Polski Rejestr Statków

RULES

PUBLICATION NO. 21/P

TESTING OF THE HULL STRUCTURES

2016
January

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

GDAŃSK

Publication No. 21/P – Testing of the Hull Structures – January 2016, based on the IACS Unified Requirements S14, is an extension of the requirements contained in *Part II – Hull of the Rules for the Classification and Construction of Sea-going Ships*.

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The present Publication replaces the *Publication No. 21/P – Testing of the Hull Structures – 2013*.

PRS/OP, 12/2015

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1 GENERAL

1.1 Application

1.1.1 The requirements of this *Publication* refer to all ships falling into the scope of the *Rules for the classification and construction of sea-going ships, Part II – Hull* and contracted for construction[1] on or after 1 January 2016.

These test procedures are to confirm the watertightness of tanks and watertight boundaries, and the structural adequacy of tanks which consist of the watertight subdivisions of ships. These procedures may also be applied to verify the weathertightness of structures/shipboard outfitting. The tightness of all tanks and watertight boundaries of ships during new construction and those relevant to major conversions or major repairs[2] is to be confirmed by these test procedures prior to the delivery of the ship.

1.1.2 All gravity tanks[3] and boundaries required to be watertight or weathertight are to be tested in accordance with this Publication 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;
– weathertight boundaries for their weathertightness.

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

Testing of structures not listed in Table 2.6-1 or 3.1 is to be specially considered by PRS.

1.2 Definitions

Boundaries – parts of decks/bulkheads/bottom constituting physical limitations to the volume of a given space (tank, compartment, room).

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. A hose test may be considered an acceptable form of leak test for certain boundaries, as indicated by Footnote 3 of Table 2.6-1).

Protective coating – a final coating protecting the structure from corrosion.

Shop primer – a thin coating applied after surface preparation and prior to fabrication as a protection against corrosion during fabrication.

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 (see Table 1.2).

Table 1.2
Specific tests definitions

Hydrostatic Test (Leak and Structural)	A test wherein a space* is filled with a liquid to a specified head.
Hydropneumatic Test (Leak and Structural)	A test combining a hydrostatic test and an air test wherein a space* is partially filled with a liquid and pressurized with air.
Hose Test (Leak)	A test to verify the tightness of a joint by a jet of water with the joint visible from the opposite side.
Air Test (Leak)	A test to verify the tightness by means of air pressure differential and leak detection indicating solution. It includes tank air test and joint air tests, such as compressed air fillet weld tests and vacuum box tests.
Compressed Air Fillet Weld Test (Leak)	An air test of a fillet welded tee joints wherein a leak indicating solution is applied on fillet welds.

[1] 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.

[2] Major repair means a repair affecting structural integrity.

[3] Major repair means a repair affecting structural integrity.

Vacuum Box Test (Leak)	A box over a joint with leak indicating solution applied on welds. A vacuum is created inside the box to detect any leaks.
Ultrasonic Test (Leak)	A test to verify the tightness of the sealing of closing devices such as hatch covers by means of ultrasonic detection techniques.
Penetration Test (Leak)	A test to verify that no visual dye penetrant indications of potential continuous leakages exist in the boundaries of a compartment by means of low surface tension liquids (i.e. dye penetrant test).

* Compartment, tank, etc.

2 TEST

2.1 General

Tests are to 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 2.4 and Table 2.6-1. For the timing of application of coating and the provision of safe access to joints, see 2.5, 2.6 and Table 2.6-2.

2.2 Structural test procedure

2.2.1 Type and time of test

Where a structural test is specified in Table 2.6-1 or Table 3.1, a hydrostatic test in accordance with 2.4.1 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 2.4.2 may be accepted instead.

A hydrostatic test 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.

2.2.2 Testing schedule for new construction or major structural conversion

2.2.2.1 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.

2.2.2.2 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 localized differences determined to be acceptable by the attending PRS 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.

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

2.2.2.4 Where the structural adequacy of the tanks of a vessel were verified by the structural testing required in Table 2.6-1, 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 PRS surveyor.

2.2.2.5 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 2.2.2.2 shall apply in lieu of paragraph 2.2.2.4.2.

2.2.2.6 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 2.2.2.4 at the discretion of PRS, 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 PRS and:

.2 an enhanced NDT programme is implemented for the tanks not subject to structural tests.

2.2.2.7 For watertight boundaries of spaces other than tanks structural testing may be exempted, provided that the watertightness 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 2.2.2.1 to 2.2.2.5 shall apply, for ballast holds, chain lockers and a representative cargo hold if intended for in-port ballasting.

