
S14 Testing Procedures of Watertight Compartments

(1996)
(Rev.1
Feb
2001)
(Rev.2
May
2001)
(Rev.3
May
2010)
(Rev.4
Aug
2012)
(Rev.5
Jan
2015)

S14.1 Application

Revision ~~4~~⁵ of this UR is to be complied with in respect of the testing of watertight compartments in accordance with Notes ~~1, and 2~~ 2 and 3.

S14.2 General

Testing procedures of watertight compartments is to be carried out in accordance with ANNEX I, the "PROCEDURES FOR TESTING TANKS AND TIGHT BOUNDARIES".

Notes:

1. Revision 4 of this UR is to be applied by IACS Societies to ships contracted for construction on or after 1 July 2013.
2. Revision 5 of this UR is to be applied by IACS Societies to ships contracted for construction on or after 1 January 2016.
23. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

ANNEX I

PROCEDURES FOR TESTING TANKS AND TIGHT BOUNDARIES

1 GENERAL

These test procedures are to confirm the watertightness of tanks and watertight boundaries, and the structural adequacy of tanks and which consist of the watertight subdivisions of ships. These procedures may also be applied to verify the weathertightness of structures/ and shipboard outfitting. The tightness of all tanks and tight watertight boundaries of: ships during new construction and those relevant to major conversions or major repairs¹ is to be confirmed by these test procedures prior to the delivery of the ship.

- ~~New ships prior to delivery, and~~
- ~~Structures involved in, or affected by, major conversions or repairs¹ is to be confirmed by these test procedures.~~

2 APPLICATION

2.1 All gravity tanks² and other boundaries required to be watertight or weathertight are to be tested in accordance with this Procedure and proven to be tight and structurally adequate as follows:

- 1. Gravity Tanks for their tightness and structural adequacy,
- 2. Watertight Boundaries Other Than Tank Boundaries for their watertightness, and
- 3. Weathertight Boundaries for their weathertightness.

2.2 The testing of ~~the~~ cargo containment systems of liquefied gas carriers is to be in accordance with standards deemed appropriate by the Classification Society.

2.3 ~~The~~ Testing of structures not listed in Table 1 or 2 is to be specially considered.

3 TEST TYPES OF TESTS AND DEFINITION OF TEST DEFINITIONS

3.1 The following two types of tests are specified in this requirement:

Structural ~~I~~test:

A test to verify the structural adequacy of ~~the~~ the tank construction ~~of the tanks.~~ This may be a hydrostatic test or, where the situation warrants, a hydropneumatic test.

Leak ~~I~~test:

A test to verify the tightness of ~~a~~ the boundary. Unless a specific test is indicated, this may be a hydrostatic/hydropneumatic test or an air test. ~~Leak test with remark *3 in Table 1 includes~~ A hose test as may be considered an acceptable medium form of leak test for certain boundaries, as indicated by Footnote 3 of Table 1. ~~of the test.~~

¹ Major repair means a repair affecting structural integrity.

² Gravity tank means a tank that is subject to vapour pressure not greater than 70 kPa.

S14

(cont)

3.2 Definition The definition of each test type of test is as follows:

<i>Hydrostatic Test:</i> (Leak and Structural)	A test by filling the <u>wherein a space is filled</u> with a liquid to a specified head.
<i>Hydropneumatic Test:</i> (Leak and Structural)	A test <u>combining a hydrostatic test and an air test</u> , wherein the a space is partially filled with <u>a liquid and air pressure applied on top of the liquid surface pressurized with air.</u>
<i>Hose Test:</i> (Leak)	A test to verify the tightness of the a joint by a jet of water <u>with the joint visible from the opposite side.</u>
<i>Air Tests:</i> (Leak)	A test to verify the tightness by means of air pressure differential and leak detection <u>indicating solution</u> . It includes tank air tests and joint air tests, such as a <i>compressed air fillet weld tests</i> and <i>vacuum box tests</i> .
<i>Compressed Air Fillet Weld Test:</i> (Leak)	An air test of a fillet welded tee joints <u>wherein with a leak indicating solution is</u> applied on the fillet welds.
<i>Vacuum Box Test:</i> (Leak)	A box over a joint with leak indicating solution applied on the fillet or butt welds. A vacuum is created inside the box to detect any leaks.
<i>Ultrasonic Test:</i> (Leak)	A test to verify the tightness of a <u>the sealing of closing devices such as hatch covers</u> by means of <u>ultrasonic detection techniques.</u> ultrasound.
<i>Penetration Test:</i> (Leak)	A test to verify that no <u>visual dye penetrant indications of potential</u> continuous leakages exist in the boundaries of a compartment by the application means of low surface tension liquids (i.e. <u>dye penetrant test</u>).

