

# Mechanical Joints for Pipes and Flexible Hose Assemblies

## Amended Rules and Guidance

Rules for the Survey and Construction of Steel Ships Part D

Rules for the Survey and Construction of Inland Waterway Ships

Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

## Reason for Amendment

IACS specifies requirements relating to mechanical joints for pipes as UR P2.7.4 and this UR specifies that usage classifications and fire resistance tests are dependent on pipe applications.

In response to requests from the industry to amend its requirements for mechanical joints, IACS amended requirements for fire resistance tests to specify the intended use of each piping system. This amendment was adopted as IACS P2.7.4(Rev.10) in January 2021. IACS also amended requirements for fire resistance tests of mechanical joints. This amendment was adopted as UR P2.11(Rev.5).

Furthermore, the maximum length of the relevant pipe and the criteria for the nominal size to be used for approval tests of flexible hose assemblies (as specified in IACS UR P2.12) have been clarified in order to ensure they conform with IMO MSC.1/Circ.1321. For the protection of piping systems (as specified in IACS UR P2.13), requirements for mechanical damage, etc. were also amended. These amendments were respectively adopted as P2.12(Rev.3) and P2.13(Rev.1).

Accordingly, relevant requirements are amended in accordance with URs P2.7.4(Rev.10), P2.11(Rev.5), P2.12(Rev.3) and P2.13(Rev.1).

## Outline of Amendment

The main contents of this amendment are as follows.

- (1) Adds columns for “Classification of pipe system” and “Fire endurance test condition” to tables indicating the usage distinction of mechanical joints.
- (2) Clarifies the specific locations of seawater pipes for which protection is required.
- (3) Clarifies the specific maximum length of flexible hose assemblies used for essential services.
- (4) Amends requirements for fire-resistance tests required as part of approval tests of mechanical joints.

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

## **Part D            MACHINERY INSTALLATIONS**

### **Chapter 12 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES**

#### **12.1    General**

##### **12.1.2    Terminology**

Sub-paragraph -4 has been amended as follows.

#### **4    Flexible Hose Assemblies**

Flexible hose assemblies are short length metallic or non-metallic hoses that are normally those flexible hoses with end fittings. Flexible hose assemblies for essential services or containing either flammable or toxic media are not to exceed 1.5 m in length.

Table D12.8 has been amended as follows.

Table D12.8 Application Classifications of Mechanical Joints<sup>(1)</sup>

Application Purpose	System	Kind of Connections <sup>(2)(3)</sup>			Classification of pipe system	Fire endurance test condition <sup>(2)</sup>
		Pipe Union	Compression Coupling	Slip-on Joint <sup>(4)(11)</sup>		
Flammable fluids <sup>(9)(10)</sup> (Flash point ≤ 60 Material °C)	Cargo oil lines <sup>(6)(4)</sup>	+	+	+	<u>dry</u>	<u>30 min dry<sup>(2)</sup></u>
	Crude oil washing lines <sup>(6)(4)</sup>	+	+	+	<u>dry</u>	
	Vent lines <sup>(6)(6)</sup>	+	+	+	<u>dry</u>	
Inert gases	Water seal effluent lines	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Scrubber effluent lines	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Main lines <sup>(4)(6)(5)</sup>	+	+	+	<u>dry</u>	<u>30 min dry<sup>(2)</sup></u>
	Distributions lines <sup>(6)(4)</sup>	+	+	+	<u>dry</u>	<u>30 min dry<sup>(2)</sup></u>
Flammable fluids <sup>(9)(10)</sup> (Flash point > 60 °C)	Cargo oil lines <sup>(6)(4)</sup>	+	+	+	<u>dry</u>	<u>30 min dry<sup>(2)</sup></u>
	Fuel oil lines <sup>(4)(5)(6)</sup>	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Lubricating oil lines <sup>(4)(5)(6)</sup>	+	+	+	<u>wet</u>	
	Hydraulic oil <sup>(4)(5)(6)</sup>	+	+	+	<u>wet</u>	
	Thermal oil <sup>(4)(5)(6)</sup>	+	+	+	<u>wet</u>	
Sea Water	Bilge lines <sup>(6)(7)</sup>	+	+	+	<u>dry/wet</u>	<u>8 min dry + 22 min wet<sup>(2)</sup></u>
	Water filled fire extinguishing systems, e.g. <u>fire main</u> , sprinkler systems <sup>(6)(6)</sup>	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Non water filled fire extinguishing systems, e.g. foam, drencher systems and <u>fire main</u> <sup>(6)(6)</sup>	+	+	+	<u>dry/wet</u>	<u>8 min dry + 22 min wet<sup>(2)</sup></u> (comply with Chapter 26, Part R)
	<del>Fire main<sup>(6)</sup></del>	<del>+</del>	<del>+</del>	<del>+</del>		
	Ballast systems <sup>(6)(7)</sup>	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Cooling water systems <sup>(6)(7)</sup>	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Tank cleaning services	+	+	+	<u>dry</u>	<u>Fire endurance test not required</u>
	Non-essential systems	+	+	+	<u>dry</u> <u>dry/wet</u> <u>wet</u>	<u>Fire endurance test not required</u>
Fresh water	Cooling water systems <sup>(6)(7)</sup>	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Condensate returns <sup>(6)(7)</sup>	+	+	+	<u>wet</u>	<u>30 min wet<sup>(2)</sup></u>
	Non-essential systems	+	+	+	<u>dry</u> <u>dry/wet</u> <u>wet</u>	<u>Fire endurance test not required</u>
Sanitary/ Drains/ Scuppers	Deck drains (internal) <sup>(7)(8)</sup>	+	+	+	<u>dry</u>	<u>Fire endurance test not required</u>
	Sanitary drains	+	+	+	<u>dry</u>	
	Scuppers and discharges (overboard)	+	+	-	<u>dry</u>	
Sounding/Vents	Water tanks/Dry spaces	+	+	+	<u>dry, wet</u>	<u>Fire</u>

