Polski Rejestr Statków

RULES

PUBLICATION NO. 80/P

NON-DESTRUCTIVE TESTING

2017
July

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

GDAŃSK

Publication No. 80/P – Non-destructive Testing – July 2017, is an extension of the requirements contained in *Part I – Classification Regulations* and *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships*.

The present *Publication* was approved by the PRS Board on 20 June 2017 and enters into force on 1 July 2017.

Publication No. 80/P – Non-destructive Testing – 2017 replaces *Publication No. 80/P – Non-destructive Testing – 2014.*

PRS/OP, 06/2017

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1 GENERAL

1.1 General Provisions

1.1.1 The requirements of this Publication apply where the *Rules* require performance of non-destructive examinations while no specific requirements for such examinations are given or when technical documentation does not details such requirements.

1.1.2 Referenced documents are necessary for use of this *Publication*. In the case of dated references only the quoted issue applies. For non-dated references, the last issue of referenced document including amendments applies.

1.1.3 The present *Publication* specifies the requirements for the testing and assessment of metallic materials and products, as well as welded joints using one or several non-destructive methods, listed below, i.e.:

- visual testing (VT),
- penetrant testing (PT),
- magnetic-particle testing (MT),
- radiographic testing (RT),
- ultrasonic testing (UT),
- eddy-current testing (ET),
- leak tightness testing (LT).

The selection of a testing method depends on location and type of anticipated imperfections, as well as access to the tested area or test segment.

1.1.4 The laboratory performing non-destructive tests, specified in 1.1.3, shall be approved by PRS in accordance with the principles set forth in *Publication No. 56/P – Procedural Requirements for Laboratories*.

1.1.5 The testing may be performed only by qualified and certified operators in relevant industrial sector and product sector. The certification shall comply with the requirements of EN ISO 9712 Standard. Possibility of carrying out testing by operators having qualifications granted in accordance with another personnel certification systems is subject to separate consideration by PRS.

1.1.6 Procedures for non-destructive testing shall be approved by persons having qualification level 3 in relevant industrial sector and product sector. Certification shall be in accordance with requirements of EN ISO 9712 Standard. Possibility of approving testing procedures by operators having qualifications granted in accordance with another personnel certification systems is subject to separate consideration by PRS.

1.1.7 Procedures for non-destructive testing shall be presented to PRS before the tests for agreement.

1.1.8 The scope of non-destructive testing, applied non-destructive testing methods and required level of acceptance or quality shall be specified in the product technical documentation, e.g. Non-destructive Testing Plan, which is subject to agreeing with PRS.

1.1.9 Detected imperfections which are not acceptable shall be repaired as agreed with PRS and the repaired areas shall be re-tested. The extent of testing shall cover the repair area and minimum 100 mm beyond the repair boundaries. Reports on the tests performed after the repair, together with documents relating to the tests performed before the repair, shall be submitted to PRS' Surveyor.

1.1.10 Report on non-destructive testing shall be prepared. The report, in addition to testing method, shall contain at least the following information:

- name of the laboratory conducting the tests,
- date of the tests and test report number,
- identification of the tested object (e.g. material grade, material thickness, weld type, welding process),
- unambiguous identification of the tested area,

– acceptance criteria (e.g. quality level or acceptance level),
– testing procedure (e.g. standard or procedure number),
– testing equipment and arrangement used for the tests, including test parameters (see para. 1.1.10),
– any test limitations, as well as ambient conditions, e.g.: air temperature, humidity, temperature of structure,
– results of the testing with reference to the size and location of detected imperfections,
– statement of compliance or non-compliance with the relevant requirements,
– name, surname, qualification level and signature of the operator who has performed the testing.

In addition to general information, the test report shall contain the following specific items:

for liquid penetrant testing (PT):
– name and type of penetrant, cleaner, developer used,
– penetration time and development time,
– test temperature,
– viewing conditions (e.g.: type and intensity of light);

for magnetic-particle testing (MT):
– magnetization method,
– magnetic field intensity,
– type of detection media,
– viewing conditions (e.g.: type and intensity of light),
– information on demagnetization, if required;

for radiographic testing (RT):
– type and size of radiation source,
– type of film,
– type of intensifying screens,
– exposure technique, time of exposure and source-to-film distance,
– sensitivity, type and position of IQI,
– density of radiograph,
– geometric unsharpness;

for ultrasonic testing (UT):
– type and identification of the used probe,
– type of the used couplant,
– sensitivity level calibrated and applied for each probe,
– transfer loss corrections applied,
– type of reference block,
– signal response used for defect detection.