4 TEST PROCEDURES

4.1 General

Tests are to be carried out in the presence of ~~the a~~ Surveyor at a stage sufficiently close to the completion of ~~the~~ work with all hatches, doors, windows, etc., installed and all penetrations including pipe connections fitted, and before any ceiling and cement work is applied over the joints. Specific test requirements are given in 4.4 and Table 1. For the timing of the application of coating and the provision of safe access to joints, see 4.5, 4.6 and Table 3.

4.2 Structural test procedures

4.2.1 Type and time of test

Where a structural test is specified in Table 1 or Table 2, a hydrostatic test in accordance with 4.4.1 will be acceptable. Where practical limitations (strength of building berth, light density of liquid, etc.) prevent the performance of a hydrostatic test, a hydropneumatic test in accordance with 4.4.2 may be accepted instead ~~as an equivalent method~~.

~~Provided the results of a leak test are confirmed satisfactory, a~~ A hydrostatic test for or hydropneumatic test for the confirmation of structural adequacy may be carried out while the vessel is afloat, provided the results of a leak test are confirmed to be satisfactory before the vessel is afloat.

S14

(cont)

4.2.2 Testing Schedule for New Construction or Major Structural Conversion *Number of Structural Tests*

- ~~.1 — A structural test is to be carried out for at least one tank of the same construction (i.e. tanks of the same structural design and configuration and same general workmanship as determined by the attending Surveyor) on each vessel provided all subsequent tanks are tested for leaks by an air test.
However, where structural adequacy of a tank was verified by structural testing required in Table 1, the subsequent vessels in the series (i.e. sister ships built in the same shipyard) may be exempted from such testing for other tanks which have the structural similarity to the tested tank, provided that the water tightness in all boundaries of exempted tanks are verified by leak tests and thorough inspection. For sister ships built several years after the last ship of the series, such exemption may be reconsidered. In any case, structural testing is to be carried out for at least one tank for each vessel in order to verify structural fabrication adequacy.~~
- ~~.2 — For watertight boundaries of spaces other than tanks (excluding chain lockers), structural testing may be exempted, provided that the watertightness in all boundaries of exempted spaces are verified by leak tests and thorough inspection.~~
- ~~.3 — These subsequent tanks may require structural testing if found necessary after the structural testing of the first tank.~~
- ~~.4 — Tanks for structural test are to be selected so that all representative structural members are tested for the expected tension and compression.~~

4.2.2.1 The tank boundaries are to be tested from at least one side. The tanks for structural test are to be selected so that all representative structural members are tested for the expected tension and compression.

4.2.2.2 Structural tests are to be carried out for at least one tank of a group of tanks having structural similarity (i.e. same design conditions, alike structural configurations with only minor localised differences determined to be acceptable by the attending Surveyor) on each vessel provided all other tanks are tested for leaks by an air test. The acceptance of leak testing using an air test instead of a structural test does not apply to cargo space boundaries adjacent to other compartments in tankers and combination carriers or to the boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships.

4.2.2.3 Additional tanks may require structural testing if found necessary after the structural testing of the first tank.

4.2.2.4 Where the structural adequacy of the tanks of a vessel were verified by the structural testing required in Table 1, subsequent vessels in the series (i.e. sister ships built from the same plans at the same shipyard) may be exempted from structural testing of tanks, provided that:

1. Water-tightness of boundaries of all tanks is verified by leak tests and thorough inspections are carried out.
2. Structural testing is carried out for at least one tank of each type among all tanks of each sister vessel.
3. Additional tanks may require structural testing if found necessary after the structural testing of the first tank or if deemed necessary by the attending Surveyor.

