Polski Rejestr Statków

RULES

PUBLICATION NO. 57//P

TYPE APPROVAL OF MECHANICAL JOINTS

2017
January

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

GDAŃSK

Publication No. 57/P – Type Approval of Mechanical Joints – January 2017 was approved by the PRS Board on 16 December 2016 and enters into force on 1 January 2017.

PRS/OP, 12/2016

CONTENTS

1 GENERAL PROVISIONS

1.1 Application

1.1.1 The present *Publication* specifies the type testing condition for type approval of mechanical joints intended for use in marine piping systems.

1.1.2 On the basis of approval procedure satisfactory results, PRS issues *Type Approval Certificate* for mechanical joints.

1.2 Technical documentation

The following documents and information are to be submitted by the manufacturer to the PRS Head Office for approval:

.1 product quality assurance system implemented;
.2 complete description of the product;
.3 typical sectional drawings with all dimensions necessary for evaluation of joint design;
.4 complete specification of materials used for all components of the assembly;
.5 proposed test procedure and corresponding test reports or other previous relevant tests;
.6 initial information:
- maximum design pressures (pressure and vacuum),
- maximum and minimum design temperatures,
- conveyed media,
- intended services,
- maximum axial, lateral and angular deviation, allowed by the manufacturer,
- installation details.

1.3 Materials

1.3.1 The materials used for mechanical joints are to be compatible with the piping material and internal and external media.

1.3.2 The manufacturer is to submit evidence to substantiate that all components are adequately resistant to the working media at design pressure and temperature specified.

1.4 Testing, procedures and requirements

1.4.1 The aim of tests is to demonstrate ability of the pipe joints to operate satisfactory under intended service conditions, specified in the approved technical documentation.

1.4.2 Unless otherwise specified, the water or oil as test fluid is to be used.

1.4.3 Testing requirements for mechanical joints are to be as indicated in Table 1.4.3.

Table 1.4.3
Tests of mechanical joints

Tests		Types of mechanical joints		
		Compression couplings and pipes unions	Slip-on joints	
			Grip type & machine grooved type	Slip type
1	2	3	4	5
1	Tightness test	+	+	+
2	Vibration (fatigue test)	+	+	–
3	Pressure pulsation test[1)]	+	+	–
4	Burst pressure test	+	+	+

1	2	3	4	5
5	Pull-out test	+	+	–
6	Fire endurance test [2]	+	+	+
7	Vacuum test [3]	+[4]	+	+
8	Repeated assembly test	+[5]	+	–

Notes to Table 1.4.3:

[1] For use in those systems where pressure pulsation other than water hammer is expected.

[2] If required, see Table 1.16.4.5.10-1 of *Part VI – Machinery Installations and Refrigerating Plants*.

[3] For suction lines only.

[4] Except joints with "metal-to-metal" tightening surfaces.

[5] Except press type.

1.4.4 Selection of test specimens

Test specimens are to be selected from production line or at random from stock.

Where there is a variety of size of joints requiring approval, a minimum of three separate sizes, representative of the range, from each type of joint to be tested in accordance with Table 1.4.3 are to be selected.

1.4.5 Mechanical joint assembly

Assembly of mechanical joints should consist of components selected in accordance with 1.4.4 and the pipe sizes appropriate to the design of the joints. Where pipe material would effect the performance of mechanical joints, the selection of joints for testing is to take the pipe material into consideration.

Where not specified otherwise, the length of pipes to be connected by means of the joint to be tested is to be at least five times the pipe diameter. Before assembling the joint, conformity of components to the design requirements is to be verified. In all cases the assembly of the joint is to be carried out only according to the manufacturer's instructions. No adjustment operations on the joint assembly, other than those specified by the manufacturer, are permitted during the test.

1.4.6 Test results acceptance criteria

Where a mechanical joint assembly does not pass all or any part of the tests (see Table 1.4.3), two assemblies of the same size and type that failed are to be tested and only those tests which the mechanical joint assembly failed in the first instance, are to be repeated. In the event where one of the assemblies fails the second test, that size and type of assembly are to be considered unacceptable.

The methods and results of each test are to be recorded and reproduced as and when required.

2 METHODS OF TESTS

2.1 Tightness test

In order to ensure correct assembly and tightness of the joints, all mechanical joints are to be subjected to a tightness test.

