RUSSIAN MARITIME REGISTER OF SHIPPING

CIRCULAR LETTER **No. 314-04-1757c** dated 11.05.2022

Re:

amendments to the Rules for the Classification and Construction of Sea-Going Ships, 2022, ND No. 2-020101-152-E

Item(s) of supervision:

ships under construction, welding

Entry-into-force date:
01.07.2022

~~Cancels / amends / adds Circular Letter No.~~ ~~dated~~

Number of pages: 1 + 20

Appendices:

Appendix 1: information on amendments introduced by the Circular Letter

Appendix 2: text of amendments to Part XIV "Welding"

Director General Konstantin G. Palnikov

Text of CL:

We hereby inform that the Rules for the Classification and Construction of Sea-Going Ships shall be amended as specified in the Appendices to the Circular Letter.

It is necessary to do the following:

1. Bring the content of the Circular Letter to the notice of the RS surveyors, as well as interested organizations and persons in the area of the RS Branch Offices' activity.
2. Apply the provisions of the Circular Letter during review and approval of the technical documentation on ships or materials/products installed on board the ships contracted for construction or conversion on or after 01.07.2022, in the absence of a contract, during review and approval of the technical documentation on ships or materials/products installed on board the ships requested for review on or after 01.07.2022.

List of the amended and/or introduced paras/chapters/sections:

Part XIV: Table 3.1.1.2-1, paras 3.1.2.1, 3.1.3.1, 3.2.2.1 — 3.2.2.2, 3.2.2.9, 3.2.3.1, 3.2.4.1, 3.2.5.5 — 3.2.5.7, 3.2.5.9 — 3.2.5.10, 3.2.5.12, 3.2.6.1, 3.2.6.4 — 3.2.6.6, 3.2.6.12 — 3.2.6.15, 3.2.6.20 and 3.2.8.4, Tables 3.3.3 and 3.3.4, paras 3.3.8 and 3.4.1.2, Tables 3.4.1.3, 3.4.1.4, 3.4.2.1, 3.4.5.3 and 3.4.6.1, paras 3.4.7.4, 3.5.1.1 — 3.5.1.3, 3.5.2.1 and 3.5.3.1, para and Table 3.5.4.3, Table 4.8.3.2, paras 4.8.3.3, 4.9.1.2, 4.10.1.2 and Table 4.10.3.4.

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"Thesis" System No. 22-49205

Appendix 1 to Circular Letter
No. 314-04-1757c dated 11.05.2022

Information on amendments introduced by the Circular Letter (for inclusion in the Revision History to the RS Publication)

Nos.	Amended paras/chapters/ sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
1	Table 3.1.1.2-1	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
2	Para 3.1.2.1	Title and form of the document have been specified	314-04-1757c of 11.05.2022	01.07.2022
3	Para 3.1.3.1	Requirements for content of non-destructive testing plan have been specified	314-04-1757c of 11.05.2022	01.07.2022
4	Paras 3.2.2.1 — 3.2.2.2	References to ISO standard have been specified	314-04-1757c of 11.05.2022	01.07.2022
5	Para 3.2.2.9	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
6	Para 3.2.3.1	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
7	Para 3.2.4.1	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
8	Paras 3.2.5.5 — 3.2.5.7	References to ISO standards have been specified; terminology has been specified	314-04-1757c of 11.05.2022	01.07.2022
9	Para 3.2.5.10	Terminology has been specified; references to ISO standards have been specified	314-04-1757c of 11.05.2022	01.07.2022
10	Para 3.2.5.12	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
11	Para 3.2.6.1	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
12	Para 3.2.6.6	Terminology has been specified; references to ISO standards have been specified	314-04-1757c of 11.05.2022	01.07.2022
13	Paras 3.2.6.12 — 3.2.6.15	References to ISO standards have been specified	314-04-1757c of 11.05.2022	01.07.2022
14	Para 3.2.6.20	Requirements for NDT methods have been specified considering GOST 50.05.13-2019	314-04-1757c of 11.05.2022	01.07.2022
15	Para 3.2.8.4	Editorial amendment has been made	314-04-1757c of 11.05.2022	01.07.2022
16	Tables 3.3.3 and 3.3.4	Terminology has been specified	314-04-1757c of 11.05.2022	01.07.2022
17	Tables of Chapter 3.4 (Tables 3.4.1.3, 3.4.1.4, 3.4.2.1, 3.4.5.3 and 3.4.6.1)	References to ISO standards have been specified	314-04-1757c of 11.05.2022	01.07.2022

Nos.	Amended paras/chapters/ sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
18	Para 3.4.7.4	Reference to ISO standard has been specified	314-04-1757c of 11.05.2022	01.07.2022
19	Paras 3.5.1.1 — 3.5.1.3	References to ISO standards have been specified	314-04-1757c of 11.05.2022	01.07.2022
20	Para 3.5.2.1	References to ISO standard have been specified	314-04-1757c of 11.05.2022	01.07.2022
21	Para 3.5.3.1	References to ISO standard have been specified	314-04-1757c of 11.05.2022	01.07.2022
22	Para 3.5.4.3 and Table 3.5.4.3	References to ISO standards have been specified	314-04-1757c of 11.05.2022	01.07.2022
23	Table 4.8.3.2	Reference to ISO standard has been specified; terminology and numbers of welding processes have been specified	314-04-1757c of 11.05.2022	01.07.2022
24	Chapter 4.8 — 4.10 (paras 4.8.3.3, 4.9.1.2, 4.10.1.2, Table 4.10.3.4)	References to ISO standard have been specified	314-04-1757c of 11.05.2022	01.07.2022

Appendix 2 to Circular Letter
No. 314-04-1757c dated 11.05.2022

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SEA-GOING SHIPS, 2022,

ND No. 2-020101-152-E

PART XIV. WELDING

3 TESTING OF WELDED JOINTS

1 **Table 3.1.1.2-1.** Title of the Table is replaced by the following text:

"**Generally accepted methods for detection of accessible surface imperfections for all types of welds, including fillet welds according to ISO 17635:2016**".

2 **Para 3.1.2.1** is replaced by the following text:

"**3.1.2.1** Non-destructive testing and quality assessment of welded joints shall be performed by testing laboratories (centres) which competence and status comply with the requirements for accreditation in accordance with national or international standards. The Recognition (Accreditation) Certificate issued by the Register (СПЛ, form 7.1.4.3) or by other authorized national body is a document confirming competence of the testing laboratory. In the latter case the copy of the Certificate with supplements shall be submitted to the Register surveyor prior to start of welding.

Requirements for testing laboratories performing non-destructive testing and the procedure of their recognition by the Register comply with the provisions of Section 10, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.".

3 **Para 3.1.3.1** is replaced by the following text:

"**3.1.3.1** The extent of testing and the number of checkpoints shall be agreed between the shipbuilder and the Register. Unless agreed otherwise, the testing plan for welded joints of hull structures shall be prepared and submitted to the Register for approval. For pipelines, as well as for particular products manufactured under the Register technical supervision, the necessary information may be provided on the relevant drawings without drawing up a separate document. The testing plan shall contain the following information:

.1 details and welded joints subject to testing during the acceptance of welded structures;
.2 scope and methods of testing;
.3 schematic testing locations determined in advance;
.4 requirements for quality assessment of welded joints;
.5 testing standards or written specifications.".

4 **Paras 3.2.2.1 — 3.2.2.2** are replaced by the following text:

"**3.2.2.1** Visual and measuring testing of welded joints shall be carried out in compliance with the requirements of ISO 17637:2016, ISO 6520-1:2007 or other agreed international and national standards.

3.2.2.2 Visual testing of welded joints shall be performed to reveal the weld surfaced imperfections and affected zone including the most common ones (marking as per ISO 6520-1:2007):

cracks (100, 104);
undercuts (5011, 5012, 5013);
unfilled craters, sags, runs, unfilled bevel (2025, 506, 509, 511);

surfaced blowholes (2016);
lacks of fusion in the root of a single-sided weld, concave deformation-shrinkage grooves in the weld root as well as excessive penetration-sagging in the weld root (4021, 515, 504);
surfaced pores and poor fusion (2017, 401);
root porosity (516);
arc strike (601);
incorrect weld toe — non-smoothness of conjunction with the base metal (505);
exceeding weld reinforcement (502, 503);
irregular surface – pimpling and scaling (514);
melted metal spatter (602);
correctness of the welding of crossing welds and seal welding of free edges.".

5 **Para 3.2.2.9** is replaced by the following text:

"**3.2.2.9** To perform measurement testing of welded joints there shall be applied measuring tools relevant to the Guidelines of Annex A to ISO 17637:2016.".

6 **Para 3.2.3.1** is replaced by the following text:

"**3.2.3.1** Penetrant testing including dye penetrant testing, fluorescent penetrant testing and fluorescent-dye penetrant testing (PT) of welded joints shall be applied and carried out in accordance with written specifications (procedures) developed on the basis of ISO 3452-1:2013 (Parts 1 — 6) or other agreed international and national standards.".

7 **Para 3.2.4.1** is replaced by the following text:

"**3.2.4.1** Magnetic particle testing of welded joints shall be applied and carried out in accordance with written specifications (procedures) developed on the basis of ISO 17638:2016 or other agreed international and national standards.".