S14

(cont)

For cargo space boundaries adjacent to other compartments in tankers and combination carriers or boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships, the provisions of paragraph 4.2.2.2 shall apply in lieu of paragraph 4.2.2.4.2.

4.2.2.5 Sister ships built (i.e. keel laid) two years or more after the delivery of the last ship of the series, may be tested in accordance with 4.2.2.4 at the discretion of the Classification Society, provided that:

1. general workmanship has been maintained (i.e. there has been no discontinuity of shipbuilding or significant changes in the construction methodology or technology at the yard, shipyard personnel are appropriately qualified and demonstrate an adequate level of workmanship as determined by the Classification Society) and:
2. an enhanced NDT programme is implemented for the tanks not subject to structural tests.

4.2.2.6 For the watertight boundaries of spaces other than tanks structural testing may be exempted, provided that the water-tightness of boundaries of exempted spaces is verified by leak tests and inspections. Structural testing may not be exempt and the requirements for structural testing of tanks in 4.2.2.1 to 4.2.2.5 shall apply, for ballast holds, chain lockers and a representative cargo hold if intended for in-port ballasting.

4.3 Leak test procedures

For the leak tests specified in Table 1, a tank air tests, compressed air fillet weld tests, vacuum box tests in accordance with 4.4.4 through 4.4.6, or their combination, will be acceptable. A hydrostatic or hydropneumatic tests may also be accepted as the leak tests provided that 4.5, and 4.6 and 4.7 are complied with. A hose tests will also be acceptable for the such locations as specified in Table 1, Footnote 3, in accordance with 4.4.3.

Air tests of joints may be carried out in the block stage provided that all work on the block that may affect the tightness of the a joint is completed before the test. See also 4.5.1 for the application of final coatings and 4.6 for the safe access to the joints and their summary in Table 3.

4.4 Test Methods Details of Tests

4.4.1 Hydrostatic Test

Unless another liquid is approved, the hydrostatic tests are to consist of filling the space by with fresh water or sea water, whichever is appropriate for testing of the space, to the level specified in Table 1 or Table 2.

In cases where a tank for cargoes with higher density cargoes is to be tested with fresh water or sea water, the testing pressure height is to be specially considered.

All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

4.4.2 Hydropneumatic test

A hydropneumatic tests, where approved, are to be such that the test condition, in conjunction with the approved liquid level and supplemental air pressure, will simulate the actual loading as far as practicable. The requirements and recommendations for tank air tests in 4.4.4 will also apply to the hydropneumatic tests.

S14

(cont)

All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

4.4.3 Hose test

A ~~hose test is~~ Hose tests are to be carried out with the pressure in the hose nozzle maintained at least at $2 \cdot 10^5$ Pa during the test. The nozzle is to have a minimum inside diameter of 12 mm and be at a perpendicular distance to from the joint not exceeding 1.5 m. The water jet is to impinge directly upon the weld.

Where a hose test is not practical because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by a careful visual examination of welded connections, supported where necessary by means such as a dye penetrant test or ultrasonic leak test or an the equivalent.

4.4.4 Tank air test

All boundary welds, erection joints and penetrations, including pipe connections, are to be examined in accordance with ~~the~~ approved procedure and under a stabilized pressure differential above atmospheric pressure not less than $0.15 \cdot 10^5$ Pa, with a leak indication indicating solution such as soapy water/detergent or a proprietary brand applied.

~~It is recommended that the air pressure in the tank be raised to and maintained at about $0.20 \cdot 10^5$ Pa for approximately one hour, with a minimum number of personnel around the tank, before being lowered to the test pressure of $0.15 \cdot 10^5$ Pa.~~

A U-tube with a height sufficient to hold a head of water corresponding to the required test pressure is to be arranged. The cross sectional area of the U-tube is not to be less than that of the pipe supplying air to the tank. ~~In addition to~~ Instead of using a U-tube, a master gauge or other approved means to verify the two calibrated pressure is to gauges may be approved acceptable to verify required test pressure.

