperature shall be at least 20°C lower than the minimum heat distortion temperature of the pipe material, determined according to ISO 75 method A or equivalent;

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- d) The minimum heat distortion temperature shall not be less than 80°C. In case of thermoplastic piping system the minimum heat distortion temperature shall be in compliance with the relevant standard;
- e) Where it is proposed to use plastics piping in low temperature services, design strength testing shall be made at a temperature 10°C lower than the minimum working temperature.

2.a.i.4 Axial strength

- a) The sum of the longitudinal stresses due to pressure, weight and other loads shall not exceed the allowable stress in the longitudinal direction.
- b) In the case of fibre reinforced plastic pipes, the sum of the longitudinal stresses shall not exceed half of the nominal circumferential stress derived from the nominal internal pressure condition (see [2.a.i.2]).

2.a.i.5 Impact Resistance

Plastic pipes and joints shall have a minimum resistance to impact in accordance with a recognised national or international standard.

2.a.i.6 Bonding of pipes and fittings

- a) The procedure for making bonds shall be submitted to the EU RO for qualification. It shall include the following:
 - I. materials used;
 - II. tools and fixtures;
 - III. joint preparation requirements;
 - IV. cure temperature;
 - V. dimensional requirements and tolerances;
 - VI. acceptance criteria for the test of the completed assembly;
 - VII. environmental parameters (temperature, humidity, etc.).
- b) When a change in the bonding procedure may affect the physical and mechanical properties of the joints, the procedure shall be re-qualified;

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- c) The person carrying out the bonding shall be qualified. Records shall be available to the EU RO Surveyor for each qualified person demonstrating the bonding procedure and performance qualification, together with dates and results of the qualification testing.

2.a.i.7 Technical Requirements depending on service and/or location

2.a.i.7.a Fire endurance

- a) The requirements for fire endurance of plastic pipes and their associated fittings shall be in compliance with IMO Res. A.753(18) as amended by Res. MSC.313(88) and Res. MSC.399(95), for the various systems and locations where the pipes are used;
- b) The required fire endurance level of the pipe shall be maintained in way of pipe supports, joints and fittings, including those between plastics and metallic pipes.

2.a.i.7.b Flame spread

- a) All exposed plastic piping, 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, shall have low spread characteristics not exceeding average values listed in Appendix 3 to Res A.753(18) as amended by Res. MSC.313(88) and Res. MSC.399(95);
- b) Surface flame characteristics shall be determined using the procedure given in the 2010 FTP Code, Annex 1, Part 5 with the modifications in Appendix 3 to Res A.753(18) as amended by Res. MSC.313(88) and Res. MSC.399(95);
- c) Surface flame spread characteristics may also be determined using the test procedures given in ASTM D635, or other national equivalent standards. When using ASTM D635, maximum burning rate of 60 millimetres per minute applies. In case of adoption of other national equivalent standards, the relevant acceptance criteria shall be defined.

2.a.i.7.c Fire protection coating

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

- a) The pipes are generally to be delivered from the manufacturer with the protective coating on;
- b) The fire protection properties of the coating shall not be diminished when exposed to salt water, oil or bilge slops. It shall be demonstrated that the coating is resistant to products likely to come into contact with the piping;
- c) In considering fire protection coatings, such characteristics as thermal expansion, resistance against vibrations and elasticity shall be taken into account. It is advisable that these characteristics are close to the same characteristics of pipes;
- d) The fire protection coatings shall have sufficient resistance to impact to retain their integrity. It is advisable that these characteristics are close to the same characteristics of pipes;
- e) Random samples shall be tested to determine the adhesion qualities of the coating to the pipe.

2.a.i.7.d Electrical conductivity

- a) Piping systems conveying fluids capable of generating electrostatic charges, such as refined products and distillates, and in any case piping systems conveying fluids with a conductivity of less than 1000 pico-siemens per meter, shall be made of conductive pipes;
- b) Regardless of the fluid to be conveyed, plastic pipes passing through hazardous areas shall be electrically conductive;
- c) Where electrical conductivity shall be ensured, the resistance of the pipes and fittings shall not exceed: 1×10^5 Ohm/m;
- d) It is preferred that pipes and fittings are homogeneously conductive. Where pipes and fittings are not homogeneously conductive, conductive layers shall

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be provided, suitably protected against the possibility of spark damage to the pipe wall;

- e) Satisfactory earthing shall be provided;
- f) Electrical continuity shall be maintained across joints and fittings and the system shall be earthed. The resistance to earth from any point in the piping system shall not exceed 1M Ω m.

2.a.ii. Technical documents to be submitted

IMPORTANT: The English Language shall be used for all submitted documents.