2.3 Leak test procedures

For the leak test specified in Table 2.6-1, a tank air test, compressed air fillet weld tests, vacuum box test in accordance with 2.4.4 to 2.4.6, or their combination will be acceptable. Hydrostatic or hydropneumatic tests may also be accepted as leak tests provided that 2.5, 2.6 and 2.7 are complied with. Hose tests will also be acceptable for such locations as specified in Table 2.6-1, Footnote 3, in accordance with 2.4.3.

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 a joint is completed before the test. See also 2.5.1 for the application of final coatings and 2.6 for the safe access to joints and the summary in Table 2.6-2.

2.4 Test methods

2.4.1 Hydrostatic test

Unless another liquid is approved by PRS, hydrostatic tests are to consist of filling the space with fresh water or sea water, whichever is appropriate for testing, to the level specified in Table 2.6-1 or Table 3.1.

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

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

2.4.2 Hydropneumatic test

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 2.4.4 will also apply to hydropneumatic tests.

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

2.4.3 Hose test

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 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 the equivalent.

2.4.4 Tank air test

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

A U-tube with a height sufficient to hold a head of water corresponding to the required test pressure is to be arranged to avoid overpressure of the compartment tested and verify the test pressure. The cross sectional area of the U-tube is not to be less than that of the pipe supplying air to the tank. Instead of using a U-tube, two calibrated pressure gauges may be 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.

2.4.5 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.

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 is required for fabrication involving partial penetration welds, a compressed air test is also to be applied in the same manner as to fillet weld where the root face is large, i.e., 6–8 mm.

2.4.6 Vacuum box test

A box (vacuum testing box) with air connections, gauges and an inspection window is placed over the joint with a leak 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.

2.4.7 Ultrasonic test

An ultrasonic echo transmitter 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 sound is detectable by the receiver indicates a leakage in the sealing of the compartment.

2.4.8 Penetration test

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

2.4.9 Other tests

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

2.5 Application of coating

2.5.1 Final coating

For butt joints welded by an automatic process, the final coating may be applied any time before the completion of a leak test of spaces bounded by the joints, provided that the welds have been carefully inspected visually to the satisfaction of the PRS 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 2.6-2).

2.5.2 Temporary coating

Any temporary coating which may conceal defects or leaks is to be applied at the time as specified for the final coating (see 2.5.1). This requirement does not apply to shop primer.

2.6 Safe access to joints

For leak tests, a safe access to all joints under examination is to be provided (see also Table 2.6-2).

Table 2.6-1
Test requirements for tanks and boundaries

No.	Construction to be tested	Test type	Test head or pressure	Remarks
1	Double bottom tanks [4]	Leak and structural [1)]	The greater of – top of the overflow, – to 2.4 m above top of tank [2], or – to bulkhead deck	
2	Double bottom voids [5]	Leak	See 2.4.4 through 2.4.6 as applicable	Including pump room double bottom and bunker tank protection double hull required by MARPOL Annex I
3	Double side tanks	Leak and structural [1]	The greater of –top of the overflow, –to 2.4 m above top of tank [2], or –to bulkhead deck	
4	Double side voids	Leak	See 2.4.4 through 2.4.6 as applicable	
5	Deep tanks other than those listed elsewhere in this table	Leak and structural [1]	The greater of –top of the overflow, –to 2.4 m above top of tank [2]	
6	Cargo oil tanks	Leak and structural [1]	The greater of –top of the overflow, –to 2.4 m above top of tank [2], or –to top of tank [2] + setting of any pressure relief valve	
7	Ballast holds of bulk carriers	Leak and structural [1]	Top of cargo hatch coaming	
8	Peak tanks	Leak and structural [1]	The greater of –top of the overflow, –to 2.4 m above top of tank [2]	After peak to be tested after installation of stern tube
9	.1 Fore peak spaces with eqiupment	Leak	See 2.4.3 through 2.4.6 as applicable	
	.2 Fore peak voids	Leak and structural [1, 9]	To bulkhead deck	
	.3 Aft peak spaces with equipment	Leak	See 2.4.3 through 2.4.6 as applicable	
	.4 Aft peak voids	Leak	See 2.4.4 through 2.4.6 as applicable	After peak to be tested after installation of stern tube
10	Cofferdams	Leak	See 2.4.4 through 2.4.6 as applicable	
11	.1 Watertight bulkheads	Leak[8]	See 2.4.3 through 2.4.6 as applicable[7]	
	.2 Superstructure end bulkheads	Leak	See 2.4.3 through 2.4.6 as applicable	