The test report shall contain the number of *Approval Certificate* issued by PRS, the date of issue and validity.

In the case of tests performed after the repair, relevant information shall be given in the test report. The number of report on the tests conducted before the repair shall be also provided.

1.1.11 Test reports shall be maintained by the laboratory for at least 5 years from the date of the product or welded structure delivery. Reports may be prepared in paper or electronic format.

1.2 Definitions

Test segment – segment of a weld where non-destructive testing is performed; for penetrant testing, magnetic-particle testing and ultrasonic testing, a minimum test length of 500 mm shall be taken; for radiographic testing, a standard radiograph length of 480 mm shall be taken (the minimum RT test length should be 300 mm).

Non-destructive Testing Plan – a document containing at least the following information: location of testing areas or test segments, the method of testing, acceptance level, an explicit system of marking particular testing areas or test segments, the system of marking testing areas or test segments after repair, as well as the quality level of the product or welded structure.

Other definitions are contained in the series of standards related to non-destructive testing.

2 NON-DESTRUCTIVE TESTING METHODS

2.1 General

2.1.1 The surface condition shall be such as to enable carrying out non-destructive tests. The surface prepared for testing shall be dry and free from such impurities as: scale, slag, corrosion products, etc. and paint coatings.

2.1.2 During non-destructive tests, proper testing conditions shall be provided in accordance with the requirements specified in the relevant standards.

2.1.3 For butt joint, radiographic testing may be replaced by ultrasonic testing and vice versa, after agreeing it with PRS.

2.2 Visual Testing (VT)

2.2.1 Visual testing procedure shall contain: the method of surface preparation, testing conditions, the way of using visual testing aids.

2.2.2 Visual testing covers 100% of the tested product surface and weld lengths and may be performed as direct and/or remote visual testing.

2.2.3 Visual testing of welds shall be performed by designated personnel holding appropriate qualifications in accordance with the requirements of para. 1.1.5.

2.2.4 Visual testing shall be performed before any other non-destructive tests. Satisfactory result of visual tests allows to conduct further non-destructive tests.

2.2.5 Visual testing of materials and products shall be performed in accordance with the requirements of EN 13018, and visual testing of welds in accordance with the requirements of EN ISO 17637.

2.2.6 Visual testing aids shall comply with the requirements of EN 13927; low-power magnifiers shall comply with the requirements of ISO 3058.

2.2.7 During direct visual testing, the minimum distance between the operator's eye and tested surface shall not exceed 600 mm and the viewing angle shall not be less than 30°.

2.2.8 Minimum illuminance on the tested surface shall be not less than 500 lx.

2.3 Penetrant Testing (PT)

2.3.1 Penetrant testing procedure shall contain: the method of surface preparation, cases requiring the preparation of reference test blocks, testing conditions (e.g. temperature range) and viewing conditions, type of penetrant materials, the method of particular penetrant materials application, penetration and development time.

2.3.2 Penetrant testing of materials, products and welds shall be performed in accordance with the requirements of EN ISO 3452-1. The set of penetrant materials shall be produced by one manufacturer and shall be marked in accordance with the requirements of EN ISO 3452-2. The assessment of penetrant materials set shall be performed on the reference test block, type 2 in accordance with the requirements of EN ISO 3452-3.

2.3.3 The surface temperature of a tested object shall be within the range of 10 ÷ 50 °C. Testing at other temperatures shall be agreed with PRS.

2.3.4 Penetrant may be applied on the tested surface using any method, but it should be ensured that the tested surface is covered with the penetrant throughout the whole penetration period. The penetration time shall be not shorter than 10 minutes.

2.3.5 The development time shall be within the range 10 ÷ 30 minutes. The first check of indications shall be performed just after the developer has been applied; the final check of indications – after completion of development period. It is recommended that at least one intermediate check should be performed during the development period. Any indications detected during the final check shall be entered in the test report.

2.3.6 Illuminance measured on the tested surface shall be at least 500 lx for colour penetrants method. For fluorescent penetrants used indoors, illuminance of the tested object background shall not exceed 20 lx. UV-A radiation intensity shall be greater than 10 W/m^2 but in no case shall exceed 50 W/m^2. Detailed requirements concerning the viewing conditions for penetrant testing are specified in EN ISO 3059.