A double inspection is to be made of tested welds. The first is to be immediately upon applying the leak indication solution; the second is to be after approximately four or five minutes in order to detect those smaller leaks which may take time to appear.

4.4.5 Compressed air fillet weld test

In this air test, compressed air is injected from one end of a fillet welded joint and the pressure verified at the other end of the joint by a pressure gauge ~~on the opposite side~~. Pressure gauges are to be arranged so that an air pressure of at least $0.15 \cdot 10^5$ Pa can be verified at each end of all passages within the portion being tested.

Note: ~~Where a leak test of is required for fabrication involving partial penetration welding is required and the root face is sufficiently large (i.e., 6-8mm), the welds, a compressed air test is also to be applied in the same manner as for a~~ to fillet weld where the root face is large, i.e., 6-8 mm.

4.4.6 Vacuum box test

A box (vacuum testing box tester) with air connections, gauges and an inspection window is placed over the joint with a leak indicator indicating solution applied to the weld cap vicinity. The air within the box is removed by an ejector to create a vacuum of $0.20 \cdot 10^5 - 0.26 \cdot 10^5$ Pa inside the box.

S14

(cont)

4.4.7 Ultrasonic test

An arrangement of an ultrasonic echoes transmitter placed is to be arranged inside of a compartment and a receiver is to be arranged on the outside. The watertight/weathertight boundaries of the compartment are scanned with the receiver in order to detect an ultrasonic leak indication. A location where ~~the~~ sound is detectable by the receiver displays indicates a leakage in the sealing of the compartment.

4.4.8 Penetration test

A test of butt welds ~~by applying a~~ or other weld joints uses the application of a low surface tension liquid to at one side of a compartment boundary. ~~When or structural arrangement.~~ If no liquid is detected on the opposite sides of the boundary boundaries after the expiration of a definite defined period of time, the verification of this indicates tightness of the ~~compartments boundary can~~ boundaries. In certain cases, a developer solution may be ~~assumed~~ painted or sprayed on the other side of the weld to aid leak detection.

4.4.9 Other test

Other methods of testing may be considered by each Classification Society society upon submission of full particulars prior to the commencement of ~~the~~ testing.

4.5 Application of coating**4.5.1 Final coating**

For butt joints welded by an automatic process, the final coating may be applied anytime any time before the completion of ~~the~~ a leak test of ~~the~~ spaces bounded by the joints, provided that the welds have been carefully inspected visually to the satisfaction of the Surveyor.

Surveyors reserve the right to require a leak test prior to the application of final coating over automatic erection butt welds.

For all other joints, the final coating is to be applied after the completion of the leak test of the joint. See also Table 3.

~~The Surveyor reserves the right to require a leak test prior to the application of the final coating over automatic erection butt welds.~~

4.5.2 Temporary coating

Any temporary coating which may conceal defects or leaks is to be applied at a the time as specified for the final coating (see 4.5.1). This requirement does not apply to shop primer.

4.6 Safe access to joints

For leak tests, a safe access to all joints under examination is to be provided. See also Table 3.

4.7 Hydrostatic or hydropneumatic tightness test

In cases where the hydrostatic or hydropneumatic tests are applied instead of a specific leak test, examined boundaries must be dew-free, otherwise small leaks are not visible.

S14

(cont)