No.	Construction to be tested	Test type	Test head or pressure	Remarks
12	Watertight doors below freeboard or bulkhead deck	Leak [6, 7]	See 2.4.3 through 2.4.6 as applicable	See Chapter 3 for details
13	Double plate rudder blades	Leak	See 2.4.4 through 2.4.6 as applicable	
14	Shaft tunnel clear of deep tanks	Leak [3]	See 2.4.3 through 2.4.6 as applicable	
15	Shell doors	Leak [3]	See 2.4.3 through 2.4.6 as applicable	
16	Weathertight hatch covers and closing appliances	Leak [3, 7]	See 2.4.3 through 2.4.6 as applicable	Hatch covers closed by tarpaulins and battens excluded
17	Dual purpose tank/dry cargo hold hatch cover	Leak [3, 7]	See 2.4.3 through 2.4.6 as applicable	In addition to structural test in item 6 or 7
18	Chain locker	Leak and structural [1]	Top of chain pipe	
19	L.O. sump tanks and other similar tanks/ spaces under main engines	Leak and structural [1]	See 2.4.3 through 2.4.6 as applicable	
20	Ballast ducts	Leak and structural [1]	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	

1 Refer to section 2.2.2

2 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 1.2.

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

7 As an alternative to the hose testing, other testing methods listed in 2.4.7 through 2.4.9 may be applicable subject to the adequacy of such testing methods being verified. See *SOLAS* II-1/11.1.

8 A "Leak and structural test", see 2.2.2 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 PRS.

Table 2.6-2
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 but before structural test	Leak test	Structural test
Butt	Automatic	Not required	Allowed[3]	N/A	Not required	Not required
	Manual or semiautomatic[4]	Required	Not allowed	Allowed	Required	Not required
Fillet	Boundary including penetrations	Required	Not allowed	Allowed	Required	Not required

[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.

2.7 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.

3 REQUIRMENTS FOR SPECIAL SERVICE SHIPS/TANKS

3.1 General

Additional test requirements for certain spaces within the cargo area of some types ships are given in Table 3.1.

Table 3.1
Additional test requirements for special service ships/tanks

No.	Type of ship/tank	Structures to be tested	Type of test	Test head or pressure	Remarks
1	Liquefied gas carriers	Integral tanks	Leak and structural	Refer to 3.2	
		Hull structure supporting membrane or semi-membrane tanks		Refer to 3.2	
		Independent tanks type A		Refer to 3.2	
		Independent tanks type B		Refer to 3.2	
		Independent tanks type C		Refer to 3.3	
2	Edible liquid tanks	Independent tanks	Leak and structural	The greater of – top of the overflow, or – to 0.9 m above top of tank[1]	
3	Chemical carriers	Integral or independent cargo tanks	Leak and structural	The greater of – to 2.4 m above top of tank[1], or – to top of tank[1] plus setting of any pressure relief valve	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

[1] Top of tank is a deck forming the top of the tank excluding any hatchways.

3.2 Detailed requirements for liquefied gas tankers

3.2.1 Integral tanks are to be hydrostatically or hydropneumatically tested in accordance with the present rules. The test is in general to be performed so that the stresses approximate, as far as practicable, the design stresses and so that the pressure at the top of the tank corresponds at least to the maximum allowable relief valve setting (MARVS).

3.2.2 For ships fitted with membrane or semi-membrane tanks, cofferdams and all spaces which may normally contain liquid and are adjacent to the hull structure supporting the membrane are to be hydrostatically or hydropneumatically tested in accordance with the requirements of the present rules. Pipe tunnels and other compartments which do not normally contain liquid are not required to be hydrostatically tested.

In addition, the ship hold structure supporting the membrane is to be given a tightness testing.

3.2.3 Each independent tank is to be subjected to a hydrostatic or hydropneumatic test.

For tanks type A, this test is to be performed so that the stresses approximate, as far as practicable, the design stresses and so that the pressure at the top of the tank corresponds at least to the MARVS. When the hydropneumatic test is performed, the conditions are to simulate, as far as possible, the actual loading of the tank and of its supports.

For tanks type B, the test is to be performed as for tanks type A.

Moreover, the maximum primary membrane stress or maximum bending stress in a primary membrane under test conditions is not to exceed 0.90 of the yield strength of the material (as fabricated) at the test temperature.

To ensure that this condition is satisfied, when calculations indicate that stress exceeds 0.75 of the yield strength, the prototype test is to be monitored by the use of strain gauges or other suitable equipment.

For tanks type C, see 3.3.

3.2.4 All tanks are to be subjected to a tightness testing which may be performed in combination with the pressure test mentioned above or separately.

3.2.5 Requirements with respect to inspection of the secondary barrier will be decided in each separate case.

3.2.6 On ships using independent tanks type B, at least one tank and its support is to be instrumented to confirm stress levels unless the design and arrangement for the size of the ship involved are supported by full scale experience. Similar instrumentation may be required by PRS for independent tanks type C dependent on their configuration and on the arrangement of their supports and attachments.

3.2.7 The ship is to be surveyed during the initial cool-down, loading and discharging of the cargo to verify the overall performance of the containment system for compliance with the design parameters.

