

RULES FOR CLASSIFICATION(STEEL SHIPS)

(Part 2 Materials and Welding)

- For external opinion inquiry -
2022.09.



Machinery Rule Development Team

- Main Amendments -

(1) Enter into force on 1 January 2023 (the date of application for certification of material & welding or the contract date for ship construction)

- Circular -

- To reflect IACS UR W2(Rev.3 Sep 2021)
- To reflect IACS UR W13(Rev.7 Sep 2021)
- To reflect IACS UR W17(Rev.6 Sep 2021)
- To reflect IACS UR W25(Rev.6 Sep 2021)

Present	Amendment	reason
<p align="center">CHAPTER 1 MATERIALS</p> <p align="center">Section 1 <Omitted></p> <p>Section 2 Test Specimens and Testing Procedures</p> <p>201. General</p> <p>1. <Omitted></p> <p>2. Testing machine</p> <p>(1) The testing machines used for the tests relative to this Chapter are to be managed by competent personnel on machines.</p> <p>(2) Tension/compression testing machines are to be calibrated in accordance with <u>ISO 7500-1</u> or other recognised standard. [See Guidance]</p> <p>(3) Impact testing machines are to be calibrated in accordance with <u>ISO 148-2</u> or other recognised standard. [See Guidance]</p> <p>(4) The accuracy of tensile test machines is to be within $\pm 1\%$</p> <p>3. <Omitted></p> <p>201. ~ 203. <Omitted></p>	<p align="center">CHAPTER 1 MATERIALS</p> <p align="center">Section 1 <Same as the present Rules></p> <p>Section 2 Test Specimens and Testing Procedures</p> <p>201. General</p> <p>1. <Same as the present Rules></p> <p>2. Testing machine</p> <p>(1) The testing machines used for the tests relative to this Chapter are to be managed by competent personnel on machines.</p> <p>(2) Tension/compression testing machines are to be calibrated in accordance with <u>ISO 7500-1:2018</u> or other recognised standard. (2023) [See Guidance]</p> <p>(3) Impact testing machines are to be calibrated in accordance with <u>ISO 148-2:2016</u> or other recognised standard. (2023) [See Guidance]</p> <p>(4) The accuracy of tensile test machines is to be within $\pm 1\%$.</p> <p>3. <Same as the present Rules></p> <p>201. ~ 203. <Same as the present Rules></p>	<p>* To reflect IACS UR W2(Rev.3 Sep 2021)</p>

Present	Amendment	reason
<p style="text-align: center;">Section 3 Rolled Steels</p> <p>301. Rolled steels for hull structural</p> <p>1. ~ 7. <Omitted></p> <p>8. Verification of dimensions and thickness [See Guidance]</p> <p>(1) Scope</p> <p>(a) The Requirements apply to the tolerance on thickness of steel plates and wide flats with widths of 600 mm or greater with thicknesses of 5 mm and over. The thickness tolerances for products below 5 mm are to be in accordance with a national or international standard, e.g. Class B of <u>ISO 7452</u>. However, the minus tolerance is to be not exceed 0.3 mm. The wide flats with under 600 mm of width may be agreed between the manufacturer and purchaser at the time of ordering. (2019)</p> <p>(b) ~ (d) <Omitted></p> <p>(2) ~ (5) <Omitted></p> <p>9. ~ 13. <Omitted></p> <p>302. ~ 312. <Omitted></p> <p style="text-align: center;">Section 4 ~ Section 7 <Omitted></p>	<p style="text-align: center;">Section 3 Rolled Steels</p> <p>301. Rolled steels for hull structural</p> <p>1. ~ 7. <Same as the present Rules></p> <p>8. Verification of dimensions and thickness [See Guidance]</p> <p>(1) Scope</p> <p>(a) The Requirements apply to the tolerance on thickness of steel plates and wide flats with widths of 600 mm or greater with thicknesses of 5 mm and over. The thickness tolerances for products below 5 mm are to be in accordance with a national or international standard, e.g. Class B of <u>ISO 7452:2013</u>. However, the minus tolerance is to be not exceed 0.3 mm. The wide flats with under 600 mm of width may be agreed between the manufacturer and purchaser at the time of ordering. (2019) (2023)</p> <p>(b) ~ (d) <Same as the present Rules></p> <p>(2) ~ (5) <Same as the present Rules></p> <p>9. ~ 13. <Same as the present Rules></p> <p>302. ~ 312. <Same as the present Rules></p> <p style="text-align: center;">Section 4 ~ Section 7 <Same as the present Rules></p>	<p>* To reflect IACS UR W13(Rev.7 Sep 2021)</p>