The request for type approval shall be submitted to EU RO by the Manufacturer or by the Applicant, if authorised by the Manufacturer, and shall include:

- a) General information:
 - I. Pipe and fitting dimensions
 - II. Maximum internal and external working pressure
 - III. Permissible temperature range
 - IV. Intended services and installation locations
 - V. The level of fire endurance
 - VI. Electrical conductivity
 - VII. Intended fluids
 - VIII. Limits on flow rates
 - IX. Serviceable life
 - X. Installation instructions
 - XI. Details of marking
 - XII. Bonding procedure (when bonding is foreseen by the Manufacturer as a joining method).
- b) Drawings and supporting documentation:
 - I. Certificates and reports of relevant tests previously carried out
 - II. Details of relevant standards
 - III. All relevant design drawings, catalogues, data sheets, calculations and functional descriptions

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- IV. Fully detailed sectional assembly drawings showing pipe, fittings and pipe connections
 - V. Specification of any internal or external liners, coverings and coatings
- c) Materials
- I. The resin type
 - II. Catalyst and accelerator types, and concentration employed in the case of reinforced polyester resin pipes or hardeners where epoxide resins are employed
 - III. 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 shall be detailed
 - IV. Full information regarding the type of gel-coat or thermoplastic liner employed during construction, as appropriate
 - V. Cure/post-cure conditions. The cure and post-cure temperatures and times
 - VI. Resin/reinforcement ratio employed
 - VII. Winding angle and orientation.
- d) Physical properties:
- I. Strength of pipe against bending and twisting
 - II. Strength of bonded section against abrasions by sand, sludge, etc.
 - III. Types of joints and relevant joining procedures (bonding procedures)
 - IV. Data of bending strength and fatigue strength for standard types of bends and joints, if available.

2.b Type testing requirements

2.b.i. General

- a) Test specimens shall be taken from the production line or from stocks†.

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- b) Tests shall be carried out in the presence of the EU RO Surveyor. In cases where the tests are conducted at Nationally Accredited Laboratories, the presence of the EU RO surveyor may be omitted†.
- c) The type tests shall demonstrate compliance of the pipes, fittings, joints, any internal or external liners, coverings and coatings for which Type Approval is sought with the requirements in paragraph. 2.a. above.: The following tests are to be performed:
- I. Internal pressure test (short-term and long-term hydrostatic test) on pipe spools made of different pipe sizes (on smaller, middle and larger diameter), fittings and connections;
 - II. Collapse test (external pressure strength). External pressure on straights pipes only (on smaller, middle and larger diameter) (**see Note 2**);
 - III. Impact resistance test followed by hydrostatic pressure test (see para. 2.b.ii);
 - IV. Fire endurance test (see **Note 1**);
 - V. Low flame spread test (see **Note 1**);
 - VI. Electrical resistance test (for electrically conductive pipes) (see **Note 1**);
 - VII. Bonding qualification test is required when bonding is foreseen by the Manufacturer for joining pipes and fittings.

Note 1: If not carried out, the range of approved application will be limited.

Note 2: In all cases the collapse pressure shall not be less than 3 bar. This requirement is applicable also when the piping system is not intended for installations subject to an external pressure.

- d) For the above tests, representative samples of pipes and fittings shall be selected to the satisfaction of EU RO;

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- e) Alternatively, hydrostatic test failure pressure and collapse pressure may be determined by a combination of tests and calculations, subject to the agreement with EU RO;
- f) EU RO reserves the right to require additional tests, if considered necessary to ensure the intended reliability;
- g) For bonding qualification tests, see para. 2.b.ii.

† For further clarification of witnessing of tests and sampling the test specimen(s), refer to paragraphs 6, 7 and 8 of the EU RO "Design Evaluation Scheme" procedure (Appendix V of EU RO Framework Document for the Mutual Recognition of Type Approval found on

<http://www.euomr.org/Guidance%20for%20Mutual%20Recognition>)

2.b.ii. Test methods

- a) Pipes, fittings, joints, any internal or external liners, coverings and coatings shall be tested for compliance with the requirements of standards acceptable to EU RO. **Table 1** and paragraph 2.b.ii.1 indicate, in addition to the compulsory test procedures given in para. 2.a above, examples of acceptable standards. In any case, the strength of pipes shall be determined by means of a hydrostatic test on pipe samples subjected to increasing pressure up to failure, the pressure being increased at a rate giving burst after 60-70 seconds. Such test shall be carried out under the standard conditions:
 - atmospheric pressure equal to 100kPa
 - relative humidity 30%
 - environmental and fluid temperature 25°C.
- b) After the impact resistance test, the specimen shall be subjected to hydrostatic pressure equal to 2,5 times the design pressure for at least 1 hour;
- c) Internal pressure test and fire endurance tests shall be carried out on pipe spools applying the appropriate bonding procedures applicable whereas all the other tests may be carried out on straight pipes or material samples as specified in the appropriate test standard.