2.1.1 The mechanical joint assembly test specimen is to be connected to the pipe or tubing in accordance with the requirements of 1.4.5 and the manufacturer's instructions, filled with test fluid and de-aerated.

Mechanical joints assemblies intended for use in rigid connections of pipe lengths are not to be longitudinally restrained.

The pressure inside the joint assembly is to be slowly increased to 1.5 times the design pressure. This test pressure is to be retained for a minimum period of 5 minutes.

In the event of a drop in pressure or visible leakage, the test (including fire test) shall be repeated for two further specimens. If during the repeat test one test piece fails, the coupling is regarded as having failed.

An alternative tightness test, such as a pneumatic test may be accepted and will be subject to special consideration by PRS.

2.1.2 For compression couplings, a static gas pressure test is to be carried out to demonstrate the integrity of the mechanical joints assembly for tightness under the influence of gaseous media. The pressure is to be raised to maximum pressure or 0.7 MPa, whichever is less.

2.1.3 Where the tightness test is carried out using gaseous media (see 2.1.1), then the static pressure test, mentioned in 2.1.2, need not be carried out.

2.2 Vibration test

In order to establish the capability of the mechanical joint assembly to withstand fatigue, which is likely to occur due to vibrations under service conditions, mechanical joint assemblies are to be subject to the following vibration test.

Conclusions of the vibration tests should show no leakage or damage.

2.2.1 Testing of compression couplings and pipe unions

Compression couplings and pipe unions intended for use in rigid pipe connections are to be tested as described below. Rigid connections are joints connecting pipe length without free angular or axial movement.

The test rig and the joint assembly specimen being tested are to be arranged as shown in Fig. 2.2.1. Two lengths of pipe are to be connected by means of the joint to be tested. One end of the pipe is to be rigidly fixed while the other end is to be fitted to the vibration rig. The joint assembly is to be filled with test fluid, de-aerated and pressurised to the design pressure of the joint.

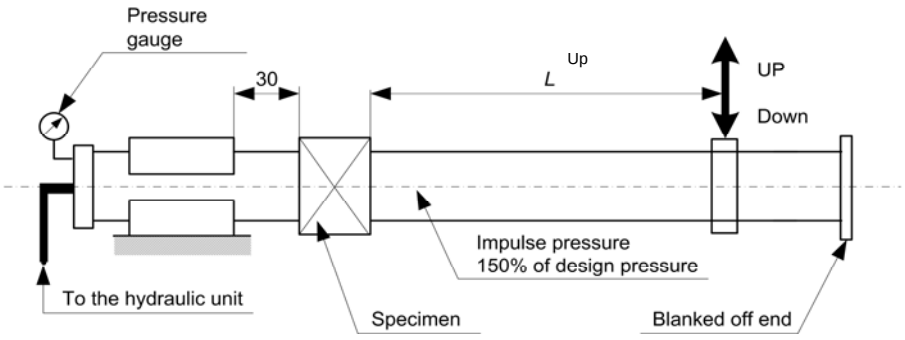

Fig. 2.2.1

Pressure during the test is to be monitored. In the event of a drop in the pressure and visible leakage, the test is to be repeated as described in 1.4.6.

Visual examination of the joint assembly is to be carried out.

Re-tightening may be accepted once during the first 1000 cycles.

Vibration amplitude is to be within 5% of the value calculated from the following formula:

$$A = \frac{2SL^2}{3ED}, \quad [\text{mm}] \qquad (2.2.1)$$

where:

A – single amplitude, [mm];

L – length of the pipe, [mm];

S – allowable bending stress [N/mm^2] based on 0.25 of the yield stress;

E – modulus of elasticity of tube material (for mild steel, E = 210 kN/mm^2);

D – outside diameter of tube, [mm].

Test specimen is to withstand not less than 10^7 cycles with frequency 20÷50 Hz without leakage or damage.

2.2.2 Grip type and machine grooved type joints

Grip type joints and other similar joints containing elastic elements are to be tested in accordance with the following method.

A test rig of cantilever type used for testing fatigue strength of components may be used. The test specimen being tested is to be arranged in the test rig as shown in Fig. 2.2.2.