8 **Paras 3.2.5.5 — 3.2.5.7** are replaced by the following text:

"**3.2.5.5** The radiation sources for radiographic inspection of welded joints, X-ray devices shall be used as well as radioactive isotopes as follows: ytterbium-169, thulium-170, selenium-75, iridium-192, cobalt-60, electron accelerators with the energy of accelerated electrons up to 12 MeV. At the same time, where possible, X-ray source shall be given priority in relation to sources of gamma radiation. Details on the application of radiation sources in accordance with ISO 17636-1:2013 are given in Tables 3.2.5.5-1, 3.2.5.5-2 and in Fig. 3.2.5.5.

Table 3.2.5.5-1

Penetrated thickness range for gamma ray sources for steel and copper and nickel base alloys

Radiation source	Penetrated thickness *w*, mm	
	Control class A	Control class B
Tm-170	$w \le 5$	$w \le 5$
Yb-169[1]	$1 \le w \le 15$	$2 \le w \le 12$
Se-75[2]	$10 \le w \le 40$	$14 \le w \le 40$
Ir-192	$20 \le w \le 100$	$20 \le w \le 90$
Co-60	$40 \le w \le 200$	$60 \le w \le 150$
[1]For aluminium and titanium, the penetrated material thickness is 10 mm ≤ *w* ≤ 70 mm for control class A and 25 mm ≤ *w* ≤ 55 for class B. [2]For aluminium and titanium, the penetrated material thickness is 35 mm ≤ *w* ≤ 120 mm for class A.		

Table 3.2.5.5-2

Acceptable penetrated thickness range for X-ray equipment with energy for steel

X-ray equipment with energy	Penetrated thickness *w*, mm	
	Control class A	Control class B
From 1 MeV to 4 MeV	$30 \le w \le 200$	$50 \le w \le 180$
From 4 MeV to 12 MeV	$w \ge 50$	$w \ge 80$
above 12 MeV	$w \ge 80$	$w \ge 100$

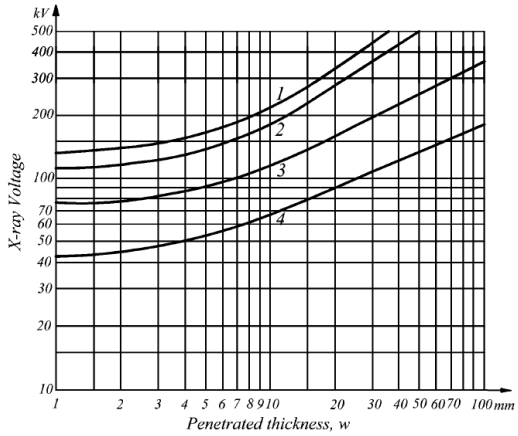


Fig. 3.2.5.5
The maximum X-ray device tube voltage values depending on the penetrated thickness of the controlled metal:
1 — copper/nickel an alloys; *2* — steel; *3* — titanium and alloys; *4* — aluminium and alloys

3.2.5.6 The sensitivity of radiographic testing shall be determined by the image on the welded joint radiograph indicator of image quality indicator in compliance with international or national standards (ISO 19232-1:2013, ISO 19232-2:2013, EN 462 and similar). It is admitted to apply indicator of image quality of wire or step/hole type as well.

As a rule, indicator of image quality (the sensitivity standard) shall be installed on a tested welded joint in the centre of an X-rayed area on the radiation source side (end). By way of exception, the installation of indicator of image quality on the film side shall be applied in the following cases:

during X-ray examination of piping welded joints at the next but two walls using an image of only the adjacent to the film seam area for the joint quality assessment;

during panoramic X-ray examination of piping welded joints.

3.2.5.7 The requirements to minimum sensitivity of radiographic inspection in compliance with ISO 17636:2013 or EN 1435 shall comply with Class A or B (examination level) depending on the requirements for the quality of welded joints and they are specified as per ISO 10675-1:2021, Table 3.4.1.4.

The control sensitivity values complying with Classes A and B according to ISO 17636-1:2013 or EN 1435 for wire-type indicator of image quality are shown in Tables 3.2.5.7-1 — 3.2.5.7-3.

Table 3.2.5.7-1

The minimum sensitivity of radiographic inspection for flat components and during X-ray of piping welded joints at the next but one wall (indicator of image quality from the radiation source side) for X-ray devices and electron accelerators[1]

Test sensitivity, mm	Penetrated thickness *w*, mm	
	Test class A	Test class B
0,050	–	$0 < w \le 1,5$
0,063	$0 < w \le 1,2$	$1,5 < w \le 2,5$
0,080	$1,2 < w \le 2$	$2,5 < w \le 4$
0,100	$2 < w \le 3,5$	$4 < w \le 6$
0,125	$3,5 < w \le 5$	$6 < w \le 8$
0,16	$5 < w \le 7$	$8 < w \le 12$
0,20	$7 < w \le 10$	$12 < w \le 20$
0,25	$10 < w \le 15$	$20 < w \le 30$
0,32	$15 < w \le 25$	$30 < w \le 35$
0,40	$25 < w \le 32$	$35 < w \le 45$
0,50	$32 < w \le 40$	$45 < w \le 65$
0,63	$40 < w \le 55$	$65 < w \le 120$
0,80	$55 < w \le 85$	$120 < w \le 200$
1,0	$85 < w \le 150$	$200 < w \le 350$
1,25	$150 < w \le 250$	$350 < w$
1,60	$250 < w$	–
[1] During X-ray of welded joints by gamma radiation (Iridium-192) the values given in Table shall be lowered down (decreased) (reduce sensitivity):		

Test sensitivity, mm	Penetrated thickness *w*, mm	
	Test class A	Test class B
Class A control: two steps lower for thicknesses over 10 up to 24 mm inclusive; two steps lower for thicknesses over 24 up to 30 mm inclusive; Class B control: a step lower for thicknesses over 12 up to 40 mm inclusive.		

Table 3.2.5.7-2

The minimum sensitivity of radiographic inspection during X-ray of piping welded joints at the next but two walls (indicator of image quality from the radiation source side) during panoramic X-ray examination of piping welded joints for X-ray devices and electron accelerators (indicator of image quality on the film side)[1]

Test sensitivity, mm	Penetrated thickness *w*, mm	
	Test class A	Test class B
0,050	–	$0 < w \le 1,5$
0,063	$0 < w \le 1,2$	$1,5 < w \le 2,5$
0,080	$1,2 < w \le 2$	$2,5 < w \le 4$
0,100	$2 < w \le 3,5$	$4 < w \le 6$
0,125	$3,5 < w \le 5$	$6 < w \le 8$
0,16	$5 < w \le 7$	$8< w \le 15$
0,20	$7 < w \le 12$	$15 < w \le 25$
0,25	$12 < w \le 18$	$25 < w \le 38$
0,32	$18 < w \le 30$	$38 < w \le 45$
0,40	$30 < w \le 40$	$45 < w \le 55$
0,50	$40 < w \le 50$	$55 < w \le 70$
0,63	$50 < w \le 60$	$70 < w \le 100$
0,80	$60 < w \le 85$	$100 < w \le 170$
1,0	$85 < w \le 120$	$170 < w \le 250$
1,25	$120 < w \le 220$	$250 < w$
1,60	$220 < w \le 380$	–
2,00	$380 < w$	–
[1] Refer to Footnote to Table 3.2.5.7-1.		

Table 3.2.5.7-3

The minimum sensitivity of radiographic inspection during X-ray of piping welded joints at the next but two walls (indicator of image quality on the film side) for X-ray devices and electron accelerators[1]

Test sensitivity, mm	Penetrated thickness *w*, mm	
	Test class A	Test class B
0,050	–	$0 < w \le 1,5$
0,063	$0<w \le 1,2$	$1,5 < w \le 2,5$
0,080	$1,2 < w \le 2$	$2,5 < w \le 4$
0.100	$2 < w \le 3,5$	$4<w \le 6$
0,125	$3,5 < w \le 5$	$6<w \le 12$
0,16	$5 < w \le 10$	$12 < w \le 18$
0,20	$10 < w \le 15$	$18 < w \le 30$
0,25	$15 < w \le 22$	$30 < w \le 45$
0,32	$22 < w \le 38$	$45 < w \le 55$
0,40	$38 < w \le 48$	$55 < w \le 70$
0,50	$48 < w \le 60$	$70 < w \le 100$
0,63	$60 < w \le 85$	$100 < w \le 180$
0,80	$85 < w \le 125$	$180 < w \le 300$
1,0	$125 < w \le 225$	300< w
1,25	$225 < w \le 375$	–
1,60	$375 < w$	–
[1] Refer to Footnote to Table 3.2.5.7-1.		

".

9 **Para 3.2.5.10** is replaced by the following text:

"**3.2.5.10** Types of radiographic films and relevant intensifying screens shall comply with the applicable international or national standards (ISO 17636-1:2013, EN 1435 and the similar standards).".

10 **Para 3.2.5.12** is replaced by the following text:

"**3.2.5.12** To interpret the welded joints radiographs X-ray viewers shall be used with adjustable size and brightness of the illuminated field in accordance with international standards, such as ISO 5580:1985.".