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Table 1 - Typical additional standards for all systems

	Test	Typical Standards	Notes
1	Internal pressure (1)	ASTM D1599 ASTM D2992 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)	ISO 15493 or equivalent	As above, for straight pipes only.
3	Load deformation	ASTM D2412 or equivalent ASTM D2924	Top, Middle, Bottom (of each pressure range).
4	Temperature limitations	GRP piping systems: HDT test on each type of resin according to ISO 75 method A. Thermoplastic piping systems: ISO 306 (Determination of Vicat Softening Temperature (VST)); ISO 2507 (Determination of VST)	Each type of resin and thermoplastic material, e.g. PP, PVC, PE.
5	Impact resistance (1)	Testing method according to ASTM D2444, ISO 3127:1994, EN 744 or equivalent	Representative sample of each type of construction
6	Aging	Manufacturer's standard; ISO 9142:2003	Each type of construction
7	Fatigue	Manufacturer's standard or service experience	Each type of construction
8	Fluid absorption	ISO 8361:1991	
9	Material compatibility (2)	Manufacturer's standard; ASTM C581	

(1) Test to be witnessed by the EU RO

(2) If applicable

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2.b.ii.1 Typical additional standards depending on service and/or locations of piping

- a) Fire endurance test on representative samples of each type of construction and type of pipe connection;
- b) The requirements for fire endurance of plastic pipes and their associated fittings shall be in compliance with IMO Res. A.753(18) as amended by Res. MSC.313(88) and Res. MSC.399(95).

2.b.ii.2 Flame spread on representative samples of each type of construction.

- a) 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, shall have low spread characteristics not exceeding average values listed in Appendix 3 to Res. A.753(18) as amended by MSC.313(88) and MSC.399(95);
- b) Surface flame spread characteristics shall be determined using the procedure given in the 2010 FTP Code, Annex 1, Part 5 with the modifications in Appendix 3 to Res. A.753(18) as amended by Res. MSC.313(88) and Res. MSC.399(95);
- c) Surface flame spread characteristics may also be determined using the text procedures given in ASTM D635, or other national equivalent standards;
- d) Electrical conductivity on representative samples of each type of construction according to ASTM F1173-95 or ASTM D257, or equivalent;
- e) Smoke generation and toxicity test according to IMO Res. MSC.307(88)(2010 FTP Code), Part 2 item 2.4.1.4 and 2.4.2, according to the test methods and criteria of Appendix 3 of IMO Res. A.753(18) as amended by Res. MSC.313(88) and Res. MSC.399(95).

2.b.ii.3 Bonding qualification test

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- a) A test assembly shall be fabricated in accordance with the procedure to be qualified. It shall consist of at least one pipe-to-pipe joint and one pipe-to-fitting joint;
- b) When the test assembly has been cured, it shall be subjected to a hydrostatic test pressure at a safety factor of 2,5 times the design pressure of the test assembly, for not less than one hour. No leakage or separation of joints is allowed. The test shall be conducted so that the joint is loaded in both longitudinal and circumferential directions;
- c) Selection of the pipes used for the test assembly shall be in accordance with the following:
 - when the largest size to be joined is 200 mm nominal outside diameter or smaller, the test assembly shall be the largest piping size to be joined.
 - when the largest size to be joined is greater than 200 mm nominal outside diameter, the size of the test assembly shall be either 200 mm or 25 % of the largest piping size to be joined, whichever is the greater.
- d) When conducting performance qualification, each bonder and each bonding operator shall make up test assemblies, the size and number of which shall be as required above.

2.c Type testing requirements for certificate renewal

The manufacturer is to notify the RO of any modification or changes to the manufacturing specifications that may affect the MR TA to be renewed.

3. PRODUCTION REQUIREMENTS

- a) Each pipe and fitting shall be tested by the manufacturer at a hydrostatic pressure not less than 1,5 times the nominal pressure;
- b) Alternatively, for pipes and fittings not employing hand layup 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 pipes or fittings are manufactured;
- c) Refer to EU RO "Product Quality Assurance (PQA)" procedure (Appendix VI of EU RO Framework Document for the Mutual Recognition of Type Approval).