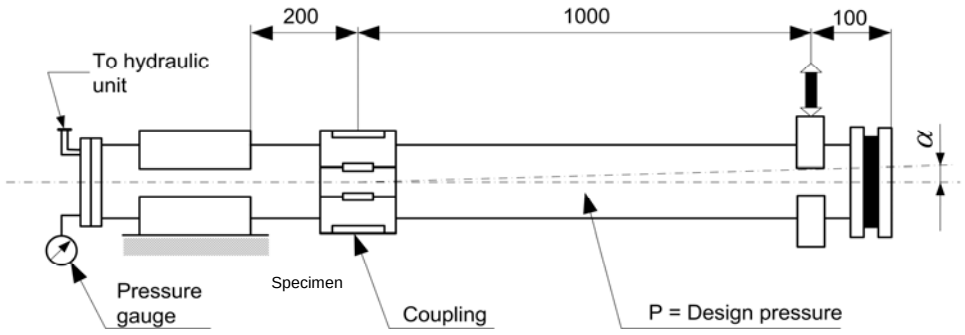

Fig. 2.2.2

Two lengths of pipes are to be connected by means of joint assembly specimen to be tested. One end of the pipe is to be rigidly fixed while the other end is to be fitted to the vibrating element on the rig. The length of pipe connected to the fixed end should be kept as short as possible and in no case should exceed 200 mm.

Mechanical joint assemblies are not to be longitudinally restrained.

The assembly is to be filled with test fluid, de-aerated and pressurized to the design pressure of the joint. Preliminary angle of deflection of pipe axis is to be equal to the maximum angle of deflection, recommended by the manufacturer. The amplitude is to be measured at 1m distance from the centre line of the joint assembly at free pipe end connected to the rotating element of the rig (see Fig. 2.2.2).

Parameters of testing are to be as indicated in Table 2.2.2 and are to be carried out on the same assembly.

Table 2.2.2

Number of cycles	Amplitude, [mm]	Frequency, [Hz]
$3 \cdot 10^6$	± 0.06	100
$3 \cdot 10^6$	± 0.5	45
$3 \cdot 10^6$	± 1.5	10

Pressure during the test is to be monitored. In the event of drop in the pressure and visual signs of leakage, the test is to be repeated as described in 1.4.6. Visual examination of the joint assembly is to be carried out for signs of damage which may eventually cause leakage.

2.3 Pressure pulsation test

In order to determine capability of a mechanical joint assembly to withstand pressure pulsation likely to occur during working conditions, joint assemblies intended for use in rigid connections of pipe lengths are to be tested in accordance with the following method.

The mechanical joint test specimen for carrying out this test may be the same as that used in 2.1.1, provided it passed that test.

The vibration test (see 2.2.1) and the pressure pulsation test are to be carried out simultaneously for compression couplings and pipe unions.

The mechanical joint test specimen is to be connected to a pressure source capable of generating pressure pulses of magnitude as shown in Fig 2.3.1.

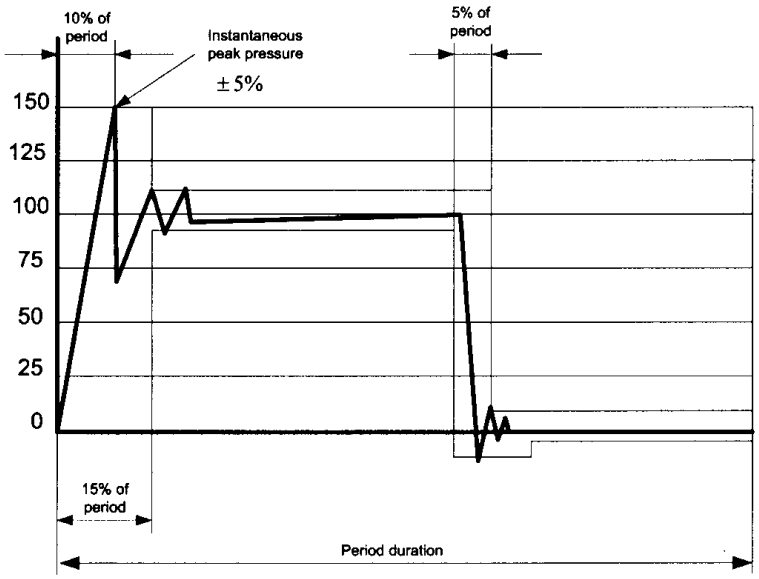

Fig 2.3.1 Impulse pressure diagram

Impulse pressure is to be raised from 0 to 1.5 times the design pressure of the joint with a frequency equal to 30÷100 cycles per minute. The number of cycles is not to be less than 5 x 10^5.