2.3.7 In the case of suspected defacement of surface discontinuity caused by mechanical cleansing, further proceedings shall be agreed with PRS.

2.4 Magnetic-particle Testing (MT)

2.4.1 Magnetic-particle testing procedure shall contain: the method of surface preparation, the method of reference blocks preparation, magnetization method, viewing conditions, type of suspension liquid used and the way of its application, cases requiring demagnetization.

2.4.2 Magnetic-particle testing of materials and products shall be performed in accordance with the requirements of EN ISO 9934-1, magnetic-particle testing of welded joints shall be performed in accordance with the requirements of EN ISO 17638.

2.4.3 Magnetic-particle testing equipment shall comply with the requirements of EN ISO 9934-3.

2.4.4 The induced magnetic field intensity on the surface of the tested object shall be greater than 2 kA/m.

2.4.5 Detection media used for magnetic-particle testing may be in the form of dry powder or suspension liquid and shall fulfil the requirements of EN ISO 9934-2.

2.4.6 When suspension liquid is used in magnetic-particle testing, magnetic field in the tested object shall be maintained as long as most of the liquid, which is the suspension liquid carrier, flows down the tested area to prevent vague indications.

2.4.7 To improve contrast between the tested surface and detection media, the application of contrastive, thin and uniform paint coating is permitted. Strictly adherent non-ferromagnetic coatings (e.g. painting) of thickness not exceeding 50 μm which do not reduce the test sensitivity need not be removed.

2.4.8 The tested object shall be magnetized in two directions approximately perpendicular to each other. The maximum deviation may be 30^o.

2.4.9 Illuminance measured on the tested area shall be not less than 500 lx. Where fluorescent penetrants are used indoors, illuminance of the tested object background shall not exceed 20 lx. UV-A radiation intensity shall be greater than 10 W/m^2. Detailed requirements concerning the viewing conditions for magnetic-particle testing are specified in EN ISO 3059.

2.4.10 After magnetic-particle testing has been completed, the tested element shall be demagnetized to the required level, where necessary.

2.4.11 In the case of testing elements subjected to machining (e.g. gear wheels, shafts, etc.) it shall be checked whether initial demagnetizing is necessary if such elements have the residual magnetism introduced by previous manufacturing processes.

2.4.12 During magnetic-particle testing of finished products or finished surfaces, due attention shall be paid to the method of magnetizing so as not to damage these surfaces.

2.5 Radiographic Testing (RT)

2.5.1 Radiographic testing procedure shall contain: type of radiation source, test parameters depending on the radiographed thickness, test arrangement and films overlapping, type and position of image quality indicator (IQI), image quality, film system and intensifying screens used (if any), scattered radiation control, film processing, film density and viewing conditions.

2.5.2 Radiographic testing of metallic materials and products shall be performed in accordance with the requirements of EN ISO 5579 or EN 13068-3; the testing of welded joints shall be performed in accordance with the requirements of EN ISO 17636-1 or EN ISO 17636-2.

2.5.3 Radiographic testing equipment shall be checked by a service company at least once a year. The service company shall provide a written statement confirming compliance of the equipment parameters with the required technical specifications.

This requirement does not absolve the user from current verification of the equipment.

2.5.4 Radiographic testing shall be performed using X-rays. Radiographic testing with the use of γ-rays is subject to PRS' consent.

2.5.5 For radiographic testing, industrial radiographic films complying with the requirements of EN ISO 11699-1 shall be used. The selection of radiographic films depends on class of the test, the thickness of the tested object and radiation source used.

2.5.6 To determine the quality of radiographs, wire type image quality indicators complying with the requirements of EN ISO 19232-1 or step/hole type image quality indicators complying with the requirements of EN 462-2 shall be used.

2.5.7 The density of the radiograph shall be not less than 2 for class A and 2.3 for class B. The maximum value of density depends on the parameters of negatoscope used for assessment.

2.5.8 The assessment of radiographs shall be performed in dark rooms using a negatoscope with controlled luminance. The negatoscope shall comply with the requirements of EN 25580.