Present	Amendment	reason
<p style="text-align: center;">Section 8 Aluminium Alloys</p> <p>801. Aluminium alloys</p> <p>1. ~ 7. <Omitted></p> <p>8. Drift expansion tests</p> <p>The manufacturer has to demonstrate by macrosection tests or drift expansion tests of closed profiles performed on each batch of closed profiles that there is no lack of fusion at the press welds.</p> <p>(1) ~ (3) <Omitted></p> <p>(4) The lengths of the drift expanding test specimens are to be equal to 1.5 times the external diameter(D) of the test specimen in accordance with <i>(KS B) ISO 8493</i>. The test piece may be shorter provided that after testing the remaining cylindrical portion is not less than 0.5D.</p> <p>(5) ~ (6) <Omitted></p> <p>9. Corrosion testing</p> <p>(1) Testing procedures</p> <p>(a) <Omitted></p> <p>(b) A reference photomicrograph taken at 500x, under the conditions specified in ASTM B928, Section 9.4.1, shall be established for each of the alloy-temper and thickness ranges relevant.</p> <p>(c) The reference photographs shall be taken from samples which have exhibited no evidence of exfoliation corrosion and a pitting rating of PB or better, when subjected to the test described in ASTM G66 (ASSET).</p> <p>(d) The samples shall also have exhibited resistance to intergranular corrosion at a mass loss no greater than 15mg/cm², when subjected to the test described in ASTM G67 (NAMLT).</p> <p>(e) ~ (f) <Omitted></p>	<p style="text-align: center;">Section 8 Aluminium Alloys</p> <p>801. Aluminium alloys</p> <p>1. ~ 7. <Same as the present Rules></p> <p>8. Drift expansion tests</p> <p>The manufacturer has to demonstrate by macrosection tests or drift expansion tests of closed profiles performed on each batch of closed profiles that there is no lack of fusion at the press welds.</p> <p>(1) ~ (3) <Same as the present Rules></p> <p>(4) The lengths of the drift expanding test specimens are to be equal to 1.5 times the external diameter(D) of the test specimen in accordance with <i>(KS B) ISO 8493:1998</i>. The test piece may be shorter provided that after testing the remaining cylindrical portion is not less than 0.5D. (2023)</p> <p>(5) ~ (6) <Same as the present Rules></p> <p>9. Corrosion testing</p> <p>(1) Testing procedures</p> <p>(a) <Same as the present Rules></p> <p>(b) A reference photomicrograph taken at 500x, under the conditions specified in <i>ASTM B928:2015</i>, Section 9.4.1, shall be established for each of the alloy-temper and thickness ranges relevant. (2023)</p> <p>(c) The reference photographs shall be taken from samples which have exhibited no evidence of exfoliation corrosion and a pitting rating of PB or better, when subjected to the test described in <i>ASTM G66:2018</i> (ASSET). (2023)</p> <p>(d) The samples shall also have exhibited resistance to intergranular corrosion at a mass loss no greater than 15mg/cm², when subjected to the test described in <i>ASTM G67:2018</i> (NAMLT). (2023)</p> <p>(e) ~ (f) <Same as the present Rules></p>	<p>* To reflect IACS UR W2(Rev.3 Sep 2021)</p> <p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p> <p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p> <p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p>