11 **Para 3.2.6.1** is replaced by the following text:

"**3.2.6.1** Ultrasonic testing of welded joints shall be applied and carried out in accordance with written specifications (procedures) developed on the basis of ISO 17640:2017 or other agreed international and national standards.".

12 **Para 3.2.6.6** is replaced by the following text:

"**3.2.6.6** To carry out ultrasonic testing the following shall be applied:

ultrasonic flaw pulse detectors of general purpose with piezoelectric transducers (probes) complying with the requirements of international and national standards (e.g., EN 12668 — all parts) included in the State Register of Measuring Equipment (for the Russian Federation) and with technical characteristics as per the requirements of these rules and specifications to carry out monitoring of specific objects;

PEC straight dual, straight single-dual, inclined dual and single-dual search units providing a frequency range of at least 2 to 6 MHz;

national or international standard specimens (gauge blocks) to check the basic control characteristics and settings of working modes of non-destructive testing (NDT) instruments (e.g., specimens of K-1 and K-2 of the International Institute of Welding for ISO 2400:2012; specimens of CO-2, CO-3 according to GOST 14782-86);

standard samples of the firm (gauge blocks) to set the reference sensitivity level of control that meet the requirements of the applicable standards;

devices for control of the mirror-like echo method as per schemes "straddle" and "tandem";

devices for stabilizing the acoustic coupling (bearings, nozzles) under the control by curved surfaces;

auxiliary arrangements and devices for evaluating the surface roughness and waviness, compliance with scanning parameters and measurement of parameters of the imperfections revealed;

DAC (distance-amplitude-curve) or DGS (distance gain size) of a diagram or scale;

specialized non-standard probes:

means of providing ultrasonic contact in accordance with the requirements of the applicable standards (e.g., EN 583-1).".

13 **Paras 3.2.6.12 — 3.2.6.15** are replaced by the following text:

"**3.2.6.12** In the case when estimation is performed in compliance with the admissible assessment levels of the revealed imperfections based on the length and amplitude of the echo signal, such as ISO 11666:2018, EN 1714 for initial testing the frequency shall be selected if possible closer to the lower limit within the recommended range of 2 to 6 MHz. Higher speed values closer to the upper limit of the recommended range, can be used to improve the control resolution capability range in the case it is necessary to assess the readings for compliance with the acceptable levels based on the characteristics of imperfections, such as ISO 23279:2017, EN 1713.

Frequencies within 1 MHz may be used for testing products with a longer sound channel where the signal attenuation level by the material is above average.

3.2.6.13 In accordance with the standards ISO 17640:2017 and ISO 11666:2018 during ultrasonic testing the following four levels of sensitivity and assessment of results are applied:

reference level is a sensitivity level used to set the initial level of the reference echo amplitudes;

evaluation level is a sensitivity level according to which or while exceeding it the assessment of the revealed imperfections shall be carried out (refer to Table 3.4.6.1);

recording level is a sensitivity level defined as complying with the admissible level of assessment minus 4 dB;

acceptance level is a level of assessment of the identified imperfections in compliance with the requirements for acceptance of products (refer to Table 3.4.6.1).

3.2.6.14 In accordance with ISO 17640:2017 for setting the reference level of ultrasonic testing sensitivity one of the methods listed may be used:

method 1 — reference level is a DAC (distance-amplitude curve) chart drawn up using standard specimens of the firm with the side drilled hole of 3 mm diameter (refer to Table 3.2.6.14-1);

method 2 — to set the reference level for the longitudinal and transverse waves DGS (distance gain size) charts or scales are used built using standard specimens with flat-bottom DSR — disc shaped reflectors. Reference levels of sensitivity in accordance with ISO 17640:2017 for inclined and straight PEC are shown in Table 3.2.6.14-2 and 3.2.6.14-3.

method 3 — for the reference level DAC chart is taken drawn up with the use of the firm's reference materials (standard specimens) with a rectangular notch 1 mm in width and 1 mm in depth. This method of sensitivity settings can be used for inclined PEC with an input angle of over 70° and a range of thicknesses of 8 mm ≤ *t* <15 mm;

Table 3.2.6.14-1

The requirement to the size of the firm's standard specimens (gauge blocks) to draw u DAC charts

The material thickness to be inspected, mm	Standard specimen thickness, mm	Hole diameter, mm	Distance from the hole to one of the surfaces, mm
10 < *t* ≤ 50	40 or *t*	Ø3±0,2	*t*/2 and *t*/4 Additional holes are permitted and recommended.
50 < *t* ≤ 100	75 or *t*		
100 < *t* ≤ 150	125 or *t*	Ø6±0,2	
150 < *t* ≤ 200	175 or *t*		
200 < *t* ≤ 250	225 or *t*		
t > 250	275 or *t*		
Notes: 1. The calibration (gauge) block (arrangement) shall be made of actually tested material, it shall have approved dimensions and be checked in accordance with the established procedure. 2. In the case ultrasonic testing is used to control rolled steel structures as delivered CR (controlled rolling) or TM (thermo-mechanical rolling), relevant gauge blocks (arrangements) shall be made perpendicular and parallel to the rolling direction. Rolling direction shall be clearly identified both on the gauge blocks and on a controlled product (item). 3. The use of reference materials for the control of large thicknesses with a side hole diameter of 6 mm is recommended as it is not regulated by ISO 17640:2017 and EN 1712.			

Table 3.2.6.14-2

Reference levels for acceptance levels 2 and 3 for technique 2 using angle beam scanning with transverse waves (method 2 of ISO 17640:2017)

Nominal probe frequency, MHz	The diameter of the disk-shaped reflector D_{DSR} at the thickness of parental metal *t*					
	8 ≤ *t* < 15		15 ≤ *t* < 40		40 ≤ *t* < 100	
	AL 2	AL 3	AL 2	AL 3	AL 2	AL 3
1,5 — 2,5	–	–	2,5 mm	2,5 mm	3,0 mm	3,0 mm
3 — 5	1,5 mm	1,5 mm	2,0 mm	2,0 mm	3,0 mm	3,0 mm
AL 2, AL 3 are admissible imperfections acceptance levels according to ISO 11666:2018.						

Table 3.2.6.14-3

Reference levels for acceptance levels (AL) 2 and (AL) 3 for technique 2 using straight beam scanning with longitudinal waves (method 2 of ISO 17640:2017)

Nominal frequency of PEC signal, MHz	The diameter of the disk-shaped reflector D_{DSR} at the thickness of parental metal *t*					
	8 ≤ *t* < 15		15 ≤ *t* < 40		40 ≤ *t* < 100	
	AL 2	AL 3	AL 2	AL 3	AL 2	AL 3
1,5 to 2,5	–	–	2,5 mm	2,5 mm	3,0 mm	3,0 mm
3 to 5	2,0 mm	2,0 mm	2,0 mm	2,0 mm	3,0 mm	3,0 mm
AL 2, AL 3 are admissible imperfections acceptance levels according to ISO 11666:2018.						

method 4 — using sonic testing schemes "straddle" and "tandem" as a reference level signal is received from the flat- bottomed hole with a diameter of 6 mm (for all thicknesses) perpendicular to the surface scanned. This method only applies to the loop input angle of 45° and thickness $t \geq 15$ mm.

3.2.6.15 Weld test scheme on the quantity of scanning directions and scan camera angles applied (PEC inclined input angle) shall comply with the applicable international or national standards, such as ISO 17640:2017 or EN 1712. Thus, for welds of increased and high steel strength irrespective of applicable acceptable level, as well as for an applicable acceptable level "B" as per ISO 5817:2014 (procedure and testing level is not lower than "B" ISO 17640:2017, ISO 11666:2018 acceptance level 2, refer to Table 3.4.1.4) it is obligatory to perform sounding (scanning) to detect transverse imperfections (T-scan).

Note. If the manufacturer is able to provide documentary evidence of indisposition for cracking of the applied materials used and welding process, scanning cannot be implemented for high strength steels of categories A/F 40 and lower in thicknesses up to 40 mm inclusive to detect transverse imperfections (T-scan) at the control level on acceptance level 3 ISO 11666:2018.".

14 **Para 3.2.6.20** is replaced by the following text:

"**3.2.6.20 Ultrasonic testing method. Automated ultrasonic examination using Phased Array Ultrasonic Testing (PAUT).**

3.2.6.20.1 Phased Array Ultrasonic Testing (PAUT) is used for metal welded joints made by fusion welding with the minimum thickness of 6 mm.

Depending on automation degree, there are automated (AUT) and semi-automated (SAUT) ultrasonic testing using phased array.

Automated ultrasonic examination (AUT) is a technique of ultrasonic examination performed with equipment and search units that are mechanically mounted and guided, remotely operated, and motor-controlled (driven) without adjustments by the technician. The equipment used to perform the examinations is capable of recording the ultrasonic response data, including the scanning positions, by means of integral encoding devices such that imaging of the acquired data can be performed. When performing AUT, one or more operations (scanning, positioning, result recording) is effected in automated mode.

Semi-automated ultrasonic examination (SAUT) is a technique of ultrasonic examination performed with equipment and search units that are mechanically mounted and guided, manually assisted (driven), and which may be manually adjusted by the technician. The equipment used to perform the examinations is capable of recording the ultrasonic response data, including the scanning positions, by means of integral encoding devices such that imaging of the acquired data can be performed. SAUT is carried out using manual scanning devices with result recording.