2.6 Ultrasonic Testing (UT)

2.6.1 Ultrasonic testing procedure shall contain: flaw detector particulars, type of probes (frequency, angle of incidence), coupling media, type of reference blocks, method for range and sensitivity setting, method for transfer corrections, scanning technique, sizing technique and intervals for calibration checks during testing.

2.6.2 The ultrasonic tetsing:

- by pulse-echo method (UT-PE) of materials and products shall be carried out in accordance with EN ISO 16810 Standard.
- by Time of Flight Diffraction method (UT-TOFD) shall be carried out in accordance with EN ISO 16828 Standard,
- by Phased array method (UT-PA) shall be separately agreed with PRS,
- of welded joints of thickness above 8 mm shall be carried out in accordance with EN ISO 17640 Standard,
- testing of flat elements of thickness above 6 mm, testing of forgings, castings and welded pipes, as well as austenitic steel products shall be carried out in accordance with relevant standards.

2.6.3 Ultrasonic testing equipment shall comply with the requirements of EN 12668-1 and shall be checked by a service company at least once a year. The service company shall provide a written statement confirming compliance of the equipment parameters with the required technical specifications.

This requirement does not absolve the user from current verification of the equipment – flaw detector and probe in accordance with the requirements of EN 12668-3.

2.6.4 The probes of frequency 2-5 MHz used for ultrasonic testing shall comply with the requirements of EN 12668-2. The selection of ultrasonic probe type depends on:
– the material thickness, shape and surface condition,
– the type and metallurgical conditions of the material from which the object to be tested is manufactured,
– the type, position and orientation of the imperfections to be detected.

For angle probes, the probe angle and centre position shall be checked at the beginning and at the end of each test and also during the test if there is suspicion that these parameters were changed.

2.6.5 For test sensitivity setting, the DGS method is recommended by PRS. Disk shaped reflectors with diameters as given in EN ISO 11666 shall be used for reference level setting.

2.6.6 For calibration of the equipment – flaw detector and probe, calibration block No. 1 complying with the requirements of EN ISO 2400 and/or calibration block No. 2 complying with the requirements of EN 27963 shall be used.

2.6.7 To enable the passage of an ultrasonic wave from the probe into a tested object, couplants, e.g. gel for ultrasonic testing or other media of homogeneous structure (e.g. oil, grease or wallpaper glue solution) shall be used.

2.6.8 In way of the probe passage, the surface shall allow the free passage of the probe and constant acoustic coupling conditions so that local variation will not exceed +/– 2 dB.

2.6.9 Prior to welded joint testing, the angle probe passage area shall be checked. The test shall be performed with a single normal probe.

In the case of any imperfections detected, the weld test using an angle probe shall be continued from a probe passage area in which imperfections have not been detected.

2.6.10 While testing welded joints with an angle probe, scanning shall provide at least 10% coverage of the probe motion area.

2.6.11 A system using the DGS method is recommended by PRS for the assessment of the detected imperfections. Another method which may be used is a Distance-Amplitude-Corrected curve (DAC curve). A 6 dB-drop technique shall be used for the assessment of linear imperfections. Where other assessment system for the assessment of the detected imperfections is to be applied, its description shall be submitted to PRS for acceptance.

3 SCOPE OF NON-DESTRUCTIVE TESTING

3.1 General

3.1.1 The scope of non-destructive testing of materials, products and welded joints shall be specified in the working documentation of a welded structure, e.g. *Non-destructive Testing Plan*. In a welded joint, a weld and 10 mm welding zone or heat affected zone, whichever is the greater, are subject to testing. General principles for selection of non-destructive tests for welded joints are specified in EN ISO 17635 Standard.

3.1.2 PRS may require the extension of the previously agreed scope of non-destructive tests and conducting simultaneous tests by several methods, depending on the current assessment of work quality.

3.1.3 After completion of fabrication work or welding operations on a given structure, the manufacturer's quality control staff shall mark locations to be subjected to non-destructive testing (test areas/ test segments) in accordance with the agreed documentation.

3.1.4 Non-destructive testing of the product or welded structure shall not be carried out until the welding operations or heat treatment (where applicable) have been completed and the welds have cooled to ambient temperature.

3.1.5 Non-destructive testing of the welded joint shall not be carried out until completion of treatment time as specified in EN 1090-2 Standard. Where heat treatment is applicable, the testing may be performed not earlier than after 48 hours from completion of the heat treatment.