The mechanical joint is to be examined visually for sign of leakage or damage during the test.

2.4 Burst pressure test

In order to determine the capability of a mechanical joint assembly to withstand a pressure of 4 times the design pressure, the following burst test is to be carried out.

Mechanical joint test specimen is to be connected to the pipe or tubing in accordance with the requirements of 1.4.5, filled with test fluid, de-aerated and pressurized to test pressure with an increasing rate of 10% per minute of test pressure.

The mechanical joint assembly intended for use in rigid connections of pipe lengths is not to be longitudinally restrained.

Duration of this test is not to be less than 5 minutes at the maximum pressure.

Where considered convenient, the mechanical joint test specimen used in tightness test in 2.1.1 may be used for the burst test, provided it passed the tightness test.

The specimen may exhibit small deformations whilst under test pressure, but no leakage or visible cracks are permitted.

2.5 Pull-out test

In order to determine the ability of a mechanical joint assembly to withstand the axial loading likely to be encountered in service without causing detachment of the connecting pipe from the joint, the following pull-out test is to be carried out.

Pipes of suitable length are is to be fitted to each end of the mechanical joints assembly test specimen. The test specimen is to be pressurized to design pressure. When pressure is attained, an external axial load L is to be imposed with a value calculated by the following formula:

$$L = \frac{\pi}{4} D^2 p \quad , \quad [\text{N}] \tag{2.5}$$

where:

D – pipe outside diameter, [mm];

p – design pressure, [N/mm^2].

The pressure and axial load are to be maintained for a period of 5 minutes.

During the test, pressure is to be monitored and relative movement between the joint assembly and the pipe measured. There are to be no movements between the mechanical joint assembly and the connecting pipes.

The mechanical joint assembly is to be visually examined for drop in pressure and signs of leakage or damage.

2.6 Fire endurance test

In order to establish capability of the mechanical joints to withstand effects of fire which may be encountered in service, mechanical joist are to be subjected to a fire endurance test. The fire endurance test is to be conducted on the selected test specimens in accordance with the following standards:

ISO 19921 – Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Test methods[1].

ISO 19922 – Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Requirements imposed on the test bench[2].

Alternative test methods and/or test procedures considered to be at least equivalent may be accepted at the discretion of the PRS in cases where the test pieces are too large for the test bench and cannot be completely enclosed by the flames.

Thermal insulation materials applied on couplings are to be non-combustible in dry conditions and when subjected to oil spray. A non-combustibility test according to EN-ISO 1182 is to be carried out.

2.7 Vacuum test

In order to establish the capability of the mechanical joint assembly to withstand internal pressures below atmospheric, similar to the conditions likely to be encountered under service conditions, the following vacuum test is to be carried out.

The mechanical joint assembly is to be connected to a vacuum pump and subjected to a pressure 170 mbar absolute. Once this pressure is stabilized, the specimen under test is to be isolated from the vacuum pump and this pressure is to be maintained for a period of 5 minutes.

Pressure is to be monitored during the test.

No internal pressure rise is permitted.

2.8 Repeated assembly test

The mechanical joint test specimen is to be dismantled and reassembled 10 times, in accordance with the manufacturer's instructions.

After the repeated assembly test, the mechanical joint is to be subjected to a tightness test as defined in 2.1.

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[1] If the fire test is conducted with circulating water at a pressure different from the design pressure of the joint (however by at least 0.5 MPa), the subsequent pressure test is to be carried out to twice the design pressure.

[2] A selection of representative nominal bores may be tested in order to evaluate the fire resistance of a series or mechanical joint of the same design. When a mechanical joint of a given nominal bore (D_n) is so tested, then other mechanical joints falling in the range D_n to 2x D_n (both inclusive) are considered accepted.

List of amendments effective as of 1 January 2017

Item	*Regarding*	*Source*
1.3.1	Materials	UR P2.11 (Rev.4 Mar 2016)
Table 1.4.3	Footnote [2)] changed	
1.4.4	Selection of test specimens	
2.1.1	Tightness test	
2.2	Vibration test	
2.2.1	Compression couplings and pipe unions	
2.4	Burst pressure test	
2.5	Pull-out test	
2.6	Fire endurance test (new text is added)	
2.7	Vacuum test	
2.8	Repeated assembly test	