Present	Amendment	reason
<p>(2) Acceptance criteria</p> <p>(a) For batch acceptance of 5xxx-alloys in the H116 and H321 tempers, metallographic examination of one sample selected from mid width at one end of a coil or random sheet or plate is to be carried out in accordance with <u>ASTM B928</u> or equivalent standards agreed by the Society. The microstructure of the sample is to be compared to the reference photomicrograph of acceptable material in the presence of the Surveyor. 【See Guidance】</p> <p>(b) <Omitted></p> <p>(c) Corrosion tests with respect to exfoliation and intergranular corrosion resistance are to be in accordance with <u>ASTM G66</u> and <u>G67</u> or equivalent standards agreed by the Society. 【See Guidance】</p> <p>(i) The samples have exhibited no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test described in <u>ASTM G66</u>.</p> <p>(ii) The samples shall also have exhibited resistance to intergranular corrosion at a mass loss no greater than 15 mg/cm², when subjected to the test described in <u>ASTM G67</u>.</p> <p>If the results from testing satisfy the acceptance criteria, the batch is accepted, else it is to be rejected.</p> <p>(d) As an alternative to metallographic examination, each batch may be tested for exfoliation-corrosion resistance and intergranular corrosion resistance, in accordance with <u>ASTM G66</u> and <u>G67</u> under the conditions specified in <u>ASTM B928</u>, or equivalent standards. If this alternative is used, then the results of the test must satisfy the acceptance criteria stated in (c) above.</p> <p>10. ~ 14. <Omitted></p>	<p>(2) Acceptance criteria</p> <p>(a) For batch acceptance of 5xxx-alloys in the H116 and H321 tempers, metallographic examination of one sample selected from mid width at one end of a coil or random sheet or plate is to be carried out in accordance with <u>ASTM B928:2015</u> or equivalent standards agreed by the Society. The microstructure of the sample is to be compared to the reference photomicrograph of acceptable material in the presence of the Surveyor. (2023) 【See Guidance】</p> <p>(b) <Same as the present Rules></p> <p>(c) Corrosion tests with respect to exfoliation and intergranular corrosion resistance are to be in accordance with <u>ASTM G66:2018</u> and <u>G67:2018</u> or equivalent standards agreed by the Society. (2023) 【See Guidance】</p> <p>(i) The samples have exhibited no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test described in <u>ASTM G66:2018</u>. (2023)</p> <p>(ii) The samples shall also have exhibited resistance to intergranular corrosion at a mass loss no greater than 15 mg/cm², when subjected to the test described in <u>ASTM G67:2018</u>. (2023)</p> <p>If the results from testing satisfy the acceptance criteria, the batch is accepted, else it is to be rejected.</p> <p>(d) As an alternative to metallographic examination, each batch may be tested for exfoliation-corrosion resistance and intergranular corrosion resistance, in accordance with <u>ASTM G66:2018</u> and <u>G67:2018</u> under the conditions specified in <u>ASTM B928:2015</u>, or equivalent standards. If this alternative is used, then the results of the test must satisfy the acceptance criteria stated in (c) above. (2023)</p> <p>10. ~ 14. <Same as the present Rules></p>	<p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p> <p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p> <p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p> <p>* To reflect IACS UR W25(Rev.6 Sep 2021)</p>

Present	Amendment	reason
<p align="center">CHAPTER 2 WELDING</p> <p align="center">Section 1 ~ Section 2 <Omitted></p> <p align="center">Section 6 Welding Consumables</p> <p>601. <Omitted></p> <p>602. Electrodes for manual arc welding for normal strength steels, higher strength steels and steels for low temperature service</p> <p>1. ~ 5. <Omitted></p> <p>6. Hydrogen test</p> <p>The hydrogen test to be carried out by the mercury method or thermal conductivity detector method. The use of the glycerine method may be admitted at the Society discretion. (2017)</p> <p>(1) The mercury method to be as specified in the Standard <u>ISO 3690</u>. (2017)</p> <p>(2) The thermal conductivity detector method is to be as specified in <u>ISO 3690</u>. Four weld assemblies are to be prepared. The temperature of the specimens and minimum holding time are to be complied with Table 2.2.31, according to the measuring method respectively. (2017)</p> <p>(3) ~ (4) <Omitted></p> <p>7. ~ 9. <Omitted></p> <p>603. ~ 609. <Omitted></p>	<p align="center">CHAPTER 2 WELDING</p> <p align="center">Section 1 ~ Section 2 <Same as the present Rules></p> <p align="center">Section 6 Welding Consumables</p> <p>601. <Same as the present Rules></p> <p>602. Electrodes for manual arc welding for normal strength steels, higher strength steels and steels for low temperature service</p> <p>1. ~ 5. <Same as the present Rules></p> <p>6. Hydrogen test</p> <p>The hydrogen test to be carried out by the mercury method or thermal conductivity detector method. The use of the glycerine method may be admitted at the Society discretion. (2017)</p> <p>(1) The mercury method to be as specified in the Standard <u>ISO 3690:2018</u>. (2017) (2023)</p> <p>(2) The thermal conductivity detector method is to be as specified in <u>ISO 3690:2018</u>. Four weld assemblies are to be prepared. The temperature of the specimens and minimum holding time are to be complied with Table 2.2.31, according to the measuring method respectively. (2017) (2023)</p> <p>(3) ~ (4) <Same as the present Rules></p> <p>7. ~ 9. <Same as the present Rules></p> <p>603. ~ 609. <Same as the present Rules></p>	<p>* To reflect IACS UR W17(Rev.6 Sep 2021)</p>

- Main Amendments -

(1) Enter into force on 1 July 2023 (the date of application for certification of material & welding or the contract date for ship construction)

- To reflect IACS UR W7(Rev.4 Feb 2022)
- To reflect IACS UR W8(Rev.3 Mar 2022)
- To reflect Rec.70 (Rev.2 Sep 2021)
- To reflect Rec.105(Rev.1 Sep 2021)
- To reflect Request for Establishment/Revision of Classification Technical Rules