3.2.6.20.2 Phased array ultrasonic testing (PAUT) shall be conducted in accordance with the procedures based on ISO 13588:2019, ISO 18563-1:2015, ISO 18563-2:2017, ISO 18563-3:2015 and ISO 19285:2017 or agreed standards and appropriate RS requirements.

3.2.6.20.3 PAUT procedure shall be written and include the following information as in minimum shown in Table 3.2.6.20.3. When an essential variable shall change from the value specified in Table 3.2.6.20.3, or range of values, the written procedure shall require requalification. When a nonessential variable shall change from the specified value, or range of values, requalification of the written procedure is not required. All changes of essential or nonessential variables from the value, or range of values, specified by the written procedure shall require revision of, or an addendum to, the written procedure.

Table 3.2.6.20.3

Requirements of a phased array ultrasonic testing procedure (PAUT)

Requirement	Essential Variable	Nonessential Variable
Material types or weld configurations to be examined, including thickness dimensions and material product form (castings, forgings, pipe, plate, etc.)	X	–
The surfaces from which the examination shall be performed	X	–
Technique(s) (straight beam, angle beam, contact, and/or immersion)	X	–
Angle(s) and mode(s) of wave propagation in the material	X	–

Requirement	Essential Variable	Nonessential Variable
Search unit type, frequency, element size and number, pitch and gap dimensions, and shape	X	–
Focal range (identify plane, depth, or sound path)	X	–
Virtual aperture size (i.e., number of elements, effective height1, and element width)	X	–
Focal laws for E-scan and S-scan (i.e., range of element numbers used, angular range used, element or angle increment change)	X	–
Special search units, wedges, shoes, or saddles, when used	X	–
Ultrasonic instrument(s)	X	–
Calibration [calibration block(s) and technique(s)]	X	–
Directions and extent of scanning	X	–
Scanning (by using mechanical / automatic means)	X	–
Method for sizing indications and discriminating geometric from flaw indications	X	–
Computer enhanced data acquisition, when used	X	–
Scan overlap (decrease only)	X	–
Personnel performance requirements, when required	X	–
Testing levels, acceptance levels and/or recording levels	X	–
Personnel qualification requirements	–	X
Surface condition (examination surface, calibration block)	–	X
Couplant (brand name or type)	–	X
Post-examination cleaning technique	–	X
Automatic alarm and/or recording equipment, when applicable	–	X
Records, including minimum calibration data to be recorded (e.g., instrument settings)	–	X
Environmental and safety issues	–	X
[1] Effective height is the distance from the outside edge of the first to last element used in the focal law.		

".

15 **Para 3.2.8.4** is replaced by the following text:

"**3.2.8.4** ANDT procedure approval.

The testing procedure shall be evaluated based upon the qualification results and, if satisfactory, the procedure can be considered approved.".

16 **Tables 3.3.3 and 3.3.4.** Throughout the text of Tables the term "visual" is replaced by "visual and measurement".

17 **Tables 3.4.1.3, 3.4.1.4, 3.4.2.1, 3.4.5.3** and **3.4.6.1.** References to ISO standards are specified as follows:

"Table 3.4.1.3

Class of structure[1]	Type of welded joint	Minimum quality level in compliance with ISO 5817:2014	
		Boilers and heat exchangers	Piping
I	Plate butt	B	B
	Fillet joints, T-joints and cruciform joints with full penetration	B	B
	Fillet joints, T-joints and cruciform joints with beveling and structural lacks of fusion	B	B
	Fillet joints, T-joints and cruciform joints performed by a fillet weld without beveling	C	C
II	Plate butt	B	B
	Fillet joints, T-joints and cruciform joints with full penetration	B	B
	Fillet joints, T-joints and cruciform joints with beveling and structural lacks of fusion	C	C
	Fillet joints, T-joints and cruciform joints performed by a fillet weld without beveling	C	C
III	Plate butt	B	B
	Fillet joints, T-joints and cruciform joints with full penetration	C	C
	Fillet joints, T-joints and cruciform joints with beveling and structural lacks of fusion	C	C
	Fillet joints, T-joints and cruciform joints performed by a fillet weld without beveling	C	C
[1] In compliance with 1.3.2, Part VIII "Systems and Piping" and 1.3.1.2, Part X "Boilers, Heat Exchangers and Pressure vessels".			

";

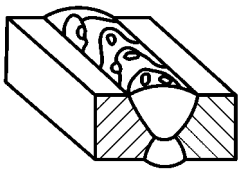
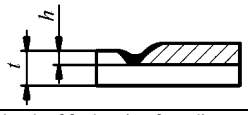
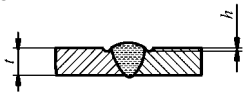
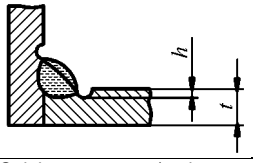
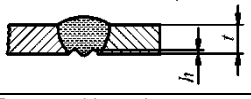
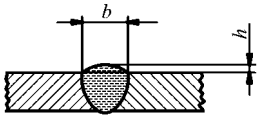
"Table 3.4.1.4

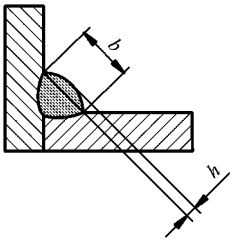
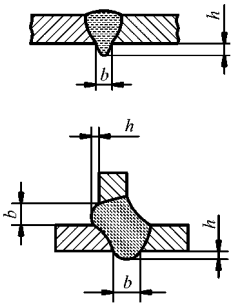
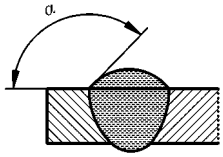
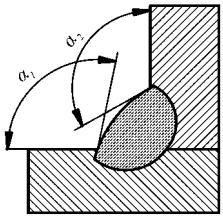
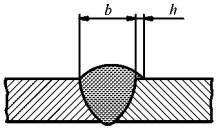
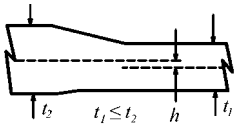
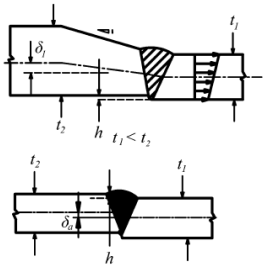
Quality level in accordance with ISO 5817:2014	Radiographic testing		Ultrasonic (US) testing[1]		Visual and Inspection testing		Magnetic Particle testing		Penetrant testing	
	Testing techniques and classes in accordance with ISO 17636-1:2013	Acceptance levels in accordance with ISO 10675-1:2021	Testing technique and level in accordance with ISO 17640:2018	Acceptance level in accordance with ISO 11666:2018	Testing technique and level in accordance with ISO 17637: 2016	Acceptance level[2]	Testing techniques and classes in accordance with ISO 17638:2016	Acceptance levels in accordance with ISO 23278: 2015	Testing technique and level in accordance with ISO 3452-1: 2021	Acceptance levels in accordance with ISO 23277: 2015
B	B	1	at least B	2	Testing level is not specified	B	Testing level is not specified	2×[3]	Testing level is not specified	2×[3]
C	B[4]	2	at least A	3		C		2×[3]		2×[3]
D	A	3	at least A[5]	3[5]		D		3×[3]		3×[3]

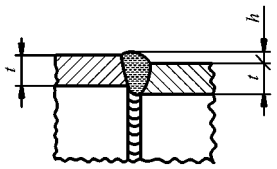
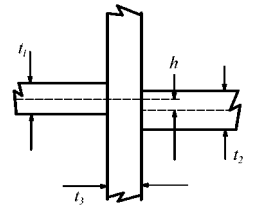
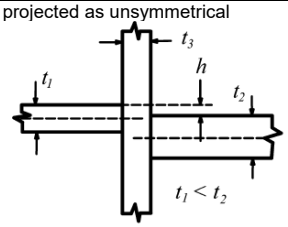
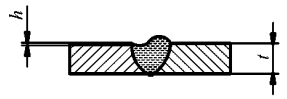
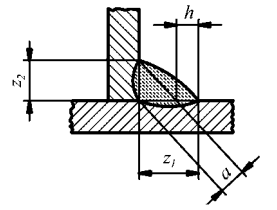
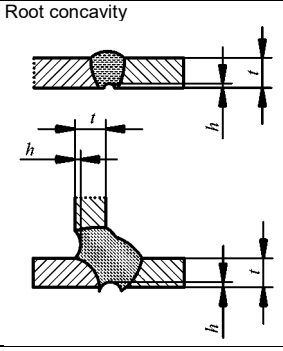
[1] In case the definition of the imperfections character is required ISO 23279:2017 is applied.
[2] Acceptance level for visual and inspection testing are incompliance with Quality Levels in accordance with ISO 5817:2014.
[3] Quality levels 2 and 3 can have index "×" which designates all imperfections above 25 mm and are not permitted.
[4] The minimum number of exposure for circumferential weld testing may correspond to the requirements of class A of ISO 17636-1:2013.
[5] UT in accordance with ISO 11666:2018 for Level Quality D (ISO 5817:2014) is not recommended, but upon its application it can be defined with the same requirements as Quality level C (ISO 5817:2014).