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4. MARKING REQUIREMENTS

Manufacturers of the approved equipment are, in principle, to mark the product before shipment for identification of approved equipment as per referenced standard. In addition, and as a minimum, the following items to be marked at the suitable place:

- a) Manufacturer's name or logo;
- b) Type designation;
- c) Size;
- d) Pressure ratings;
- e) The design standards that the pipe or fitting is manufactured in accordance with the material of which the pipe or fitting is made;
- f) Date of fabrication/ serial number.

5. TYPE APPROVAL CERTIFICATE CONTENT

The EU RO MR Type Approval Certificate shall contain the minimum information as defined in the "EU RO Framework Document for the Mutual Recognition of Type Approval" - see Appendix I EU RO MR Type Approval Certificate Information.

6. APPROVAL DATE AND REVISION NUMBER

Date	Revision	Comment
2013-04-30	0.0	Accepted by Advisory Board
2014-01-31	0.1	Added reference to EU RO Framework Document for the Mutual Recognition of Type Approval.
2015-01-31	0.2	CRF018 – Revision to par. 2.a.ii - Test results to be in English; CRF020 – Revision to par. 5 - 'Type Approval Certificate Content'.
1 April 2016	0.3	CRF025 – Updated to new MR TR document format incl. par. 8; CRF026/026a – Witness testing & control of test specimen; CRF028 – addition of 6 month application clause.
	0.4	CRF036 CRF054 – TI005 implemented Paragraph 2.c. included Paragraph 9 included (ref 21030)

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7. BACKGROUND INFORMATION / REFERENCES

- a) IACS UR P2 Rev. 2 - Rules for Piping Design, Construction and Testing;
- b) IACS UR P4 Rev. 4 - Production and Application of Plastic Pipes on Ships;
- c) ASTM C581-15 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service;
- d) ASTM D257-14 - Standard Test Methods for DC Resistance or Conductance of Insulating Materials;
- e) ASTM D635-14 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position;
- f) ASTM D1212-91(2013) - Standard Test Methods for Measurement of Wet Film Thickness of Organic Coatings;
- g) ASTM D1598-15 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure;
- h) ASTM D1599-14 - Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings;
- i) ASTM D2444-99(2010) - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight);
- j) ASTM D2837-13 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products;
- k) ASTM D2924-12 - Standard Test Method for External Pressure Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe;
- l) ASTM D2992-12 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings;
- m) ASTM F1173-01(2012) - Standard Specification for Thermosetting Resin Fiberglass Pipe Systems to Be Used for Marine Applications;
- n) ISO 75-2:2013 - Plastics -- Determination of temperature of deflection under load -- Part 2: Plastics and ebonite;

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- o) ISO 306:2013 - Plastic – Thermoplastic materials – Determination of Vicat softening temperature (VST);
- p) ISO 15493:2003 - Plastics piping systems for industrial applications -- Acrylonitrile-butadiene-styrene (ABS), unplasticized poly (vinyl chloride) (PVC-U) and chlorinated poly (vinyl chloride) (PVC-C) -- Specifications for components and the system -- Metric series;
- q) ISO 2507-1: 1995 - Thermoplastics pipes and fittings -- Vicat softening temperature -- Part 1: General test method;
- r) ISO 8361-1:1991 - Thermoplastics pipes and fittings -- Water absorption -- Part 1: General test method;
- s) ISO 9142:2003 - Adhesives -- Guide to the selection of standard laboratory ageing conditions for testing bonded joints;
- t) ISO 3127:1994 - Thermoplastics pipes -- Determination of resistance to external blows -- Round-the-clock method;
- u) EN 744:1995 - Thermoplastics pipes - Test method for resistance to external blows by the round-the-clock method;
- v) IMO Res. A.753(18) – “Guidelines for the Application of Plastic Pipes on Ships” as amended;
- w) IMO Res. A.653 (16) - Recommendation on Improved Fire Test Procedures for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials;
- x) IMO Res. MSC 307(88) - 2010 FTP Code;
- y) EU RO Framework Document for the Mutual Recognition of Type Approval.

8. MAINTENANCE / CLARIFICATION OF TECHNICAL REQUIREMENTS

Anyone wishing to propose changes to this document or request clarification of technical issues should contact the EU RO MR Group Secretariat in the first instance: Secretariat@euomr.org.

Review and approval of change requests shall follow the EU RO MR Maintenance Process detailed in the EU RO Framework Document for the Mutual Recognition of Type Approval: <http://www.euomr.org/Guidance%20for%20Mutual%20Recognition>.

EU RO Mutual Recognition Technical Requirements

PLASTIC PIPING SYSTEMS (COMPONENTS)	Version	0.4
	Adoption Date	1 January 2023
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	Tier	2
This document is subject to controlled issue and can be found here: http://www.euomr.org/technical-requirements *** Uncontrolled if downloaded or printed ***		

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