3.1.6 The welded structures manufacturer is obliged to determine, at least every six months, the quality index of welded joints on the basis of test segments for radiographic and ultrasonic testing and to submit the results to PRS' Surveyor upon request. The quality index shall be calculated from the following formula:

$$K = \frac{l}{D} 100\% \tag{3.1.6}$$

K – quality index of welded joints, [%];
l – total length of test segments showing inadmissible defects, [m];
D – total length of all test segments for radiographic and ultrasonic testing, [m].

If the quality index of welded joints exceeds 10%, PRS may require increasing the number of test segments by 5 % per each 1% above the 10% limit. The number of test segments may be reduced to the original level when PRS' Surveyor considers the welding work quality acceptable.

3.2 Scope of Non-destructive Testing of Welded Joints in the Ship's Hull

3.2.1 The scope of non-destructive testing of the shell plating and stiffeners welded joints on ships with length L > 24 m shall be specified in *Non-destructive Testing Plan for Welded Joints* and shall be prepared in accordance with the guidelines given in Table 3.2.1.

The number of test segments for the region 0.4L amidships shall be determined in accordance with the following formula:

$$N = \frac{L(B+H)}{45} \tag{3.2.1}$$

N – number of test segments for radiographic and ultrasonic testing,
B – breadth of ship, [m],
H – depth of ship, [m],
L – length of ship, [m].

Formula (3.2.1) determines the number of 500 mm test segments for ultrasonic testing and standard 480 mm test segments for radiographic testing. In the case of radiographic testing, if the length of radiographs is less than the standard length (e.g. 300 mm), the number of radiographs shall be increased so that the total length of welded joints tested by such radiograms will be at least equal to the total length of welded joints tested by standard length radiographs.

The testing shall cover, first of all, the crossings of the joints. The test segment at the crossings of the joints shall be located in line with the joint in which higher stresses are expected. In the case of ultrasonic testing, the scope of the tests shall be extended to 100 mm on each side of the joint not located in line with the test segment.

Table 3.2.1
Scope of non-destructive testing of hull plating and stiffeners welded joints on ships with length $L > 24$ m

Item	Testing location	Type of weld	Scope of testing		
			VT	RT or UT	
			Region		
			over the whole ship's length L	0.4L amidships	outside 0.4L amidships
1	**Butts of plating (mainly intersections):** – strength deck outside the hatch line, – sheer strake (however, not less than 0.1H below the strength deck), – bilge (however, not less than 0.1H above the bottom), – bottom. **Butts of:** – hatchway longitudinal coamings, – hatch corners strengthenings, – strengthenings at superstructure ends, – longitudinal bulkheads within the area of 0.1H below the strength deck.	butt	100%	0.6N	at random[1)]
2	**Other butts of hull plating[2)] (mainly intersections)**	butt	100%	0.4N	at random[1)]
3	**Butts of longitudinal stiffeners (longitudinal section):** – strength deck outside hatch line, – sheer strake (however, not less than 0.1H below the strength deck), – bilge (however, not less than 0.1H above the bottom), – bottom, – longitudinal bulkheads within the area of 0.1H below the strength deck	butt	100%	1 test segment per each 5 butts (mainly assembly butts)	at random[1)]
4	**Other butts of longitudinal stiffeners**	butt	100%	1 test segment per each 10 butts (mainly assembly butts)	at random[1)]
5	**Butts of transverse stiffeners (transverse section):**	butt	100%	1 test segment per each 10 butts	at random[1)]
6	**Connection of stringer plate with sheer strake**	angle joint with the butt weld	100%	4 test segments subjected to inspection on the length of one steel sheet[3)]	at random [1), 3)]

1) The number of test segments shall not exceed 35% of all test segments for the appropriate structural groups specified for the region 0.4L amidships.
2) In the case of ice strengthenings, ice belt butts shall be mainly tested.
3) Ultrasonic testing is recommended.

3.2.2 The scope of non-destructive testing of testing of the shell plating and stiffeners welded joints on ships with length $L \leq 24$ m or the hull of inland waterway vessels shall be specified in *Non-destructive Testing Plan for Welded Joints*. The testing locations indicated in Table 3.2.1 shall be mainly tested. The scope of the testing, i.e. the number of test segments and their location are subject to a separate consideration of PRS.