Present	Amendment	reason
<p style="text-align: center;">CHAPTER 1 MATERIALS</p> <p style="text-align: center;">Section 1 ~ Section 2 <Omitted> Section 3 Rolled Steels</p> <p>301. ~ 303. <Omitted></p> <p>304. Rolled steels for low temperature service</p> <p>1. Application</p> <p>(1) The requirements are to apply to the rolled steels not exceeding <u>40 mm</u> in thickness intended for tanks and ship's hull structures adjacent to tanks of liquefied gas carriers, and other parts such a hull structures of refrigerated cargo carrier which are exposed to low temperature (hereinafter referred to as "steels").</p> <p>(2) Any requirement regarding the steels over <u>40 mm</u> in thickness is left to the discretion of the Society. 【See Guidance】</p> <p>(3) The requirements other than those specified in 304. are applicable to the requirements in 301.</p> <p>(4) The steels other than those specified in 304. are to comply with the requirements in 101. 2.</p> <p>2. Kinds</p> <p>Steels are classified as specified in Table 2.1.16.</p>	<p style="text-align: center;">CHAPTER 1 MATERIALS</p> <p style="text-align: center;">Section 1 ~ Section 2 <Same as the present Rules> Section 3 Rolled Steels</p> <p>301. ~ 303. <Same as the present Rules></p> <p>304. Rolled steels for low temperature service</p> <p>1. Application</p> <p>(1) The requirements are to apply to the rolled steels not exceeding <u>50 mm</u> in thickness intended for tanks and ship's hull structures adjacent to tanks of liquefied gas carriers, and other parts such a hull structures of refrigerated cargo carrier which are exposed to low temperature (hereinafter referred to as "steels"). <i>(2023)</i></p> <p>(2) Any requirement regarding the steels over <u>50 mm</u> in thickness is left to the discretion of the Society. <i>(2023)</i> 【See Guidance】</p> <p>(3) The requirements other than those specified in 304. are applicable to the requirements in 301.</p> <p>(4) The steels other than those specified in 304. are to comply with the requirements in 101. 2.</p> <p>2. Kinds</p> <p>Steels are classified as specified in Table 2.1.16.</p>	<p>- Update (consistent) for requirements</p> <p>: The material requirements in Pt 7, Chapter 5 of the Rules reflect IACS UR W1 and stipulate to use up to 50 mm.</p> <p>- To reflect KS D 3541 : chemical composition,</p> <p>- Modified the strength of RL 360</p>

<Present>

Table 2.1.16 Grades and Chemical Composition (2017)

Kinds	Grade	Deoxida tion	Chemical composition (%)												
			<i>C</i>	<i>Si</i>	<i>Mn</i>	<i>P</i>	<i>S</i>	<i>Ni</i>	<i>Cr</i>	<i>Cu</i>	<i>Mo</i>	<i>Al</i> ⁽³⁾	<i>Nb</i>	<i>V</i>	<i>Ti</i>
Carbon steels	<i>RL 235A</i>	Fully killed Alumin ium treated fine grain	0.15 max.	<u>0.15</u> ~ 0.3 0	0.70 ~ 1.5 0	<u>0.035</u> max.	<u>0.035</u> max.	0.8 max.	(1)			0.02 min.	-		
	<i>RL 235B</i>														
	<i>RL 325A</i>		0.16 max.	<u>0.15</u> ~ <u>0.5</u> <u>0</u>	0.80 ~ 1.6 0										
	<i>RL 325B</i>														
	<u><i>RL 360</i></u>		0.16 max.	<u>0.15</u> ~ <u>0.5</u> <u>0</u>	0.80 ~ 1.6 0										
Nickel alloy steels	<i>RL 1N355</i>	Killed and fine grain treated	0.18 max.	0.35 max.	0.80 ~ 1.5 0	0.025 max.	0.010 max.	1.30 ~ 1.70	(2)			-	-		-
	<i>RL 2N255</i>		0.17 max.	0.30 max.	0.70 max.		0.020 max.	2.10 ~ 2.50					0.30 max .		0.40 max .
	<i>RL 3N355</i>		0.15 max.	0.35 max.	0.30 ~ 0.8 0	0.020 max.	0.005 max.	3.25 ~ 3.75	(2)				-	0.05 max .	-
	<i>RL 5N390</i>		0.15 max.					4.75 ~ 5.25							
	<i>RL 9N490</i>		0.10 max.					8.50 ~ 10.00							
	NOTE: (1) These elements may be added, the certificates is to contain these elements. (2) The content of Cr + Cu + Mo is not to exceed 0.50 %. The content of Mo for <i>RL 9N490</i> is not to exceed 0.10 % (3) Aluminium content is to be represented by the total aluminium content, but may be determined by the acid solu- ble aluminium content. In such a case, the acid soluble aluminium content is not to be less than 0.015 %.														

