

IACS Guideline for Procedures of Testing Tanks and Tight Boundaries

1. General

These test procedures are to ensure the weathertightness of structures/shipboard outfitting, the watertightness of tanks and watertight boundaries and structural adequacy of tanks. Tightness of all tanks and tight boundaries of the ships at the new construction and, when major conversions or repairs* have been made, those relevant to the major conversions/repairs should be confirmed by these test procedures prior to delivery of the ship.

* Major repair means a repair affecting structural integrity.

2. Application

2.1 All gravity tanks** and other boundaries required to be watertight or weathertight should be tested in accordance with this Guideline and proven tight and structurally adequate as follows:

- *Gravity Tanks* for their tightness and structural adequacy
- *Watertight Boundaries Other Than Tank Boundaries* for their watertightness, and
- *Weathertight Boundaries* for their weathertightness

** Gravity tank means a tank having a design working pressure not greater than 70 kPa at the top of the tank.

2.2 The testing of cargo containment systems of liquefied gas carriers should be in accordance with standards deemed appropriate by the Administration.

2.3 Testing of structures not listed in Table 1 or 2 should be specially considered.

3. Types of Tests and Definition of Test

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

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

Leak Test: A test to verify the tightness of the boundary. Unless a specific test is indicated, this may be a hydrostatic/hydropneumatic test or air test. *Leak*

test with remark *3 in Table 1 includes hose test as an acceptable medium of the test.

3.2 Definition of each type of test is as follows:

Hydrostatic Test:
(Leak and Structural) A test by filling the space with a liquid to specified head.

Hydropneumatic Test:
(Leak and Structural) A test wherein space is partially filled with liquid and air pressure applied on top of the liquid surface.

Hose Test:
(Leak) A test to verify the tightness of the joint by a jet of water.

Air Tests:
(Leak) A test to verify the tightness by means of air pressure differential and leak detection solution. It includes tank air test and joint air test, such as *compressed air test* and *vacuum box test*.

Compressed Air Fillet Weld Test:
(Leak) An air test of fillet welded tee joint and leak indicating solution applied on the fillet welds.

Vacuum Box Test:
(Leak) A box over a joint with leak indicating solution applied on the fillet or butt welds. Vacuum is created inside the box to detect any leaks.

Ultrasonic Test:
(Leak) A test to verify the tightness of a sealing by means of ultrasonic.

Penetration Test:
(Leak) A test to verify that no continuous leakages exist in the boundaries of a compartment by means of low surface tension liquids.

4. Test Procedures

4.1 General

Tests should be carried out in the presence of the 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 application of coating and 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 as an equivalent method.

Provided the results of a leak test are confirmed satisfactory, a hydrostatic test for confirmation of structural adequacy may be carried out while the vessel is afloat.

4.2.2 Number of Structural Test

- (1) Structural test should be carried out for at least one tank of 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 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 should be carried out. For sister ships built several years after the last ship of the series, such exemption may be reconsidered. In any case, structural testing should be carried out for at least one tank for each vessel in order to assure structural fabrication adequacy.

- (2) For watertight boundaries of spaces other than tanks (excluding chain lockers), structural testing may be exempted, provided that the water-tightness in all boundaries of exempted spaces are verified by leak tests and thorough inspection should be carried out.
- (3) These subsequent tanks may require structural test if found necessary after the structural testing of the first tank.
- (4) Tanks for structural test should be selected so that all representative structural members are tested for the expected tension and compression.

4.3 Leak Test Procedures

For leak test specified in Table 1, tank air test, compressed air fillet weld test, vacuum box test in accordance with 4.4.3 through 4.4.6, or their combination will be acceptable. Hydrostatic or hydropneumatic test may also be accepted as leak test provided 4.5 and 4.6

are complied with. Hose test will also be acceptable for the locations as specified in Table 1 with the foot note *3.

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

4.4 Details of Tests

4.4.1 Hydrostatic Test

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

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

4.4.2 Hydropneumatic Test

Hydropneumatic test where approved should be such that the test condition in conjunction with the approved liquid level and 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 hydropneumatic test.

4.4.3 Hose Test

Hose test should be carried out with the pressure in the hose nozzle maintained at least at $2 \cdot 10^5$ Pa during the test. The nozzle should have a minimum inside diameter of 12 mm and be at a distance to the joint not exceeding 1.5 meters.

Where 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 equivalent.

4.4.4 Tank Air Test

All boundary welds, erection joints and penetrations including pipe connections should be examined in accordance with the approved procedure and under a pressure differential above atmosphere pressure not less than $0.15 \cdot 10^5$ Pa with a leak indication solution 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 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 should be arranged. The cross sectional area of the U-tube should be not less than that of the pipe supplying air to the tank. In addition to U-tube, a master gauge or other approved means to verify the pressure should be approved.