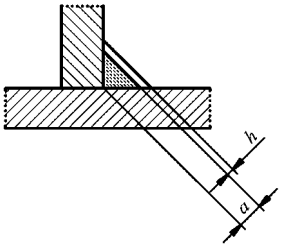
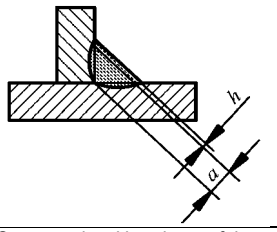
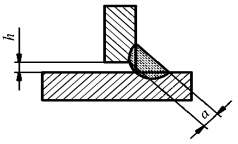
";

"Table 3.4.2.1

No	Imperfection designation Reference to	ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 5817:2014			Remarks
				B	C	D	
1	Crack	100	–	Not permitted			
2	Crater crack	104	–	Not permitted			
3	Surface pore 	2017	*d* — maximum dimension:				Clusters and lines on the weld surface are not permitted
			butt welds;	Not permitted	*d* ≤ 0,2*s* but max. 2,0 mm	*d* ≤ 0,3*s* but max. 3,0 mm	
			fillet welds	Not permitted	*d* ≤ 0,2*a* but max. 2,0 mm	*d* ≤ 0,3*a* but max. 3,0 mm	
4	End crater pipe 	2025	*h* — crater height (cross sectional dimension of under cut)	Not permitted	*h* ≤ 0,10*t* but max. 1,0 mm	*h* ≤ 0,20*t* but max. 2,0 mm	For levels C and D may not be permitted under painting conditions
5	Lack of fusion (surfaced)	401	–	Not permitted			
6	Incomplete root penetration (for single sided butt welds) 	4021	*h* — maximum height *l* — maximum length of a single imperfection	Not permitted	Not permitted	*h* ≤ 0,2*t*, but max. 2,0 mm *l* ≤ 25 mm	For level D may not be permitted under painting conditions
7	Intermittent undercut and Continuous undercut: butt weld [1)] 	5012, 5011	*h* — maximum height	*h* ≤ 0,05*t* but max. 0,5 mm	*h* ≤ 0,10*t* but max. 0,5 mm	*h* ≤ 0,20*t*, but max. 1,0 mm	[1)]Simultaneous undercut on both edges of the weld side is not permitted
	fillet joint 		*h* — maximum height	*h* ≤ 0,05*t* but max. 0,5 mm	*h* ≤ 0,10*t* but max. 0,5 mm	*h* ≤ 0,20*t*, but max. 1,0 mm	
8	Strinkage grooves (undercuts on both sides of the weld) 	5013	*h* — maximum height	*h* ≤ 0,05*t* but m. ax0,5 mm	*h* ≤ 0,1*t* but max. 1 mm	*h* ≤ 0,2*t* but max. 2,0 mm	
			l — maximum length of a single imperfection	*l* ≤ 25 mm	*l* ≤ 25 mm	*l* ≤ 25 mm	
9	Excess weld metal 	502	*h* — maximum height reinforcement *b* — breadth of reinforcement	*h* ≤ 1 mm + 0,1*b* but max. 5 mm	*h* ≤ 1 mm + 0,15*b* but max. 7 mm	*h* ≤ 1 mm +0,25*b* but max.10 mm	

No	Imperfection designation Reference to	ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 5817:2014			Remarks
				B	C	D	
10	Excessive convexity 	503	*h* — maximum convexity *b* — breadth of reinforcement	*h* ≤ 1 mm + 0,1*b* but max. 3 mm	*h* ≤ 1 mm +0,15*b* but max. 4 mm	*h* ≤ 1 mm +0,25*b* but max. 5 mm	
11	Excessive penetration (weld root slack) 	504	*h* — maximum penetration height *b* — breadth of penetration	*h* ≤ 1 mm + 0,2*b* but max. 3 mm	*h* ≤ 1 mm + 0,6*b* but max. 4 mm	*h* ≤ 1 mm + 1,0*b* but max. 5 mm	
12	Incorrect weld toe: butt welds 	505	α — angle between base metal surface and flat surface tangent to convexity	α ≥ 150°	α ≥ 100°	α ≥ 90°	
	fillet welds $\alpha_1 \geq \alpha$, $\alpha_2 \geq \alpha$ 			α ≥ 110°	α ≥ 110°	α ≥ 90°	For smooth transition for quality levels B and C special handling of the weld may be required
13	Overlap 	506	*h* — overlap dimension	Not permitted	Not permitted	*h* ≤ 0,2*b*	
14	Linear misalignment between plates and caps of pipes: projected as symmetrical; 	5071	*h* — height of linear misalignment defined as misalignment of axes along the thickness plates	*h* ≤ 0,1t_1 but max. 3 mm	*h* ≤ 0,15t_1 but max. 4 mm	*h* ≤ 0,25t_1 but max. 5 mm	
	projected as unsymmetrical 		defined as deviation of external plate line	*h* ≤ 0,1t_1 but max. 3 mm	*h* ≤ 0,15t_1 but max. 4 mm	*h* ≤ 0,25t_1 but max. 5 mm	

No	Imperfection designation Reference to	ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 5817:2014			Remarks
				B	C	D	
15	Linear misalignment between tubes (pipes) 	5072	h — height of linear misalignment defined as the deviation of the welded pipes external diameter t = min{t_1 and t_2}	$h \le 0{,}5t$ but max. 2 mm	$h \le 0{,}5t$ but max. 3 mm	$h \le 0{,}5t$ but max. 4 mm	
16	Linear misalignment of cruciform joints: projected as symmetrical; 		h — height of linear misalignment: defined as deviation of axes along the thickness plates t = min{t_1, t_2 and t_3}	$h \le 0{,}15t$	$h \le 0{,}30t$	$h \le 0{,}50t$	
	projected as unsymmetrical 		defined as deviation of common external line of plates t = min{t_1, t_2 and t_3}	$h \le 0{,}15t$	$h \le 0{,}30t$	$h \le 0{,}50t$	
17	Sagging Incompletely filled groove 	509 511	h — height of sagging or incompleteness of groove	$h \le 0{,}05t1$ but max. 0,5 mm	$h \le 0{,}1t$ but max. 1 mm	$h \le 0{,}25t1$ but max. 2,0 mm	
			l — length of imperfection	$l \le 25$ mm	$l \le 25$ mm	$l \le 25$ mm	
18	Burn-through (leakage of welding bath with formation of through hole in the weld)	510		Not permitted	Not permitted	Not permitted	
19	Excessive asymmetry of fillet weld 	512	h=z_1–z_2 — height of asymmetry (different leg lengths)	$h \le 1{,}5$ mm + 0,15a	$h \le 1{,}5$ mm + 0,15a	$h \le 1{,}5$ mm + 0,15a	
20	Irregular surface: pimpling and scaling;	514	h — height of pimpling and scaling	$h \le 1{,}5$ mm	$h \le 2$ mm	$h \le 2$ mm	Height of drops between beads, height of pimpling and scaling shall be measured among tops of pimpling and scaling
	drops between beads		h — height of drops between beads	$h \le 1{,}5$ mm	$h \le 2$ mm	$h \le 2$ mm	
21	Root concavity 	515	h — height of root concavity l — length of imperfection	$h \le 0{,}05t$ but max. 0,5 mm $l \le 25$ mm	$h \le 0{,}1t$ but max. 1 mm $l \le 25$mm	$h \le 0{,}2t$ but max. 2,0 mm $l \le 25$ mm	
22	Root porosity spongy formation at the root of a weld due to bubbling of the weld metal at the moment of solidification (for example, at insufficient gas protection at the root)	516		Not permitted	Not permitted	Permitted but only local	May not be permitted for level D under conditions of painting

No	Imperfection designation Reference to	ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 5817:2014			Remarks
				B	C	D	
23	Poor restart. local surface irregularity at a weld restart	517		Not permitted	Not permitted	Permitted	May not be permitted for level D under conditions of painting
24	Insufficient throat thickness 	5213	*h* — height if insufficience (reduction from nominal dimension) of fillet weld thickness *a*	Not permitted	*h* ≤ 0,3 mm +0,1*a* but max. 1 mm	*h* ≤ 0,3 mm +0,1*a* but max. 1 mm	
			l — length of imperfection		*l* ≤ 25 mm	*l* ≤ 25 mm	
25	Excessive throat thickness 	5214	*h* — height of excessive throat of fillet weld thickness *a*	*h* ≤ 1 mm + 0,15*a* but max. 3 mm	*h* ≤ 1 mm + 0,2*a* but max 4 mm	Unlimited	
26	Stray arc: local breakage of the base metal surface close to weld due to arc burning outside grooving	601		Not permitted	Not permitted	Permitted, if the properties of the base metal are not affected	Refer to Table 9.13, Part A, IACS Standard No. 47
27	Spatter 	602		Not permitted	To be removed from the surface subject to coating requirements.		Refer to para. 4.2.4.2, Part A, IACS Standard No. 47
28	Incorrect root gap for fillet welds 	617	*h* — height of root gap of single sided weld *a* — thickness of fillet weld	*h* ≤ 0,5 mm +0,1*a* but max 2 mm	*h* ≤ 0,5 mm +0,2*a* but max 3 mm	*h* ≤ 1 mm +0,3*a* but max 4 mm	On agreement with the Register gaps exceeding the appropriate limit may be compensated for by a corresponding increase in the throat.