3.2.3 In addition to hull structure elements specified in Table 3.2.1 or the requirements of paragraph 3.2.2, welded joints connecting the elements of equipment and hull structure elements, indicated in Table 3.2.3, shall be subjected to non-destructive testing regardless of the ship's length. Location of these tests shall be agreed with PRS' Surveyor.

Table 3.2.3
Scope of non-destructive testing of welded joints connecting the elements of equipment and hull structure elements

Item	Testing location	Scope of testing expressed as percentage	
		VT	PT/MT/RT/UT[1)]
1	Hull and stern tube connection	100	100
2	Connection of hull and elements of rudder blade suspension arrangement	100	100
3	Hull and shaft bracket connection	100	100
4	Connection of hull and thrust rudder tunnel	100	50
5	Connection of hull and main engines foundations	100	20
6	Connection of hull and auxiliary engines foundations	100	20
7	Connection of hull and lifting gear foundations	100	20
8	Connection of hull and masts foundations	100	20
9	Connection of hull and machinery and arrangements foundations	100	20

[1)] Testing method is selected depending on the weld type of the tested weld joint.

3.2.4 On container ships, ultrasonic testing is to be carried out on all block-to-block butt joints of all upper flange longitudinal structural members. Upper flange longitudinal structural members include the topmost strakes of the bulkhead, the sheer strake, main deck, coaming plate, coaming top plate and all attached longitudinal stiffeners defined in Fig. 3.2.4.

3.2.5 The scope of non-destructive testing of welded joints of the hull of a ship subjected to alteration or repair shall be each time agreed with PRS. The scope of the tests depends on the extent of the alteration or repair.

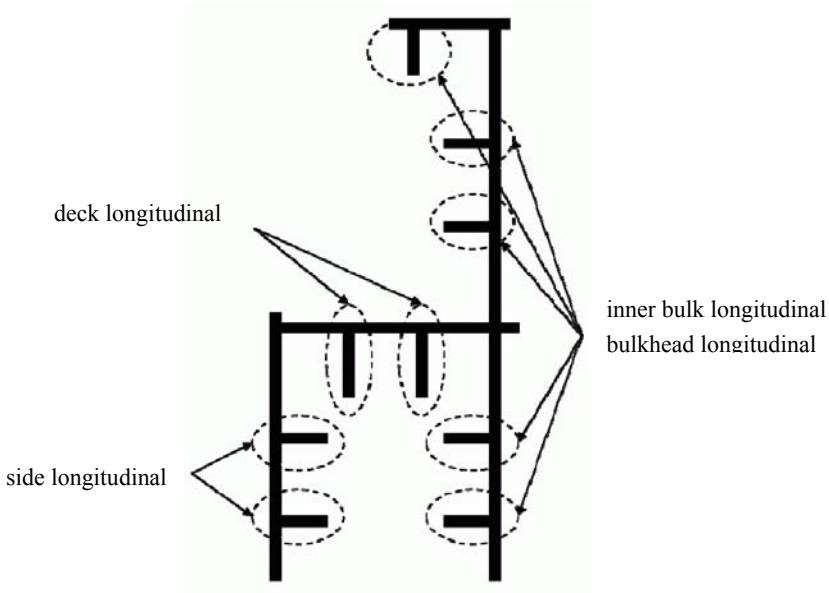

Fig. 3.2.4 Upper flange longitudinal structural members

3.2.6 The non-destructive testing of ships using gas fuel or other low flash-point fuels shall be carried out in accordance with IGF Code.

3.3 Scope of Non-destructive Testing of Welded Joints in Boilers, Pressure Vessels and Heat Exchangers

3.3.1 Welded joints in boilers, pressure vessels and heat exchangers under construction or repair shall be subjected to non-destructive testing within the scope specified in Table 3.3.1.

3.3.2 If fillet joints are used at welding boilers, pressure vessels and heat exchangers of class I, they shall be subjected to magnetic-particle testing.

Table 3.3.1
Scope of non-destructive testing of welded joints in boilers, pressure vessels and heat exchangers

Structure class[1)]	Joint type	Scope of testing, expressed as percentage, of the total length of welded joints	
		VT	RT or UT
I	Longitudinal welds	100	100
II			50[2)]
III			as agreed with PRS
I	Circumferential welds		50[2)]
II			25[2)]
III			as agreed with PRS

1) The division into classes is defined in the *Rules for the Classification and Construction of Sea-going Ships, Part VII – Machinery, Boilers and Pressure Vessels*.
2) Testing shall cover all crossings of welds.