<Amendment>

Table 2.1.16 Grades and Chemical Composition (2017) (2023)

Kinds	Grade	Deoxida tion	Chemical composition (%)												
			<i>C</i>	<i>Si</i>	<i>Mn</i>	<i>P</i>	<i>S</i>	<i>Ni</i>	<i>Cr</i>	<i>Cu</i>	<i>Mo</i>	<i>Al</i> ⁽³⁾	<i>Nb</i>	<i>V</i>	<i>Ti</i>
Carbon steels	<i>RL 235A</i>	Fully killed Alumin ium treated fine grain	0.15 max.	<u>0.10</u> ~ 0.3 0	0.70 ~ 1.5 0	<u>0.030</u> <u>max.</u>	<u>0.030</u> <u>max.</u>	0.8 max.	(1)			0.02 min.	-		
	<i>RL 235B</i>														
	<i>RL 325A</i>		0.16 max.	<u>0.10</u> ~ <u>0.5</u> <u>5</u>	0.80 ~ 1.6 0	<u>0.025</u> <u>max.</u>	<u>0.025</u> <u>max.</u>								
	<i>RL 325B</i>														
	<u><i>RL 355</i></u>		0.16 max.	<u>0.10</u> ~ <u>0.5</u> <u>5</u>	0.80 ~ 1.6 0	<u>0.025</u> <u>max.</u>	<u>0.025</u> <u>max.</u>								
Nickel alloy steels	<i>RL 1N355</i>	Killed and fine grain treated	0.18 max.	0.35 max.	0.80 ~ 1.5 0	0.025 max.	0.010 max.	1.30 ~ 1.70	(2)			-	-		-
	<i>RL 2N255</i>		0.17 max.	0.30 max.	0.70 max.		0.020 max.	2.10 ~ 2.50	0.30 max .	0.40 max .	0.12 max .		0.02 max .		0.03 max .
	<i>RL 3N355</i>		0.15 max.	0.35 max.	0.30 ~ 0.8 0	0.020 max.	0.005 max.	3.25 ~ 3.75	(2)				-	0.05 max .	-
	<i>RL 5N390</i>		0.15 max.					4.75 ~ 5.25							
	<i>RL 9N490</i>		0.10 max.					8.50 ~ 10.00							
NOTE:															
(1) These elements may be added, the certificates is to contain these elements.															
(2) The content of Cr + Cu + Mo is not to exceed 0.50 %. The content of Mo for <i>RL 9N490</i> is not to exceed 0.10 %															
(3) Aluminium content is to be represented by the total aluminium content, but may be determined by the acid solu- ble aluminium content. In such a case, the acid soluble aluminium content is not to be less than 0.015 %.															