	Oil tanks (f.p.> 60 °C) <sup>(4)(5)(6)</sup>	+	+	+	dry	endurance test not required
Miscellaneous	Starting/Control air <sup>(7)</sup>	+	+	-	dry	30 min dry <sup>(2)</sup>
	Service air (non-essential)	+	+	+	dry	Fire endurance test not required
	Brine	+	+	+	wet	
	CO <sub>2</sub> systems <sup>(8)</sup> (outside protected space)	+	+	-	dry	30 min dry <sup>(2)</sup>
	CO <sub>2</sub> systems (inside protected space)	±	±	=	dry	Mechanical joints are to be constructed of materials with melting point above 925°C. (refer to Chapter 25, Part R)
Steam	+	+	± <sup>(9)</sup>	wet	Fire endurance test not required	

Notes:

- (1) +: Application is allowed; -: Application is not allowed
- (2) Fire endurance test in accordance with **9.3.2(6), Part 6 of Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use.**
- ~~(3)~~ If mechanical joints include any components which readily deteriorate in case of fire, the following ~~(34)~~ to ~~(67)~~ apply.
- ~~(3)~~ ~~Inside machinery spaces of category A, fire resistant types approved by the Society.~~
- (4) Fire endurance test is to be applied when mechanical joints are installed in pump rooms and open decks.
- ~~(45)~~ Slip-on joints are not accepted inside machinery spaces of category A or accommodation spaces. May be accepted in machinery spaces other than those of category A provided that the joints are located in easily visible and accessible positions (refer to *MSC/Circ.734*).
- ~~(56)~~ Fire resistant types approved by the Society except in cases where such mechanical joints are installed on open decks as defined in **9.2.3-2(10), Part R of the Rules**; this excludes spaces in the cargo areas of tankers, ships carrying liquefied gases in bulk and ships carrying dangerous chemicals in bulk (as defined in **3.2.6, Part R, 1.1.4(6), Part N** and **1.3.1(4), Part S**), but not used for fuel oil lines, fire extinguishing systems and fire mains.
- ~~(67)~~ ~~In pump rooms and open decks, fire resistant types approved by the Society.~~ Fire endurance test is to be applied when mechanical joints are installed inside machinery spaces of category A
- ~~(78)~~ Only above the freeboard deck.
- ~~(89)~~ Slip type slip-on joints as shown in **Fig. D12.1** may be used for pipes on deck with a design pressure of 1.0 MPa or less.
- ~~(910)~~ Piping where mechanical joints are used is also to comply with the requirements specified in **13.2.4-4**.
- ~~(101)~~ Piping where slip joints are used is also to comply with the requirements specified in **13.2.4-6**.
- (12) If a connection has passed the “30 min dry” test, it is considered suitable also for applications for which the “8 min dry + 22 min wet” and/or “30 min wet” tests are required. If a connection has passed the “8 min dry+22 min wet” test, it is considered suitable also for applications for which the “30 min wet” test is required.

## Chapter 13 PIPING SYSTEMS

### 13.2 Piping

#### 13.2.1 General\*

Sub-paragraph -5(1) has been amended as follows.