Table 1
Test Requirements for Tanks and Boundaries

	Tank or boundary to be tested	Test type	Test head or pressure	Remarks
1	Double bottom tanks ^{*4}	Leak <u>and structural</u> ¹ & <u>Structural</u> ^{*4}	The greater of - top of the overflow, - to 2.4m above top of tank ^{*2} , or - to bulkhead deck	
2	Double bottom voids ^{*5}	Leak	See 4.4.4 through 4.4.6, as applicable	<u>including pump room double bottom and bunker tank protection double hull required by MARPOL Annex I</u>
3	Double side tanks	Leak <u>and structural</u> ¹ & <u>Structural</u> ^{*4}	The greater of - top of the overflow, - to 2.4m above top of tank ^{*2} , or - to bulkhead deck	
4	Double side voids	Leak	See 4.4.4 through 4.4.6, as applicable	
5	Deep tanks other than those listed elsewhere in this table	Leak <u>and structural</u> ¹ & <u>Structural</u> ^{*4}	The greater of - top of the overflow, or - to 2.4m above top of tank ^{*2}	
6	Cargo oil tanks	Leak <u>and structural</u> ¹ & <u>Structural</u> ^{*4}	The greater of - top of the overflow, - to 2.4m above top of tank ^{*2} , or - to top of tank ^{*2} plus setting of any pressure relief valve	
7	Ballast hold of bulk carriers	Leak <u>and structural</u> ¹ & <u>Structural</u> ^{*4}	The greater of - top of the overflow, or - top <u>Top</u> of cargo hatch coaming	
8	Peak tanks	Leak <u>and structural</u> ¹ & <u>Structural</u> ^{*4}	The greater of - top of the overflow, or - to 2.4m above top of tank ^{*2}	After peak to be tested after installation of stern tube
9	<u>a.1 Fore peak voids spaces with equipment</u>	Leak	See 4.4.4 3 through 4.4.6, as applicable	
	<u>.2 Fore peak voids</u>	<u>Leak and structural</u> ^{1,9}	<u>To bulkhead deck</u>	
	<u>.3 Aft peak spaces with equipment</u>	<u>Leak</u>	<u>See 4.4.3 through 4.4.6, as applicable</u>	
	b. <u>.4 Aft peak voids</u>	Leak	See 4.4.4 through 4.4.6, as applicable	After peak to be tested after installation of stern tube
10	Cofferdams	Leak	See 4.4.4 through 4.4.6, as applicable	

S14

(cont)

	Tank or boundary to be tested	Test type	Test head or pressure	Remarks
11	a.1 Watertight bulkheads	Leak ⁸	See 4.4.3 through 4.4.6, as applicable ^{*7}	
	b.2 Superstructure end bulkheads	Leak	See 4.4.3 through 4.4.6, as applicable	
12	Watertight doors below freeboard or bulkhead deck	Leak ^{*6, Z8}	See 4.4.3 through 4.4.6, as applicable	
13	Double plate rudder blades	Leak	See 4.4.4 through 4.4.6, as applicable	
14	Shaft tunnels clear of deep tanks	Leak ^{*3}	See 4.4.3 through 4.4.6, as applicable	
15	Shell doors	Leak ^{*3}	See 4.4.3 through 4.4.6, as applicable	
16	Weather-tight hatch covers and closing appliances	Leak ^{*3, Z8}	See 4.4.3 through 4.4.6, as applicable	Hatch covers closed by tarpaulins and battens excluded
17	Dual purpose tanks/dry cargo hatch covers	Leak ^{*3, Z8}	See 4.4.3 through 4.4.6, as applicable	In addition to structural test in item 6 or 7
18	Chain lockers	Leak and structural ¹ & Structural	Top of chain pipe	
19	Independent tanks L.O. sump. tanks and other similar tanks/spaces under main engines	Leak & Structural ^{*4}	The greater of - top of the overflow, or - to 0.9m above top of tank See 4.4.3 through 4.4.6, as applicable	
20	Ballast ducts	Leak and structural ¹ & Structural ^{*4}	The greater of - ballast pump maximum pressure, or - setting of any pressure relief valve	
21	Fuel Oil Tanks	Leak and structural ¹	The greater of - top of the overflow, - to 2.4m above top of tank ² , or - to top of tank ² plus setting of any pressure relief valves, or - to bulkhead deck	

Notes:

*1 Structural test is to be carried out for at least one tank of the same construction (i.e., same design and same workmanship) on each vessel provided all subsequent tanks are tested for leaks by an air test. However, where structural adequacy of a tank was verified by structural testing, the subsequent vessels in the series (i.e., sister ships built in the same shipyard) may be exempted from such testing for other tanks which have the structural similarity to the tested tank, provided that the water-tightness in all boundaries of exempted tanks are verified by leak tests and thorough inspection is carried out. In any case, structural testing is to be

S14

(cont)

carried out for at least one tank for each vessel in order to verify structural fabrication adequacy. (See 4.2.2(1))

1 “Refer to section 4.2.2”

*2 ~~Top of tank is~~ The top of a tank is the deck forming the top of the tank, excluding any hatchways.