3.4 Scope of Non-destructive Testing of Welded Joints in Piping

3.4.1 Welded joints in piping shall be subjected to non-destructive testing within the scope specified in Table 3.4.1.

Table 3.4.1
Scope of non-destructive testing of welded joints in piping

Pipeline class [1)]	Outside diameter of pipe [mm]	Scope of testing, expressed as percentage, of the total length of welded joints		
		VT	MT[2)]	RT or UT
I	≤ 75	100	100	10[3)]
	> 75		100	100
II	≤ 100		at random	at random
	> 100		10[3)]	10[3)]
III	regardless of the pipe diameter		at random	at random

1) The division into classes is defined in the *Rules for the Classification and Construction of Sea-going Ships, Part VII – Machinery, Boilers and Pressure Vessels*.
1) Fillet welds connecting the flange to the pipe.
2) Not less, however, than one joint performed by the particular welder.

3.4.2 In Class I piping, fillet welds of flange connections shall be subjected to magnetic-particle testing.

3.5 Scope of Non-destructive Testing of Welded Joints in Components of Machinery, Arrangements and Other Structures

3.5.1 The scope of non-destructive testing of welded joints in components of machinery, arrangements and structures other than those covered by the present *Publication* shall be specified in technical documentation. The number of testing locations will be specially considered by PRS.

Heavy loaded nodes of parts of machinery, equipment and other arrangements shall be mainly tested.

4 ASSESSMENT CRITERIA

4.1 General

4.1.1 The required quality level shall be defined in the technical documentation of material, product or in working documentation of welded structure, e.g. in *Non-destructive Testing Plan*.

Detailed quality levels for materials, products or welded joints are specified in *PRS Rules*. If such requirements are not specified in *PRS Rules,* standards pertinent to a particular product shall apply.

4.1.2 Detected imperfections shall be classified and described in accordance with the requirements of EN ISO 6520-1.

4.1.3 The quality level for welded joints in steel products shall be determined in accordance with the requirements of EN ISO 5817, for welded joints in aluminium or its alloys in accordance with the requirements of EN ISO 10042.

4.1.4 Guidelines for acceptance/quality levels regarding particular methods are given in EN ISO 17635. In the case of visual testing, quality levels are equivalent to acceptance levels. For the remaining testing methods, acceptance levels shall be determined in accordance with standards relating to particular methods, as follows:

- EN ISO 23277 for PT,
- EN ISO 23278 for MT,
- EN ISO 10675-1 for RT,
- EN ISO 11666 for UT.

4.1.5 In the testing methods visual testing (VT), penetrant testing (PT) and magnetic-particle testing (MT), the level of testing technique is not specified.

4.2 Acceptance/Quality Levels of Welded Joints in the Ship's Hull

4.2.1 Acceptance/quality levels of plating and hull stiffeners elements welded joints for ships with length $L > 24$ m, depending on the joints location, are specified in Table 4.2.1.

4.2.2 Acceptance/quality levels of the shell plating and hull stiffeners elements welded joints for ships with length $L > 24$ m other than those specified in Table 4.2.1 will be specially considered by PRS.

Table 4.2.1
Acceptance level and quality level of plating and hull stiffeners elements welded joints for ships with length $L > 24$ m

Testing method	Within 0.4*L*		Outside 0.4*L*	
	Quality level	Acceptance level	Quality level	Acceptance level
Visual (VT)	B	B	C	C
Penetrant (PT)	B	2X	C	2X
Magnetic-particle (MT)	B	2X	C	2X
Radiographic (RT)	B	1	C	2
Ultrasonic (UT)	B	2	C	3

4.2.3 Acceptance/quality levels of the shell plating and hull stiffeners elements welded joints for ships with length $L \leq 24$ m and inland waterway vessels are specified in Table 4.2.3.

Table 4.2.3
Acceptance/quality levels of plating and hull stiffeners elements welded joints for ships with length $L \leq 24$ m and inland waterways vessels

Testing method	Quality level	Acceptance level
Visual (VT)	C	C
Penetrant (PT)	C	2X
Magnetic-particle (MT)	C	2X
Radiographic (RT)	C	2
Ultrasonic (UT)	C	3

4.2.4 Acceptance/quality levels of the shell plating and hull stiffeners elements welded joints for ships with length $L \leq 24$ m lower than those specified in Table 4.2.3 will be specially considered by PRS.