##### 5 Protection of piping systems and fittings

- (1) All pipes, including seawater pipes, valves, cocks, pipe fittings, valve operating rods, handles, etc. in cargo holds for dry cargoes (including cargo spaces of container ships and ro-ro ships) are to be protected from ~~mechanical damage in cases where they are located in cargo holds or other spaces where they may be subject to impacts (e.g. fish holds, chain lockers)~~ impact of cargo where they are liable to be damaged. Where a casing is provided for protection, the casing is to be constructed so as to facilitate easy removal for inspection.

#### 13.2.4 Mechanical Joints\*

Sub-paragraph -6 has been amended as follows.

6 The following (1) ~~to~~ and (32) limitations apply to use of slip-on joints, in addition to -2 to -5 above.

- (1) Slip-on joints are not to be used on pipelines in cargo holds, tanks and other spaces which are not easily accessible (refer to *MSC/Circ.734*), ~~unless approved by the Society~~ except that these joints may be permitted in tanks that contain the same media.
- ~~(2) Application of slip-on joints inside tanks may be permitted only for the same media that is in the tanks; this includes those tanks specified in (1) above.~~
- (32) Usage of slip type slip-on joints as the main means of pipe connection is not permitted except in cases where compensation of axial pipe deformation is necessary.

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

## **Part 7 MACHINERY INSTALLATIONS**

### **Chapter 10 PIPES, VALVES, PIPE FITTINGS AND AUXILIARIES**

#### **10.1 General**

##### **10.1.2 Terminology**

Sub-paragraph -4 has been amended as follows.

#### **4 Flexible Hose Assemblies**

Flexible hose assemblies are ~~those~~ short length metallic or non-metallic hoses that are normally flexible hoses with end fittings. Flexible hose assemblies for essential services or containing either flammable or toxic media are not to exceed 1.5 m in length.

Table 7.10.8 has been amended as follows.

Table 7.10.8 Application Classifications of Mechanical Joints<sup>(1)</sup>

Application Purpose	System	Kind of Connections <sup>(2)(3)</sup>			Classification of pipe system	Fire endurance test condition <sup>(11)</sup>
		Pipe Union	Compression Coupling	Slip-on Joint <sup>(9)(10)</sup>		
Flammable fluids <sup>(4)(8)</sup> (Flash point > 60 °C)	Fuel oil lines <sup>(4)(5)</sup>	+	+	+	wet	30 min wet <sup>(2)</sup>
	Lubricating oil lines <sup>(4)(5)</sup>	+	+	+	wet	
	Hydraulic oil <sup>(4)(5)</sup>	+	+	+	wet	
	Thermal oil <sup>(4)(5)</sup>	+	+	+	wet	
River water	Bilge lines <sup>(2)(6)</sup>	+	+	+	dry/wet	8 min dry + 22 min wet <sup>(2)</sup>
	Water filled fire extinguishing systems, e.g. fire main, sprinkler systems <sup>(5)</sup>	+	+	+	wet	30 min wet <sup>(2)</sup>
	Non water filled fire extinguishing systems, e.g. foam, drencher systems and fire main <sup>(5)</sup>	+	+	+	dry/wet	8 min dry + 22 min wet <sup>(2)</sup> (comply with Chapter 26, Part R)
	<del>Fire main<sup>(5)</sup></del>	<del>+</del>	<del>+</del>	<del>+</del>		
	Ballast systems <sup>(2)(6)</sup>	+	+	+	wet	30 min wet <sup>(2)</sup>
	Cooling water systems <sup>(2)(6)</sup>	+	+	+	wet	30 min wet <sup>(2)</sup>
	Tank cleaning services	+	+	+	dry	Fire endurance test not required
Fresh water	Cooling water systems <sup>(2)(6)</sup>	+	+	+	wet	30 min wet <sup>(2)</sup>
	Condensate returns <sup>(2)(6)</sup>	+	+	+	wet	30 min wet <sup>(2)</sup>
	Non-essential systems	+	+	+	dry dry/wet wet	Fire endurance test not required
Sanitary/ Drains/ Scuppers	Deck drains (internal) <sup>(6)(7)</sup>	+	+	+	dry	Fire endurance test not required
	Sanitary drains	+	+	+	dry	
	Scuppers and discharges (overboard)	+	+	-	dry	
Sounding/Vents	Sounding/Vents for water tanks/cofferdam	+	+	+	dry, wet	Fire endurance test not required
	Sounding/Vents for oil tanks (f.p. > 60 °C) <sup>(4)(5)</sup>	+	+	+	dry	
Miscellaneous	Starting/Control air <sup>(2)(6)</sup>	+	+	-	dry	30 min dry <sup>(2)</sup>
	Service air (non-essential)	+	+	+	dry	Fire endurance test not required
	Brine	+	+	+	wet	
	CO <sub>2</sub> systems <sup>(2)</sup> (outside protected space)	+	+	-	dry	30 min dry <sup>(2)</sup>