Present	Amendment	reason																												
<p>3. Heat treatment</p> <p>The heat treatment of steels is to comply with the requirements given in Table 2.1.17.</p> <p>Table 2.1.17 Heat Treatment (2017)</p> <table><tr><th>Kinds</th><th>grade</th><th>Heat treatment</th></tr><tr><td rowspan="5">Carbon steels</td><td><i>RL 235A</i></td><td rowspan="3">Normalized or <i>TMCP</i></td></tr><tr><td><i>RL 235B</i></td></tr><tr><td><i>RL 325A</i></td></tr><tr><td><i>RL 325B</i></td><td rowspan="2">Quenched and Tempered or <i>TMCP</i>⁽¹⁾</td></tr><tr><td><u><i>RL 360</i></u></td></tr><tr><td>Nickel alloy steels</td><td colspan="2"><Omitted></td></tr></table> <p>NOTE:</p> <p>(1) Heat treatment may be conducted according to Nomalising, subject to the special approval by the Society. (2018)</p> <p>(2) Heat treatment may be conducted according to <i>TMCP</i>, subject to the special approval by the Society.</p>	Kinds	grade	Heat treatment	Carbon steels	<i>RL 235A</i>	Normalized or <i>TMCP</i>	<i>RL 235B</i>	<i>RL 325A</i>	<i>RL 325B</i>	Quenched and Tempered or <i>TMCP</i> ⁽¹⁾	<u><i>RL 360</i></u>	Nickel alloy steels	<Omitted>		<p>3. Heat treatment</p> <p>The heat treatment of steels is to comply with the requirements given in Table 2.1.17.</p> <p>Table 2.1.17 Heat Treatment (2017)</p> <table><tr><th>Kinds</th><th>grade</th><th>Heat treatment</th></tr><tr><td rowspan="5">Carbon steels</td><td><i>RL 235A</i></td><td rowspan="3">Normalized or <i>TMCP</i></td></tr><tr><td><i>RL 235B</i></td></tr><tr><td><i>RL 325A</i></td></tr><tr><td><i>RL 325B</i></td><td rowspan="2">Quenched and Tempered or <i>TMCP</i>⁽¹⁾</td></tr><tr><td><u><i>RL 355</i></u></td></tr><tr><td>Nickel alloy steels</td><td colspan="2"><Same as the present Rules></td></tr></table> <p>NOTE:</p> <p>(1) Heat treatment may be conducted according to Nomalising, subject to the special approval by the Society. (2018)</p> <p>(2) Heat treatment may be conducted according to <i>TMCP</i>, subject to the special approval by the Society.</p>	Kinds	grade	Heat treatment	Carbon steels	<i>RL 235A</i>	Normalized or <i>TMCP</i>	<i>RL 235B</i>	<i>RL 325A</i>	<i>RL 325B</i>	Quenched and Tempered or <i>TMCP</i> ⁽¹⁾	<u><i>RL 355</i></u>	Nickel alloy steels	<Same as the present Rules>		<p>- To reflect KS D 3541 : Material grade, mechanical properties</p> <p>- Modified the strength of RL 360</p>
Kinds	grade	Heat treatment																												
Carbon steels	<i>RL 235A</i>	Normalized or <i>TMCP</i>																												
	<i>RL 235B</i>																													
	<i>RL 325A</i>																													
	<i>RL 325B</i>	Quenched and Tempered or <i>TMCP</i> ⁽¹⁾																												
	<u><i>RL 360</i></u>																													
Nickel alloy steels	<Omitted>																													
Kinds	grade	Heat treatment																												
Carbon steels	<i>RL 235A</i>	Normalized or <i>TMCP</i>																												
	<i>RL 235B</i>																													
	<i>RL 325A</i>																													
	<i>RL 325B</i>	Quenched and Tempered or <i>TMCP</i> ⁽¹⁾																												
	<u><i>RL 355</i></u>																													
Nickel alloy steels	<Same as the present Rules>																													

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Present	Amendment	reason
<p>4. <Omitted></p> <p>5. Mechanical properties</p> <p>The mechanical properties of steels are to comply with the requirements given in Table 2.1.18. Where deemed necessary by the Society, other tests on notch toughness may be required additionally.</p>	<p>4. <Same as the present Rules></p> <p>5. Mechanical properties</p> <p>(1) The mechanical properties of steels are to comply with the requirements given in Table 2.1.18.</p> <p>(2) Where deemed necessary by the Society, other tests on notch toughness may be required additionally.</p> <p>(3) <u>In the case of steels in accordance with Pt 7, Ch 5, Sec 17, 1712.(Special requirements for ammonia) of the Rules, the specified value of the maximum yield stress or proof stress may be limited after approval by the Society. (2023)</u></p>	<p>- Allows to set the maximum strength value for steels in accordance with ammonia special requirements.</p> <p>- Modified the strength of RL 360</p>

<Present>

Table 2.1.18 Mechanical properties (2017)

Kinds	grade	Tensile test					Impact ⁽⁴⁾⁽⁵⁾			
		Yield strength (N/mm ²)		Tensile strength (N/mm ²)	Elongation(%) ($L=5.65\sqrt{A}$)			T e s t temp. ⁽⁶⁾ (℃)	Average absorbed energy(J)	
		Thickness of plate t (mm)			Thickness of plate t (mm)				L	T
		$6<t\leq 30$	$30<t$		$6 < t\leq 16^{(2)}$	$16<t\leq 40^{(2)}$	$40<t^{(3)}$			
Carbon steels	<i>RL 235A</i>	235 min. ⁽¹⁾		400～510	18 min.	22 min.	24 min.	-40		27 min.
	<i>RL 235B</i>							-50		
	<i>RL 325A</i>	325 min.		440～560	22 min.	30 min.	22 min.	-60		
	<i>RL 325B</i>									
	<u><i>RL 360</i></u>	<u>360 min.</u>		490～610	20 min.	28 min.	20 min.			
Nickel alloy steels	<i>RL 1N355</i>	355 min.	345 min.	490～640	22 min.			-80	41 min.	
	<i>RL 2N255</i>	255 min.		450～590	21 min.			-70		
	<i>RL 3N355</i>	355 min.	345 min.	490～640	22 min.			-100		
	<i>RL 5N390</i>	390 min.	380 min.	530～710	20 min.			-120		
	<i>RL 9N490</i>	490 min.	480 min.	640～840	18 min.			-196		

NOTES:

(1) Same or above 215 N/mm² when the thickness of plate is above 40 mm.(2) Carbon steels are to be tested with *R5* test specimen. To be tested with *R1A* test specimen For *RL 235A* and *RL 235B*.(3) Carbon steels are to be tested with *R4* test specimen.