";

"Table 3.4.5.3

No.	Imperfection designation	Reference to ISO 6520-1: 2007	Specifications of imperfections	Limits to imperfection for quality levels		
				1	2[1]	3[1]
1	Crack	100	–	Not permitted	Not permitted	Not permitted
2*a*	Gas pore and Uniformly distributed porosity Single layer weld	2011 2012	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$ *d* — maximum pore diameter	*A* ≤ 1% *d* ≤ 0,2*s* but max. 3 mm *L* = 100 mm	*A* ≤ 1,5% *d* ≤ 0,3*s* but max. 4 mm *L* = 100 mm	*A* ≤ 2,5% *d* ≤ 0,4*s* but max. 5 mm *L* = 100 mm
2*b*	Gas pore Uniformly distributed porosity Multi layer weld	2011 2012	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$ *d* — maximum pore diameter	*A* ≤ 2% *d* ≤ 0,2*s* but max. 3 mm *L* = 100 mm	*A* ≤ 3,0% *d* ≤ 0,3*s* but max. 4 mm *L* = 100 mm	*A* ≤ 5% *d* ≤ 0,4*s* but max. 5 mm *L* = 100 mm
3	Clustered (localized) porosity	2013	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$ *d* — maximum pore diameter	*A* ≤ 4% *d* ≤ 0,2*s* but max. 2 mm *L* = 100 mm	*A* ≤ 8% *d* ≤ 0,3*s* but max. 3 mm *L*= 100 mm	*A* ≤ 16% *d* ≤ 0,4*s* but max. 4 mm *L* = 100 mm
4*a*	Linear porosity (Lines) Single layer weld	2014	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$ *d* — maximum pore diameter	*A* ≤ 2% *d* ≤ 0,2*s* but max. 2 mm *L* = 100 mm	*A* ≤ 4,0% *d* ≤ 0,3*s* but max. 3 mm *L* = 100 mm	*A* ≤ 8% *d* ≤ 0,4*s* but max. 4 mm *L* = 100 mm
4*b*	Linear porosity (Lines) Multi layer weld	2014	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$ *d* — maximum pore diameter	*A* ≤ 4% *d* ≤ 0,2*s* but max. 2 mm *L* = 100 mm	*A* ≤ 8,0% *d* ≤ 0,3*s* but max. 3 mm *L* = 100 mm	*A* ≤ 16% *d* ≤ 0,4*s* but max. 4 mm *L* = 100 mm
5	Wormholes (pipes) and Elongated cavity	2016 2015	*h* — width of imperfection projection Σl — maximum total length of weld imperfection projection *L*	*h* < 0,2 *s* but max. 2 mm Σl ≤ *s* but max. 25 mm *L* = 100 mm	*h* < 0,3 *s* but max. 3 mm Σl ≤ *s* but max. 50 mm *L*= 100 mm	*h* < 0,4 *s* but max. 4 mm Σl ≤ *s* but max. 75 mm *L* = 100 mm

No.	Imperfection designation	Reference to ISO 6520-1: 2007	Specifications of imperfections	Limits to imperfection for quality levels		
				1	2[1]	3[1]
6	Shrinkage cavity (except for crater pipe — 2024)	202	*h* — width of imperfection projection *l* — length of imperfection projection	Not permitted	Not permitted	*h* < 0,4 *s* но н.б. 4 мм *l* ≤ 25 мм
7	Crater pipe	2024	*h* — width of imperfection projection *l* — length of imperfection projection	Not permitted	Not permitted	*h* < 0,2 *t* but max. 2 mm *l* ≤ 0,2*t*, but max. 2 mm
8	Slag inclusions, Flux inclusions Oxide inclusions	301 302 303	*h* — width of imperfection projection Σl — maximum total length of weld imperfection projection *L*	*h* < 0,2 *s* but max. 2 mm Σl ≤ *s* but max. 25 mm *L* = 100 mm	*h* < 0,3 *s* but max. 3 mm Σl ≤ *s* but max. 50 mm *L*= 100 mm	*h* < 0,4 *s* but max. 4 mm Σl ≤ *s* but max. 75 mm *L* = 100 mm
9	Metallic inclusions other than copper	304	*l* — length of imperfection projection	*l* < 0,2 *s* but max. 2 mm	*l* < 0,3 *s* but max. 3 mm	*l* < 0,4 *s* but max. 4 mm
10	Copper inclusions	3042	–	Not permitted	Not permitted	Not permitted
11[2]	Lack of fusion	401	Σl — maximum total length of weld imperfection projection *L*	Not permitted	Not permitted	Permitted but only intermittent and not surfaced Σl ≤ 25 mm, *L* = 100 mm
12[2]	Lack of penetration	402	Σl — maximum total length of weld imperfection projection *L*	Not permitted	Not permitted	Σl ≤ 25 mm, *L* = 100 mm

Symbols:
L — any (with imperfection maximum density) 100 mm weld length;
s — nominal thickness of the butt weld;
t — material thickness;
Wp — weld width.

[1] Quality levels 2 and 3 can have index "×" which designates all imperfections above 25 mm and are not permitted.
[2] If the weld length is under 100 mm the maximum imperfection length shall not be above 25 % of that length.

";

"Table 3.4.6.1

Method for setting the reference level according to ISO 17640:2017[1]	Evaluation level of sensitivity for Acceptance level[2]		Acceptance level 2 (AL 2) for thicknesses[2,3,4]		Acceptance level 3 (AL 3) for thicknesses[2,3,4]	
	2	3	8 mm ≤ *t* <15 mm	15 mm ≤ *t* <100 mm	8 mm ≤ *t* <15 mm	15 mm ≤ *t* < 100 mm
1 (side-drilled holes)	H_0 – 14 dB	H_0 – 10 dB	For *l* ≤ *t*: H_0–4 dB For *l* > *t*: H_0–10 dB	For *l* ≤ 0,5t: H_0 For 0,5*t* < *l* ≤ *t*: H_0–6 dB For *l* > *t*: H_0–10 dB	For *l* ≤ *t*: H_0 For *l* > *t*: H_0–6 dB	For *l* ≤ 0,5*t*: H_0 + 4 dB For 0,5*t* < *l* ≤ *t*: H_0–2 dB For *l* > *t*: H_0–6 dB
2 (flat-bottom holes (disk-shaped reflectors))	H_0 – 8 dB	H_0 – 4 dB	For *l* ≤ *t*: H_0 + 2 dB For *l* > *t*: H_0–4 dB	For *l* ≤ 0,5*t*: H_0 + 6 dB For 0,5*t* < *l* ≤ t:H_0 For *l* > *t*: H_0– 4 dB	For *l* ≤ *t*: H_0 + 6 dB For *l* > *t*: H_0	For *l* ≤ 0,5*t*: H_0+10 dB For 0,5*t* < *l* ≤ *t* H_0 + 4 dB: For *l* > *t*: H_0
3 (rectangular notch)	H_0 – 14 dB	H_0 – 10 dB	For *l* ≤ *t*: H_0–4 dB For *l* > *t*: H_0–10 dB	–	For *l* ≤ *t*: H_0 For *l* >*t*: H_0–6 dB	–
4 (straddle and tandem technique)	H_0 – 22 dB	H_0 – 18 dB	–	For *l* ≤ 0,5*t*: H_0–8 dB For 0,5*t* < *l* ≤ *t*: H_0–14 dB For *l* > *t*: H_0–18 dB	–	For *l* ≤ 0,5*t*: H_0–4 dB For 0,5*t* < *l* ≤ *t*: H_0–10 dB For *l* > *t*: H_0–14 dB

[1] Refer to 3.2.6.14.
[2] H_0 — reference level according to ISO 17640:2017 (refer to 3.2.6.13)
[3] *l* — length of imperfection
[4] *t* — thickness of base metal

".

18 **Para 3.4.7.4** is replaced by the following text:

"**3.4.7.4** Quality assessment of welded joints based on the results of digital radiography (RT-D).

The applicable levels of defect assessment in connection with the established quality levels shall comply with ISO 10675-1:2021 or other standard agreed with the Register.

The relationship between acceptance levels, testing levels and quality levels is given in Table 3.4.7.4.

Table 3.4.7.4

Quality levels according to ISO 5817:2014 or ISO 10042:2018	Testing techniques/level(class) according to ISO 17636-2:2013	Acceptance level according to ISO 10675-1:2021
B	B (class)	1
C	B* (class)	2
D	A (class)	3
* For circumferential weld testing, the minimum number of exposures may correspond to the requirements of ISO 17636-2:2013, class A		

".

19 **Paras 3.5.1.1 — 3.5.1.3** are replaced by the following text:

"**3.5.1.1** Assessment of welded joint quality in aluminium alloy hull structures shall be carried out based on the quality levels in compliance with the relevant requirements of ISO 10042:2018 or other agreed international and national standards.