Records on performance of the components and equipment essential to verify the design parameters are to be maintained and these records are to be available to PRS.

3.2.8 Heating arrangements, are to be tested for compliance with the design requirements.

3.2.9 Inspection of the hull for cold spots is to be performed following the first loaded voyage.

3.3 Testing of pressure vessels

3.3.1 Each pressure vessel, when completely manufactured, is to be subjected to a hydrostatic test according to the present rules, at a pressure, measured at the top of the tanks, of not less than 1.5 design vapour pressure p_0, but in no case during the pressure test is the calculated primary membrane stress at any point to exceed 0.9 times the yield stress of material.

To ensure that this condition is satisfied, where calculations indicate that this stress will exceed 0.75 times the yield strength, the prototype test is to be monitored by the use of strain gauges or other suitable equipment in pressure vessels except simple cylindrical and spherical pressure vessels.

3.3.2 The temperature of the water used for test is to be at least 30°C above the nil ductility transition temperature of the material as fabricated.

3.3.3 The pressure is to be held for two hours per 25 mm of thickness but in no case less than 2 hours.

3.3.4 Where necessary for cargo pressure vessels, there may be carried out with specific approval of PRS, a hydropneumatic test in the conditions prescribed under 3.3.1, 3.3.2 and 3.3.3.

3.3.5 Special consideration will be given to testing of tanks in which higher allowable stresses are used depending on service temperature. However, the requirements of 3.3.1 are to be fully complied with.

3.3.6 After completion and assembly, each pressure vessel and relative fittings are to be subjected to an adequate tightness test.

3.3.7 Pneumatic testing of pressure vessels other than cargo tanks will be considered on an individual case basis by PRS. Such testing will be permitted only for those vessels which are so designed and/or supported that they cannot be safely filled with water, or for those vessels which cannot be dried after testing and are to be used in a service where traces of the testing medium cannot be tolerated.

4 REQUIREMENTS FOR WATERTIGHT DOORS

4.1 General requirements

4.1.1 Doors which become at least partially immersed in damaged condition with a compartment or some compartments flooded, taking into account equilibrium of weight and buoyancy forces at intermediate stages between commencement and completion of flooding, are to be subjected to a hydrostatic pressure test.

4.1.2 For large doors intended for use in the watertight subdivision boundaries of cargo spaces, structural analysis may be accepted in lieu of pressure testing.

4.1.3 Where such doors utilize gasket seals, a prototype pressure test to confirm that the compression of the gasket material is capable of accommodating any deflection, revealed by the structural analysis, is to be carried out.

4.1.4 Doors which are not immersed in damaged condition, taking into account intermediate stages between commencement and completion of flooding but become intermittently immersed at angles of heel in the required range of positive stability beyond the equilibrium position are to be hose tested.

4.2 Pressure testing

4.2.1 The head of water used for the pressure test shall correspond at least to the head measured from the lower edge of the door opening, at the location in which the door is to be fitted in the vessel, to the bulkhead deck or freeboard deck, as applicable, or to the most unfavorable damage waterplane, if that be greater.

4.2.2 Testing may be carried out at the factory or other shore based testing facility prior to installation in the ship.

4.3 Leakage criteria

4.3.1 The following acceptable leakage criteria should apply:
- doors with gaskets – no leakage;
- doors with metallic sealing – max leakage 1 *l*/min.

4.3.2 Limited leakage (q) may be accepted for pressure test on large doors located in cargo spaces employing gasket seals or guillotine doors located in conveyor tunnels, in accordance with the following:

$$q \leq \frac{(P + 4.572)}{6568} h^3 \quad [l/\text{min}] \qquad (4.3.2)$$

P – perimeter of door openings, [m],
h – test head of water, [m].

4.3.3 In the case of doors where the water head taken for the determination of the scantlings does not exceed 6.1 m, the leakage rate may be taken equal to 0.375 *l*/min if this value is greater than that calculated in 4.3.2.

4.3.4 For doors on passenger ship which are normally open and used at sea or which become submerged in damaged conditions, taking into account intermediate stages between commencement and completion of flooding, a prototype test shall be conducted, on each side of the door, to check the satisfactory closing of the door against a force equivalent to a water height of at least 1 m above the sill on the centre line of the door.

4.4 Hose testing

All watertight doors shall be subject to a hose test in accordance with requirements of 2.3 after installation in a ship. Hose testing is to be carried out from each side of a door unless, for a specific application, exposure to floodwater is anticipated only from one side. Where a hose test is not practicable because of possible damage to machinery, electrical equipment installation or outfitting items, it may be replaced by means such as an ultrasonic leak test or an equivalent test.

List of amendments effective as of 1 January 2016

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