(4) <New>

(4) L (or T) indicates that the longitudinal axis of the test specimen is arranged parallel (or transverse) to the final direction of rolling.

(5) When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified average absorbed energy or when the absorbed energy of a single test specimen is less in value than 70 % of the specified average absorbed energy, the test is considered to have failed.

(6) Impact test temperature for steels specified in Pt 7, Ch 5 is to comply with the requirements given in Table 2.1.18-1.

<Amendment>

Table 2.1.18 Mechanical properties (2017) (2023)

Kinds	grade	Tensile test					Impact ⁽⁵⁾⁽⁶⁾			
		Yield strength (N/mm ²)		Tensile strength (N/mm ²)	Elongation(%) ⁽⁴⁾ ($L = 5.65 \sqrt{A}$)			T e s t temp. ⁽⁷⁾ (°C)	Average absorbed energy(J)	
		Thickness of plate t (mm)			Thickness of plate t (mm)				L	T
		$6 < t \leq 30$	$30 < t$		$6 < t \leq 16^{(2)}$	$16 < t \leq 40^{(2)}$	$40 < t^{(3)}$			
Carbon steels	<i>RL 235A</i>	235 min. ⁽¹⁾		400 ~ 510	18 min.	22 min.	24 min.	-40	41 min.	27 min.
	<i>RL 235B</i>							-50		
	<i>RL 325A</i>	325 min.		440 ~ 560	22 min.	30 min.	22 min.	-60		
	<i>RL 325B</i>									
	<u><i>RL 355</i></u>	<u>355 min.</u>		490 ~ 610	20 min.	28 min.	20 min.			
Nickel alloy steels	<i>RL 1N355</i>	355 min.	345 min.	490 ~ 640	22 min.			-80	41 min.	27 min.
	<i>RL 2N255</i>	255 min.		450 ~ 590	21 min.			-70		
	<i>RL 3N355</i>	355 min.	345 min.	490 ~ 640	22 min.			-100		
	<i>RL 5N390</i>	390 min.	380 min.	530 ~ 710	20 min.			-120		
	<i>RL 9N490</i>	490 min.	480 min.	640 ~ 840	18 min.			-196		
NOTES: (1) Same or above 215 N/mm ² when the thickness of plate is above 40 mm. (2) Carbon steels are to be tested with R5 test specimen. To be tested with R1A test specimen For <i>RL 235A</i> and <i>RL 235B</i> . (3) Carbon steels are to be tested with R4 test specimen. (4) In the case of carbon steel, the calibrated elongation value according to ISO2566-1:2021 may be required by the different specimen type from requirements in this Table. (5) <i>L</i> (or <i>T</i>) indicates that the longitudinal axis of the test specimen is arranged parallel (or transverse) to the final direction of rolling. (6) When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified average absorbed energy or when the absorbed energy of a single test specimen is less in value than 70 % of the specified average absorbed energy, the test is considered to have failed. (7) Impact test temperature for steels specified in Pt 7, Ch 5 is to comply with the requirements given in Table 2.1.18-1 .										

<Present>

Table 2.1.18-1 Impact Test Temperature of Steels Specified in Pt 7, Ch 5. (2017)

Grade	Thickness t (mm)	Test temp ($^{\circ}\text{C}$) ⁽¹⁾
<i>RL 235A</i> <i>RL 235B</i> <i>RL 325A</i> <i>RL 325B</i> <u><i>RL 360</i></u>	$t \leq 25$	-20 or (Td-5) ⁽²⁾
	$25 < t \leq 30$	-20 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-20 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	(Td-20)
	<u>$40 < t$</u>	<u>⁽³⁾</u>
<i>RL 1N255</i>	$t \leq 25$	-65
	$25 < t \leq 30$	-65 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-65 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-65 or (Td-20) ⁽²⁾
<i>RL 2N255</i>	$t \leq 25$	-70
	$25 < t \leq 30$	-70 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-70 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-70 or (Td-20) ⁽²⁾
<i>RL 3N355</i>	$t \leq 25$	-95
	$25 < t \leq 30$	-95 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-95 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-95 or (Td-20) ⁽²⁾
<i>RL 5N390</i>	$t \leq 25$	-110
	$25 < t \leq 30$	-110 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-110 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-110 or (Td-20) ⁽²⁾
<i>RL 9N490</i>	<u>$t \leq 40$</u>	-196
NOTES: (1) T_d is the design temperature ($^{\circ}\text{C}$). (2) The test temperature is to be the lower of those specified above. <u>(3) <New></u> <u>(4) <New></u> <u>(3)</u> This may be accepted by approval of the Society. And the test temperature is to be as deemed appropriate by the Society. <u>(6) <New></u>		