3.5.1.2 Requirements for the quality levels that meet the requirements of ISO 10042:2018 for hull structures of ships shall be agreed with the Register individually depending on the type of a ship and its size. In any case, an acceptable level of quality shall be at least "C" in accordance with ISO 10042:2018 except for the size requirements for weld reinforcement during an external examination and measurements, which can be lowered to level "D" as agreed with the Register.

3.5.1.3 For specific non-destructive testing procedure acceptable levels of imperfection acceptance in accordance with the specified quality levels as per ISO 10042:2018, as well as the requirements for the class and procedure of control are established by the requirements of the relevant international standards and shall be assigned in accordance with Table 3.5.1.3.

Table 3.5.1.3

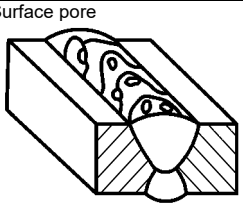
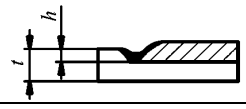
Quality level in compliance with ISO 10042:2018	Requirements for radiographic testing		Requirements for penetrant methods	
	Methods and class as per ISO 17636-1:2013 and ISO 17636-2:2013	Assessment level (quality grade) in compliance with ISO 10675-2:2021	Methods and class as per ISO 3452-1:2021	Assessment level (quality grade) in compliance with ISO 23277:2015
B	B	1	Test Class (level) is not specified	2×
C	B[1]	2		2×
D	A	3		3×
[1] For circumferential piping welded joints minimum quantity of exposures (radiographs) can comply with the requirements for class A ISO 17636:2013 (Parts 1 and 2).				

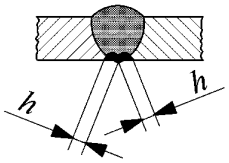
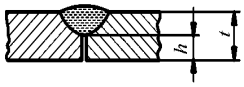
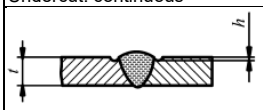
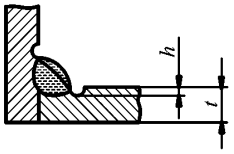
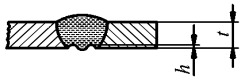
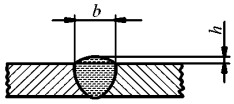
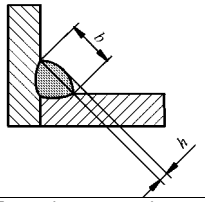
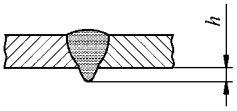
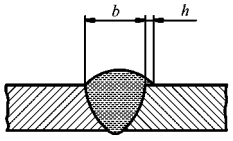
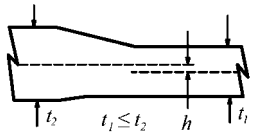
".

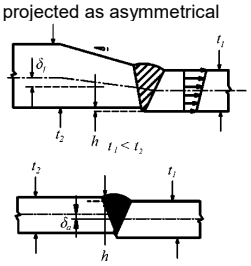
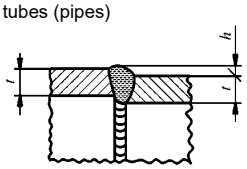
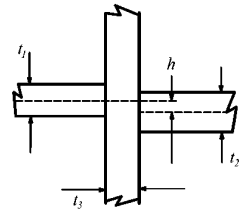
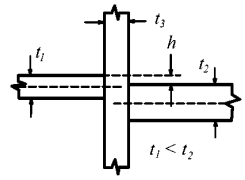
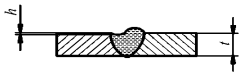
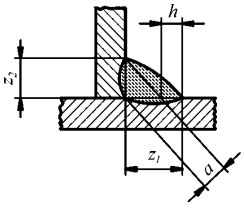
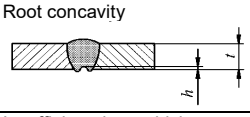
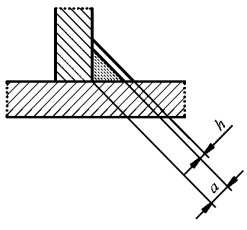
20 **Para 3.5.2.1** is replaced by the following text:

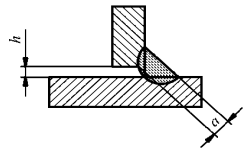
"**3.5.2.1** If otherwise is not agreed with the Register, assessment of the welded joints quality on the visual testing results shall be carried out in accordance with ISO 10042:2018 (refer to Table 3.5.2.1) for the quality levels agreed with the Register.

Table 3.5.2.1

No.	Imperfection designation	Reference to ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 10042:2018			Remarks
				B	C	D	
1	Crack	100	—		Not permitted		–
2	Crater crack	104	*l* — length *h* — height	Not permitted		*l* ≤ 0,4*t* or *l* ≤ 0,4*a* *h* ≤ 0,4*t* or *h* ≤ 0,4*a*	–
3	Surface pore 	2017	*d* — maximum dimension for weld profile concavity: 0,5 mm ≤ *t* ≤ 3 mm	*d* ≤ 0,1*t* or *d* ≤ 0,1*a*	*d* ≤ 0,2*t* or *d* ≤ 0,2*a*	*d* ≤ 0,3*t* or *d* ≤ 0,3*a*	Clusters and lines on the weld surface are not permitted
			t > 3 mm	*d* ≤ 0,2*t* or *d* ≤ 0,2*a* but max. 1 mm	*d* ≤ 0,3*t* or *d* ≤ 0,3*a* but max. 1,5 mm	*d* ≤ 0,4*t* or *d* ≤ 0,4*a* but max. 3 mm	
4	End crater pipe 	2025	*h* — crater height (cross sectional dimension of undercut)	Not permitted	*h* ≤ 0,20*t*, but max. 1,5 mm	*h* ≤ 0,40*t*, but max. 3 mm	For levels C and D may not be permitted under painting conditions

No.	Imperfection designation	Reference to ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 10042:2018			Remarks
				B	C	D	
5	Lack of fusion (surfaced) 	401	*h* — height *l* — length of a single imperfection	Not permitted	Not permitted	*h* ≤ 0,1*t* or *h* ≤ 0,1*a* but max. 3 mm *l* ≤ 25 mm	
6	Incomplete root penetration (for single sided butt welds) 	4021	*h* — maximum height *l* — maximum length of a single imperfection	Not permitted	Not permitted	*h* ≤ 0,20*t* but max. 2,0 mm *l* ≤ 25 mm Single non systematical imperfections may be permitted	For level D may not be permitted under painting conditions
7	Undercut: continuous						
		5011	*h* — maximum height	Not permitted	*h* ≤ 0,10*t* but max. 0,5 mm	*h* ≤ 0,20*t* but max. 1,0 mm	
	intermittent 	5012	*h* — maximum height *l* — length	*h* ≤ 0,10*t* but max. 0,5 mm *l* ≤ 25 mm	*h* ≤ 0,10*t* but max. 1 mm *l* ≤ mm	*h* ≤ 0,20*t* but max. 1,5 mm *l* ≤ 25 mm	
8	Strinkage grooves (undercuts on both sides of the weld) 	5013	*h* — maximum height *l* — maximum length of a single imperfection	*h* ≤ 0,05*t* but max. 0,5 mm *l* ≤ 25 mm	*h* ≤ 0,1*t* but max. 1 mm *l* ≤ 25 mm	*h* ≤ 0,2*t* but max. 1,5 mm *l* ≤ 25 mm	
9	Excess weld metal 	502	*h* — maximum reinforcement height *b* — breadth of reinforcement	*h* ≤ 1,5 mm + 0,1*b* but max. 6 mm	*h* ≤ 1,5 mm + 0,15*b* but max. 8 mm	*h* ≤ 1,5 mm + 0,2*b* but max. 10 mm	
10	Excessive convexity 	503	*h* — maximum convexity *b* — breadth of fillet weld	*h* ≤ 1,5 mm + 0,1*b* but max. 3 mm	*h* ≤ 1,5 mm+0,15*b* but max. 4 mm	*h* ≤ 1,5 mm + 0,3*b* but max. 5 mm	
11	Excessive penetration 	504	*h* — maximum penetration height *b* — breadth of penetration	*h* ≤ 3 mm	*h* ≤ 4 mm	*h* ≤ 5 mm	
12	Overlap 	506	*h* — overlap height *l* — length of a single imperfection	Not permitted	Not permitted	*h* ≤ 0,2*t* *l* ≤ 25 mm	
13	Linear misalignment between plates and caps of pipes: projected as symmetrical 	5071	*h* — dimension of linear misalignment: defined as misalignment of axes along the thickness plates	*h* ≤ 0,2*t* but max. 2 mm	*h* ≤ 0,3*t* but max. 4 mm	*h* ≤ 0,4*t* but max. 8 mm	