*3 *Hose Test* may also be considered as a medium of the test. See 3.2.

*4 Including tanks arranged in accordance with the provisions of SOLAS regulation II-1/9.4.

*5 Including duct keels and dry compartments arranged in accordance with the provisions of SOLAS regulation II-1/11.2 and II-1/9.4 respectively, and/or oil fuel tank protection and pump room bottom protection arranged in accordance with the provisions of MARPOL Annex I, Chapter 3, Part A regulation 12A and Chapter 4, Part A, regulation 22 respectively.

*6 Where water tightness of a watertight door has not been confirmed by prototype test, testing by filling watertight spaces with water is to be carried out. See SOLAS regulation II-1/16.2 and MSC/Circ.1176.

*7 ~~Where a hose test is not practicable, other testing methods listed in 4.4.7 through 4.4.9 may be applicable subject to adequacy of such testing methods being verified. See SOLAS regulation II-1/11.1.~~

*8 As an alternative to the hose testing, other testing methods listed in 4.4.7 through 4.4.9 may be applicable subject to the adequacy of such testing methods being verified. See SOLAS regulation II-1/11.1. For watertight bulkheads (item 11.1) alternatives to the hose testing may only be used where a hose test is not practicable.

8 A “Leak and structural test”, see 4.2.2 is to be carried out for a representative cargo hold if intended for in-port ballasting. The filling level requirement for testing cargo holds intended for in-port ballasting is to be the maximum loading that will occur in-port as indicated in the loading manual.

9 Structural test may be waived where demonstrated to be impracticable to the satisfaction of the Classification Society.

S14

(cont)

Table 2
Additional Test Requirements for Special Service Ships/Tanks

	Type of Ship/Tank	Structures to be tested	Type of Test	Test Head or Pressure	Remarks
1	Liquefied gas carriers	Cargo containment systems (See remarks) Integral tanks	See 4.4.1 <u>Leak and structural</u>	See 4.4.1 Refer to UR G1	See also Table 1 for other tanks and boundaries
		<u>Hull structure supporting membrane or semi-membrane tanks</u>			
		<u>Independent tanks type A</u>			
		<u>Independent tanks type B</u>			
		<u>Independent tanks type C</u>		Refer to UR G2	
2	Edible liquid tanks	Independent tanks	Leak and <u>structural</u> & <u>Structural</u>	The greater of - top of the overflow, or - to 0.9m above top of tank ^{*1}	
3	Chemical carriers	Integral or independent cargo tanks	Leak and <u>structural</u> & <u>Structural</u>	The greater of - to 2.4m above top of tank ^{*1} , or - to top of tank ^{*1} plus setting of any pressure relief valve	<u>Where a cargo tank is designed for the carriage of cargoes with specific gravities larger than 1.0, an appropriate additional head is to be considered</u>

Note:

*1 Top of tank is deck forming the top of the tank excluding any hatchways.

S14
(cont)

Table 3
Application of Leak Test, Coating and Provision of Safe Access
For Type of Welded Joints

Type of Welded Joints <u>welded joints</u>		Leak Test <u>test</u>	Coating* ¹		Safe Access* ²	
			Before Leak Test <u>leak test</u>	After Leak Test & <u>leak test</u> but before <u>Structural Test structural test</u>	Leak Test <u>test</u>	Structural Test <u>test</u>
Butt	Automatic	Not required	Allowed ³	N/A	Not required	Not required
	Manual or Semi-automatic ⁴	Required	Not allowed	Allowed	Required	Not required
Fillet	Boundary including penetrations	Required	Not allowed	Allowed	Required	Not required

Notes:

*1 Coating refers to internal (tank/hold coating), where applied, and external (shell/deck) painting. It does not refer to shop primer.

*2 Temporary means of access for verification of the leak test.

3 The condition applies provided that the welds have been carefully inspected visually to the satisfaction of the Surveyor.

4 Flux Core Arc Welding (FCAW) semiautomatic butt welds need not be tested provided that careful visual inspections show continuous uniform weld profile shape, free from repairs, and the results of NDE testing show no significant defects.

End of Document