4.4.5 Compressed Air Fillet Weld Test

In this air test, compressed air is injected from one end of fillet welded joint and the pressure verified at the other end of joint by a pressure gauge on the opposite side. Pressure gauges should 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 the leak test is required in way of the fabrication applying the partial penetration weld, compressed air test is also applied in the same manner for fillet weld where the root face is sufficiently large, i.e., 6 – 8 mm.

4.4.6 Vacuum Box Test

A box (vacuum tester) with air connections, gauges and inspection window is placed over the joint with leak indicator applied. 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.

4.4.7 Ultrasonic Test

An arrangement of an ultrasonic echoes sender inside of a compartment and a receiver outside. A location where the sound is detectable by the receiver displays a leakage in the sealing of the compartment.

4.4.8 Penetration Test

A test of butt welds by using of a low surface tension liquid at one side of a compartment boundary. If no liquid were detected on the opposite sides of the boundaries after expiration of a definite time this means the verification of tightness of the compartments boundaries.

4.4.9 Other Test

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

4.5 Application of Coating

4.5.1 Final Coating

For butt joints by automatic process, final coating may be applied anytime before completion of leak test of the space bounded by the joint.

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

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

4.5.2 Temporary Coating

Any temporary coating which may conceal defects or leaks should be applied at a time as specified for final coating. 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 should be provided. See also Table 3.

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 & Structural ^{*1}	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	
3	Double side tanks	Leak & Structural ^{*1}	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 & Structural ^{*1}	The greater of - top of the overflow, or - to 2.4m above top of tank ^{*2}	
6	Cargo oil tanks	Leak & 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 valve	
7	Ballast hold of bulk carriers	Leak & Structural ^{*1}	The greater of - top of the overflow, or - top of cargo hatch coaming	
8	Peak tanks	Leak & Structural ^{*1}	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	a. Fore peak voids	Leak	See 4.4.4 through 4.4.6, as applicable	
	b. Aft peak voids	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 4.6, as applicable	
11	a. Watertight bulkheads	Leak	See 4.4.3 through 4.4.6, as applicable	
	b. Superstructure end bulkhead	Leak	See 4.4.3 through 4.4.6, as applicable	

12	Watertight doors below freeboard or bulkhead deck	Leak ^{*6}	See 4.4.3 through 4.4.6, as applicable	
13	Double plate rudder blade	Leak	See 4.4.4 through 4.4.6, as applicable	
14	Shaft tunnel 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	Weathertight hatch covers and closing appliances	Leak ^{*3}	See 4.4.3 through 4.4.6, as applicable	Hatch covers closed by tarpaulins and battens excluded
17	Dual purpose tank/dry cargo hatch cover	Leak ^{*3}	See 4.4.3 through 4.4.6, as applicable	In addition to structural test in item 6 or 7
18	Chain locker	Leak & Structural	Top of chain pipe	
19	Independent tanks	Leak & Structural ^{*1}	The greater of - top of the overflow, or - to 0.9m above top of tank	
20	Ballast ducts	Leak & Structural ^{*1}	The greater of - ballast pump maximum pressure, or - setting of any pressure relief valve	

Note: ^{*1} Structural test is to be carried out for at least one tank of 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 are to be carried out. In any case, structural testing is to be carried out for at least one tank for each vessel in order to assure structural fabrication adequacy. (See 4.2.2(1))

^{*2} Top of tank is 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-1/9.4

^{*6} Where water tightness of watertight door has not 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.

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 carrier	Cargo containment systems (See remarks)	See 4.4.1	See 4.4.1	See also Table 1 for other tanks and boundaries
2	Edible liquid tanks	Independent tanks	Leak & Structural	The greater of - top of the overflow, or - to 0.9m above top of tank ^{*1}	
3	Chemical carrier	Integral or independent cargo tanks	Leak & Structural	The greater of - to 2.4m above top of tank ^{*1} , or - to top of tank ^{*1} plus setting of any pressure relief valve	

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

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

Type of Welded Joints		Leak Test	Coating ^{*1}		Safe Access ^{*2}	
			Before Leak Test	After Leak Test & before Structural Test	Leak Test	Structural Test
Butt	Automatic	Not required	Allowed	N/A	Not required	Not required
	Manual or Semi-automatic	Required	Not allowed	Allowed	Required	Not required
Fillet	Boundary including penetrations	Required	Not allowed	Allowed	Required	Not required

Note: *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