	<u>CO<sub>2</sub> systems</u> (inside protected space)	±	±	=	dry	<u>Mechanical joints shall be constructed of materials with melting point above 925°C.</u> (refer to Chapter 25, Part R)
	Steam	+	+	<del>±</del> <sup>(9)</sup>	wet	<u>Fire endurance test not required</u>

Notes:

- (1) +: Application is allowed; -: Application is not allowed
- (2) Fire endurance test in accordance with 9.3.2(6), Part 6 of Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use.
- (23) If mechanical joints include any components which readily deteriorate in case of fire, they are to be of a Society approved fire resistant type under consideration of the following (34) to (56):
- ~~(3) Only Society approved fire resistant types may be used inside machinery spaces of category A.~~
- (4) May not be used inside machinery spaces of category A or accommodation spaces. May be used in machinery spaces other than category A ones provided that the joints are located in easily visible and accessible positions.
- (5) Only Society approved fire resistant types may be used except in cases where such mechanical joints are installed on exposed open decks, as defined in Regulation 9.2.3.3.2.2(10), Chapter II-2, SOLAS Convention, except for the cargo areas of tankers, ships carrying liquefied gases in bulk and ships carrying dangerous chemicals in bulk, and are not used for fuel oil lines, fire extinguishing systems and fire main.
- (6) Fire endurance test is to be applied when mechanical joints are installed inside machinery spaces of category A
- (7) May only be used above the free board deck.
- (8) The number of mechanical joints in flammable fluid systems is to be kept to a minimum. In general, flanged joints which conform to recognized standards are to be used.
- (9) Slip type slip-on joints as shown in Fig. 7.10.1 may be used for pipes on deck with a design pressure of 1.0 MPa or less.
- (10) The use of slip joints is to comply with the requirements specified in 11.2.4.
- (11) If a connection has passed the “30 min dry test”, it is considered suitable also for applications for which the “8 min dry + 22 min wet” and/or “30 min wet” tests are required. If a connection has passed the “8 min dry+22 min wet” test, it is considered suitable also for applications for which the “30 min wet” test is required.

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

## Part 6 MACHINERY

### Chapter 2 TYPE APPROVAL OF USE OF MACHINERY AND EQUIPMENT

#### 2.4 Approval Tests

##### 2.4.2 Details of Tests

Sub-paragraph -11 has been amended as follows.

**11** Flexible hose assemblies are to be approved for each size in accordance with the following tests. Hose assemblies with more than 3 different diameters are to be tested at least for the largest diameter, the smallest diameter and an intermediate diameter (intermediate diameters selected within a range of 2 times the smallest diameter to 0.5 times the largest diameter). For fire resistance tests the specimens are to be selected in accordance ISO 15540:2016.

- (1) For metallic flexible hose assemblies, the following tests correspondingly in accordance with *ISO 10380:2012* are to be included.
  - (a) Pressure test
  - (b) Burst test
  - (c) Fatigue test
  - (d) Bend test
  - (e) Leakage test
  - (f) Other tests as deemed necessary by the Society
- (2) For non-metallic flexible hose assemblies, the following tests are to be included.
  - (a) Pressure test and burst test correspondingly in accordance with *ISO 1402* (The minimum burst pressure is to be not less than four times the design pressure.)
  - (b) Hydraulic impulse test (Correspondingly in accordance with *ISO 6802:2018* where with flexing during operation or *ISO 6803:2017* where without flexing during operation)
  - (c) Fire resistance test correspondingly in accordance with *ISO 15540:2016* and *15541:2016* for those hoses used for flammable oil and sea water pipes where failure may result in flooding. However, this does not include hoses installed on exposed open decks and not used for fuel oil lines.
  - (d) Other tests as deemed necessary by the Society

## Chapter 9 APPROVAL OF USE OF MECHANICAL JOINTS

### 9.3 Approval Tests

#### 9.3.1 General

Table 6.9-1 has been amended as follows.