4.2.5 Acceptance/quality levels of welded joints connecting the elements of equipment and hull structure elements, are given in Table 4.2.5.

4.2.6 Acceptance/quality levels of welded joints connecting the elements of equipment and hull structure elements lower than those indicated in Table 4.2.5 will be specially considered by PRS.

Table 4.2.5
Acceptance/quality levels of welded joints connecting the elements of equipment and hull structure elements

Item	Testing location	Acceptance level					Quality level
		VT	PT	MT	RT	UT	
1	Hull plating and stern tube connection	B	1	1	1	2	B
2	Connection of hull plating and elements of rudder blade suspension arrangement	B	1	1	1	2	B
3	Hull and shaft bracket connection	B	1	1	1	2	B
4	Connection of hull and thrust rudder tunnel	B	1	1	1	2	B
5	Connection of hull and main engines foundations	B	1	1	1	2	B
6	Connection of hull and auxiliary engines foundations	C	2X	2X	2	3	C
7	Connection of hull and lifting gear foundations	B	1	1	1	2	B
8	Connection of hull and masts foundations	C	2X	2X	2	3	C
9	Connection of hull and machinery and arrangements foundations	C	2X	2X	2	3	C

4.3 Acceptance/Quality Levels of Welded Joints in Boilers, Pressure Vessels and Heat Exchangers

4.3.1 Acceptance/quality levels of welded joints in boilers, pressure vessels and heat exchangers, depending on their class, are specified in Table 4.3.1.

Table 4.3.1
Acceptance/quality levels of welded joints in boilers, pressure vessels and heat exchangers, depending on their class[1)]

Testing method	Class I		Class II		Class III	
	Quality level	Acceptance level	Quality level	Acceptance level	Quality level	Acceptance level
Visual (VT)	B	B	C	C	C	C
Penetrant (PT)	B	1	C	2X	C	2X
Magnetic-particle (MT)	B	1	C	2X	C	2X
Radiographic (RT)	B	1	C	2	C	2
Ultrasonic (UT)	B	2	C	3	C	3

[1)] The division into classes is defined in the *Rules for the Classification and Construction of Sea-going Ships, Part VII – Machinery, Boilers and Pressure Vessels*.

4.3.2 Acceptance/quality levels of welded joints in boilers, pressure vessels and heat exchangers lower than those given in Table 4.3.1 will be specially considered by PRS. Welded joints of quality level D are not permitted for Class I boilers, pressure vessels and heat exchangers.

4.4 Acceptance/Quality Levels of Welded Joints in Piping

4.4.1 Acceptance/quality levels of welded joints in piping, depending on the piping class, are specified in Table 4.4.1.

Table 4.4.1
Acceptance/quality levels of welded joints in piping, depending on the piping class[1)]

Testing method	Class I		Class II		Class III	
	Quality level	Acceptance level	Quality level	Acceptance level	Quality level	Acceptance level
Visual (VT)	B	B	C	C	C	C
Penetrant (PT)	B	1	C	2X	C	2X
Magnetic-particle (MT)	B	1	C	2X	C	2X
Radiographic (RT)	B	1	C	2	C	2
Ultrasonic (UT)	B	2	C	3	C	3

[1)] The division into classes is defined in the *Rules for the Classification and Construction of Sea-going Ships, Part VII – Machinery, Boilers and Pressure Vessels*.

4.4.2 Acceptance/quality levels of welded joints in piping lower than those specified in Table 4.4.1 will be specially considered by PRS. Welded joints of quality level D are not permitted for Class I piping.

4.5 Acceptance/Quality Levels of Welded Joints in Elements of Machinery, Arrangements and Other Structures

4.5.1 Acceptance/quality levels of welded joints in elements of machinery, arrangements and other structures than those given in the present *Publication* shall be specified in technical documentation and will be specially considered by PRS.

List of amendments effective as of 1 July 2017

Item	*Title/Subject*	*Source*
Text of publication	Update of normative references	--
Text of publication	Update of requirements	Experience from surveys
Para. 3.2.6	Implemetation of IGF Code requirements	Resolution MSC.391(95)