No.	Imperfection designation	Reference to ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 10042:2018			Remarks
				B	C	D	
	projected as asymmetrical 		defined as deviation of external plate line	$h \le 0{,}2t$ but max. 2 mm	$h \le 0{,}3t$ but max. 4 mm	$h \le 0{,}4t$ but max. 8 mm	
14	Linear misalignment between tubes (pipes) 	5072	h — height of linear misalignment defined as the deviation of the welded pipes external diameter $t = \min\{ t_1 \text{ and } t_2\}$	$h \le 0{,}2t$ but max. 4 mm	$h \le 0{,}3t$ but. 6 mm	$h \le 0{,}4t$ but max. 10 mm	
15	Linear misalignment of cruciform joints: projected as symmetrical 		h — height of linear misalignment defined as deviation of axes along the thickness plates $t = \min\{t_1, t_2 \text{ and } t_3\}$	$h \le 0{,}2t$	$h \le 0{,}30t$	$h \le 0{,}50t$	
	projected as asymmetrical 		defined as deviation of common external line of plates $t = \min\{t1, t2 \text{ and } t3\}$	$h \le 0{,}15t$	$h \le 0{,}30t$	$h \le 0{,}50t$	
16	Sagging Incompletely filled groove 	509 511	h — height of sagging or incompleteness of groove l — length of imperfection	$h \le 0{,}05t$ but max. 0,5 mm $l \le 25$ mm	$h \le 0{,}1t$ but max. 1 mm $l \le 25$ mm	$h \le 0{,}2t$ but max. 2,0 mm $l \le 25$ mm	
17	Excessive asymmetry of fillet weld 	512	$h = z_1 - z_2$ — height of asymmetry (different leg lengths)	$h \le 1{,}5$ mm + $0{,}2a$	$h \le 2$ mm + $0{,}25a$	$h \le 3$ mm + $0{,}3a$	
18	Root concavity 	515	h — height of root concavity l — length of imperfection	$h \le 0{,}05t$ but max. 0,5 mm $l \le 25$ mm	$h \le 0{,}1t$ but max.1 mm $l \le 25$ mm	$h \le 0{,}2t$ but max.2,0 mm $l \le 25$ mm	
19	Insufficient throat thickness 	5213	h — height if insufficience (reduction from nominal dimension) of fillet weld thickness a l — length of imperfection	$h \le 0{,}1a$ but max. 1 mm	$h \le 0{,}2a$ but max. 1,5 mm	$h \le 0{,}3a$ but max. 2 mm	
				$l \le 25$ mm	$l \le 25$ mm	$l \le 25$ mm	

No.	Imperfection designation	Reference to ISO 6520-1:2007	Specifications of imperfections and the weld dimensions	Limits for imperfections for quality levels ISO 10042:2018			Remarks
				B	C	D	
20	Incorrect root gap for fillet weld 	617	*h* — height of root gap of single sided weld *a* — thickness of fillet weld	*h* ≤ 0,5 mm + 0,1*a* but max. 3 mm	*h* ≤ 0,5 mm + 0,15*a* but max. 4 mm	*h* ≤ 1 mm + 0,2*a* but max. 5 mm	On agreement with the Register gaps exceeding the appropriate limit may be compensated for by a corresponding increase in the throat

".

21 **Para 3.5.3.1** is replaced by the following text:

"**3.5.3.1** If otherwise is not agreed with the Register, assessment of the welded joints quality on the dye penetrant testing results shall be carried out in accordance with ISO 23277:2015 (refer to Table 3.5.3.1) for the quality levels agreed with the Register.

Table 3.5.3.1

Type of indicator	Assessment level (quality grade) in compliance with ISO 23277:2015[1]		
	1	2	3
Linear	*l* ≤ 2 mm	*l* ≤ 4 mm	*l* ≤ 8 mm
l — indicator bead length			
Non-linear	*d* ≤ 4 mm	*d* ≤ 6 mm	*d* ≤ 8 mm
d size of a major axis of the indicator bead			
[1] Acceptance levels 2 and 3 may include an index "x" designating that all the linear indicator beads shall be assessed as per level 1. [2] A linear indicator bead is an indicator bead with its length exceeding the width of more than three times. [3] Non-linear indicator bead is an indicator bead with its length equal to or less than three widths.			

".

22 **Para 3.5.4.3** and **Table 3.5.4.3** are replaced by the following text:

"**3.5.4.3** If otherwise is not agreed with the Register, assessment of the welded joints quality on the radiographic testing results shall be carried out in accordance with ISO 10675-2:2021 (refer to Table 3.5.4.3) for the quality levels agreed with the Register.

Table 3.5.4.3

No.	Imperfection designation	Reference to ISO 6520-1:2007	Specifications of imperfections	Limits for imperfection for quality levels		
				1	2[1]	3[1]
1	Crack	100	–	Not permitted	Not permitted	Not permitted
2*a*	Gas pore	2011	*d* — maximum pore diameter	*d* ≤ 0,2*s* but max. 4 mm	*d* ≤ 0,3*s* but max. 5 mm	*d* ≤ 0,4*s* but max. 6 mm
2*b*	Uniformly distributed porosity Material thickness 0,5 mm ≤ *s* ≤ 3 mm	2012	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$	*A* ≤ 1 % *L* = 100 mm	*A* ≤ 2% *L* = 100 mm	*A* ≤ 6% *L* = 100 mm
2*c*	Uniformly distributed porosity Material thickness 3 mm < *s* ≤ 12 mm	2012	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$	*A* ≤ 2% *L* = 100 mm	*A* ≤ 4 % *L* = 100 mm	*A* ≤ 10 % *L* = 100 mm
2*d*	Uniformly distributed porosity Material thickness 12 mm < *s* ≤ 30 mm	2012	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$	*A* ≤ 3 % *L* = 100 mm	*A* ≤ 6 % *L* = 100 mm	*A* ≤ 15 % *L* = 100 mm
2*e*	Uniformly distributed porosity Material thickness *s* > 30mm	2012	*A* — the sum of the different pore areas related to the evaluation area $Wp \times L$	*A* ≤ 4 % *L* = 100 mm	*A* ≤ 8 % *L* = 100 mm	*A* ≤ 20 % *L* = 100 mm
3	Clustered (localized) porosity	2013	*dA* — maximum diameter of the clustered porosity	*dA* ≤ 15 mm or *dA*, max ≤ *Wp*/2	*dA* ≤ 20 mm or *dA*, max ≤ *W*p	*dA* ≤ 25 mm or *dA*, max ≤ *W*p
4	Linear porosity	2014	*l* — linear porosity length	Not permitted	Not permitted	*l* ≤ 25 mm
5	Elongated cavity and pipes (wormholes)	2015 2016	*l* — imperfection length	*l* ≤ 0,2*s* but max. 3 mm	*l* ≤ 0,3*s* but max. 4 mm	*l* ≤ 0,4*s* but max. 6 mm
6	Oxide inclusions	303	*l* — length of an inclusion *s* — nominal thickness of the butt weld	*l* ≤ 0,2*s* but max. 3 mm	*l* ≤ 0,5*s* but max. 5 mm	*l* ≤ *s* but max. 10 mm
7	Tungstan inclusions	3041	*l* — imperfection length	*l* ≤ 0,2*s* but max. 3 mm	*l* ≤ 0,3*s* but max. 4 mm	*l* ≤ 0,4*s* but max. 6 mm
8[2]	Lack of fusion	401	*l* — imperfection length	Not permitted	Not permitted	Permitted but only intermittent and not surfaced *l* ≤ 25 mm, *L* = 100 mm

No.	Imperfection designation	Reference to ISO 6520-1:2007	Specifications of imperfections	Limits for imperfection for quality levels		
				1	2[1]	3[1]
9[2]	Lack of penetration	402	*l* — imperfection length	Not permitted	Permitted as applied to the double-sided welded joint and not surfaced *l* ≤ 25 mm, *L* = 100 mm	*l* < 25 mm, *L* = 100 mm

Symbols:
L — any (with imperfection maximum density) 100 mm weld length;
s — nominal thickness of the butt weld;
t — material thickness;
Wp — weld width.
[1] Quality levels 2 and 3 can have index «» which designates all imperfections above 25 mm and are not permitted.
[2] If the weld length is under 100mm the maximum imperfection length shall not be above 25 % of that length.

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4 WELDING CONSUMABLES

23 **Table 4.8.3.2** is replaced by the following text:

"Table 4.8.3.2

Welding type	Welding process (standard ISO 4063:2009)	Diameter of welding wire (rod), mm	
		for facing of edges	for filling of the groove
Manual	111	2,5 — 3,0	3,0 — 4,0
Automatic	12	2,0	2,5 — 3,2
Semi-automatic and automatic	131	1,0 — 1,2	1,4 — 1,6
	135	1,0 — 1,2	1,4 — 1,6
Manual	141	2,0 — 2,4	2,5 — 3,2
Automatic	141	1,0 — 1,6	1,2 — 1,6
Semi-automatic and automatic	114	0,9 — 1,4	1,2 — 1,6
	132	0,9 — 1,4	1,2 — 1,6
	133	0,9 — 1,4	1,2 — 1,6
	136	0,9 — 1,2	1,2 — 1,6
	138	0,9 — 1,2	1,2 — 1,6
Manual	15	2,0 — 2,4	2,0 — 3,0
Automatic	15	1,0 — 1,2	1,2 — 1,6

".

24 **Chapters 4.8 — 4.10**. Throughout the text of the Chapters (**paras 4.8.3.3, 4.9.1.2, 4.10.1.2** and **Table 4.10.3.4**) the reference "ISO 4063" is replaced by the reference "ISO 4063:2009".