Table 6.9-1 Testing Requirements for Mechanical Joints

Tests		Types of mechanical joints		
		Compression couplings and pipes unions	Slip-on joints	
			Grip type & machine grooved type	Slip type
1	Tightness test	+	+	+
2	Vibration (fatigue) test	+	+	-
3	Pressure pulsation test <sup>(1)</sup>	+	+	-
4	Burst pressure test	+	+	+
5	Pull-out test	+	+	-
6	Fire endurance test <sup>(4)</sup>	+	+	+
7	Vacuum test <sup>(5)</sup>	+ <sup>(3)</sup>	+	+
8	Repeated assembly test	+ <sup>(2)</sup>	+	-

Notes :

+ : Test is required, - : Test is not required

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

(2) Except press type and swage type.

(3) Except joints with metal-to-metal tightening surfaces.

(4) If required approved fire resistant types by 12.3.3-6, Part D of Rules for the Survey and Construction of Steel Ships.

(5) For use in suction lines.

### 9.3.2 Details of Tests

Sub-paragraph (6) has been amended as follows.

- (6) Fire endurance test
- (a) Fire endurance test is to be conducted in accordance with *ISO 19921: 2005*~~(E)~~ and *ISO 19922: 2005*~~(E)~~. After the fire testing, the specimen is to be subjected to a hydrostatic tightness test as defined in (1)(a) above. As an alternative, the fire test may be conducted with circulating water at a pressure of at least 0.5 MPa and a subsequent pressure test to ~~twice~~ 1.5 times the design pressure. Pressure and temperature during the test is to be monitored. ~~A selection of representative nominal bores may be tested in order to evaluate the fire resistance of a series or range of 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  $2 \times D_n$  (both inclusive) are considered accepted.~~
- (c) If the fire test is required in Table D12.8, Part D of Rules for the Survey and Construction of Steel Ships to be “8 min dry + 22 min wet” or “30 min dry”, i.e. conducted for a period of time without circulating of water, the following test conditions apply:
- i) The “8 min dry + 22 min wet” test does not require test piece to be rinsed with the test medium (water) in preparation for the test as required in paragraph 7.2 of ISO19921:2005. After the 8 minutes fire test with the sample dry, the piping system is to be filled with water and test pressure is to be increased up to at least 0.5 MPa within 2 minutes, and then the 22 minutes fire test is to be performed. After the fire testing, specimens are to be subjected to hydrostatic tightness tests as defined in (1)(a) above.
- ii) The “30 min dry” test is a 30minutes fire test performed with the sample dry. After the fire testing, specimens are to be subjected to hydrostatic tightness tests as defined in (1)(a) above.
- ~~(e) Thermal insulation materials applied on couplings are to be non-combustible in dry condition and when subjected to oil spray. A non-combustibility test according to ISO 1182 is to be carried out.~~
- (c) For fire tests in dry condition the pressure inside the test specimen is to be monitored for a rise due to heating of the enclosed air. Means of pressure relief are to be provided where deemed necessary.
- (d) High pressures created during this test can result in failure of the test specimen. Precautions are to be taken to protect personnel and facilities.
- (e) Paragraph 7.5 of ISO 19921:2005 does not apply to the dry tests and no forced air circulation is to be arranged.
- (f) For fire endurance test requiring exposure time greater than 30 minutes test conditions are adjusted to meet the extended required total exposure time. In all cases for dry-wet test the minimum dry test exposure time is 8 minutes.
- (g) A selection of representative nominal bores may be tested in order to evaluate the fire resistance of a series or range of 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  $2 \times D_n$  (both inclusive) are considered accepted.
- ~~(h)~~ Alternative test methods and/or test procedures considered to be at least equivalent to the test required in (a) may be accepted at the discretion of the Society in cases where the test pieces are too large for the test bench and cannot be completely enclosed by the flames.
- (i) Where thermal insulation is acceptable as a means of providing fire resistance, following

requirements apply:

- i) Thermal insulation materials applied on couplings are to be non-combustible according to *ISO 1182:2010* as required by the *FTP* Code defined in Regulation 3, Chapter II-2 of *SOLAS* as amended by *IMO* resolutions up to *MSC.421(98)*.
- ii) Precautions are to be taken to protect the insulation from being impregnated with flammable oils.
- iii) At least the fire endurance and the vibration testing in **Table D12.8, Part D of Rules for the Survey and Construction of Steel Ships** are to be carried out with thermal insulation in place.
- iv) A service restriction is to be stated on the type approval certificate that the mechanical joints are to be fitted with thermal insulation during the installation in cases where the mechanical joints are used where fire resistance is required, unless mechanical joints are delivered already fitted with thermal insulation before installation.