

# EU RO Mutual Recognition Technical Requirements

<b>PLASTIC PIPING SYSTEMS (COMPONENTS)</b>	Version	0.3
	Adoption Date	1 April 2016
	Application Date	1 October 2016
	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 thermo/mechanical properties;
- c) Pipes/piping systems means those made of plastic and include the pipes, fittings, joints, and any internal or external liners, coverings and coatings required to comply with the performance criteria. Fittings include bends, elbows, fabricated branch pieces, etc. made of plastic materials;
- 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.1.2 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 with parts made of rigid plastic;
- 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.

## **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.

## **1.d Arrangement and installation**

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

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## 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 for 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:

$$P_{sth}/4^*$$

$$P_{lth}/2,5$$

where:

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

$P_{lth}$ : 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.

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

- b) **External pressure** (to be considered for any installation subject to vacuum conditions inside the pipe or a head of liquid acting on the outside of the pipe).

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 3 bar.

## 2.a.i.3 Permissible temperature

- a) 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;
- b) The permissible working temperature range depends on the working pressure and shall be in accordance with manufacturer's recommendations;
- c) 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;
- 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 degree 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.

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- 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.1.2]).

## 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;
- 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), for the various systems and locations where the pipes are used;

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- 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, shall have low spread characteristics not exceeding average values listed in IMO Resolution A.653(16);
- b) Surface flame characteristics shall be determined using the procedure given in IMO Res. A.653(16) with regard to the modifications due to the curvilinear pipe surfaces as listed in Appendix 3 of Res. A.753(18);
- c) Surface flame spread characteristics may also be determined using the text procedures given in ASTM D635, or other national equivalent standards. When using ASTM D635, maximum burning rate of 60 mm/second 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

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;

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- 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:  $1 \times 10^5$  Ohm/m;
- d) It is preferred that pipes and fittings are homogeneously conductive. Where pipes and fittings are not homogeneously conductive, conductive layers shall 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 1MOhm.

## 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:

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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

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
- 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



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- 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 joint 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†.
- 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 in respect of:
  - I. short-term and long-term design strength collapse (external pressure strength);
  - II. impact resistance; After the test the specimen shall be subjected to hydrostatic pressure equal to 2.5 times the design pressure for at least 1 hour;
  - III. fire endurance (**see Note 1**);
  - IV. low flame spread characteristics (**see Note 1**);
  - V. electrical resistance (for electrically conductive pipes) (**see Note 1**).

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

- d) For the above tests, representative samples of pipes and fittings shall be selected to the satisfaction of EU RO;
- e) In special cases, at EU RO's discretion, the required tests will be considered on a case-by-case basis;
- f) 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;
- g) EU RO reserves the right to require additional tests, if considered necessary to ensure the intended reliability;
- h) 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.euromr.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 EURO. **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%

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– environmental and fluid temperature 25°C.

- a) 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;
- b) 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.

CONTROLLED DOCUMENT

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**Table 1 - Typical additional standards for all systems**

	Test	Typical Standard	Notes
1	Internal pressure (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)	ISO 15493 or equivalent	As above, for straight pipes only.
3	Load deformation	ASTM D 2412 or equivalent ASTM D 2924	Top, Middle, Bottom (of each pressure range)
4	Temperature limitations	GRP piping system: HDT test on each type of resin according to ISO 75 method A Thermoplastic piping systems: ISO 306 (Plastics - Thermoplastic materials - Determination of Vicat softening temperature (VST)). VICAT test according to ISO 2507	Each type of resin and thermoplastic material, e.g. PP, PVC, PE
5	Impact resistance (1)	ISO 9854: 1994, ISO 9653: 1991 ISO 15493 ASTM D 2444, or equivalent	Representative sample of each type of construction
6	Ageing	Manufacturer's standard; ISO 9142:1990	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)	ASTM C581; Manufacturer's standard	

(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).

## 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, shall have low spread characteristics not exceeding average values listed in IMO Resolution A.653(16);
- b) Surface flame characteristics shall be determined using the procedure given in IMO Res. A.653(16) with regard to the modifications due to the curvilinear pipe surfaces as listed in Appendix 3 of Res. A.753(18);
- 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, D 257, NS 6126 para. 11.2 or equivalent;
- e) Smoke generation and toxicity test according to Res. MSC.307(88), IMO FTP Code, Part 2 item 2.6.1.4 and 2.6.2 on one diameter sample.

## 2.b.ii.3 Bonding qualification test

- 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;

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- 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 50 % 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.

## 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).

## 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;

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- 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.

## 7. BACKGROUND INFORMATION / REFERENCES

- a) IACS UR P2
- b) IACS UR P4;
- c) ASTM C581
- d) ASTM D257;
- e) ASTM D635;
- f) ASTM D653;
- g) ASTM D1212;
- h) ASTM D1598;
- i) ASTM D1599;

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- j) ASTM D2444;
- k) ASTM D2837;
- l) ASTM D2924;
- m) ASTM D2992;
- n) ASTM F1173-95;
- o) ASTM NS6126;
- p) ISO 75 method A;
- q) ISO 0306;
- r) ISO 15493;
- s) ISO 2507;
- t) ISO 8361:1991;
- u) ISO 9142:1990;
- v) ISO 9653:1991;
- w) ISO 9854:1994;
- x) IMO Res. A.753(18) as amended by Res. MSC.313(88);
- y) IMO Res. A.653 (16);
- z) IMO FTP Code;
- aa) Res. MSC 307.88;
- bb) 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](mailto: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>.

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