<Amendment>

Table 2.1.18-1 Impact Test Temperature of Steels Specified in Pt 7, Ch 5. (2017) (2023)

Grade	Thickness t (mm)	Test temp ($^{\circ}\text{C}$) ⁽¹⁾
<i>RL 235A</i> <i>RL 235B</i> <i>RL 325A</i> <i>RL 325B</i> <u>RL 355</u>	$t \leq 25$	-20 or (Td-5) ⁽²⁾
	$25 < t \leq 30$	-20 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-20 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	(Td-20)
	<u>$40 < t \leq 50$</u>	<u>-20 or (Td-5)⁽²⁾⁽³⁾</u>
	<u>$40 < t \leq 45$</u>	<u>(Td-25)⁽⁴⁾</u>
	<u>$45 < t \leq 50$</u>	<u>(Td-30)⁽⁴⁾</u>
	<u>$50 < t$</u>	<u>⁽⁵⁾</u>
<i>RL 1N255</i>	$t \leq 25$	-65
	$25 < t \leq 30$	-65 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-65 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-65 or (Td-20) ⁽²⁾
	<u>$40 < t \leq 45$</u>	<u>(Td-25)⁽⁶⁾</u>
	<u>$45 < t \leq 50$</u>	<u>(Td-30)⁽⁶⁾</u>
<i>RL 2N255</i>	$t \leq 25$	-70
	$25 < t \leq 30$	-70 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-70 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-70 or (Td-20) ⁽²⁾
	<u>$40 < t \leq 45$</u>	<u>(Td-25)⁽⁶⁾</u>
	<u>$45 < t \leq 50$</u>	<u>(Td-30)⁽⁶⁾</u>
<i>RL 3N355</i>	$t \leq 25$	-95
	$25 < t \leq 30$	-95 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-95 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-95 or (Td-20) ⁽²⁾
	<u>$40 < t \leq 45$</u>	<u>(Td-25)⁽⁶⁾</u>
	<u>$45 < t \leq 50$</u>	<u>(Td-30)⁽⁶⁾</u>
<i>RL 5N390</i>	$t \leq 25$	-110
	$25 < t \leq 30$	-110 or (Td-10) ⁽²⁾
	$30 < t \leq 35$	-110 or (Td-15) ⁽²⁾
	$35 < t \leq 40$	-110 or (Td-20) ⁽²⁾
	<u>$40 < t \leq 45$</u>	<u>(Td-25)⁽⁶⁾</u>
	<u>$45 < t \leq 50$</u>	<u>(Td-30)⁽⁶⁾</u>
<i>RL 9N490</i>	<u>$t \leq 50$</u>	<u>-196⁽⁶⁾</u>
NOTES: (1) T_d is the design temperature ($^{\circ}\text{C}$). (2) The test temperature is to be the lower of those specified above. (3) <u>In addition, post-weld stress relief heat treatment shall be performed. Exemption to post-weld stress relief heat treatment based on alternative approach(e.g. Engineering Critical Assessment) shall be approved by the Society or shall be to recognized standards.</u> (4) <u>Applies to cargo tank other than type C.</u> (5) This may be accepted by approval of the Society. And the test temperature is to be as deemed appropriate by the Society. (6) <u>A further set of impact test at mid thickness for products with $40 < t \leq 50$ is required</u>		

Present	Amendment	reason
<p>6. ~ 9. <Omitted></p> <p>10. Marking</p> <p>Steels which have satisfactorily complied with the required tests are to be marked with the identification mark in accordance with the requirements in 110. For steels to which the requirements given in Notes (1) of Table 2.1.17 and Notes (7) of Table 2.1.17-1 have been applied, "TM" and impact test temperature "T" are to be suffixed to the markings. (e.g. <u>RL 33TM-50T</u>)</p> <p>(3) <New></p> <p>305. ~ 308. <Omitted></p>	<p>6. ~ 9. <Same as the present Rules></p> <p>10. Marking</p> <p>(1) Steels which have satisfactorily complied with the required tests are to be marked with the identification mark in accordance with the requirements in 110.</p> <p>(2) For steels to which the requirements given in Notes (1) of Table 2.1.17 and Notes (7) of Table 2.1.17-1 have been applied, "TM" and impact test temperature "T" are to be suffixed to the markings. (e.g. <u>RL 325TM-50T</u>)</p> <p>(3) For steel to which the requirements given in 5. (3), the specified value of the maximum yield stress or proof stress and "A" are to be suffixed to the markings. (e.g. <u>RL 325A-440A</u>) (2023)</p> <p>305. ~ 308. <Same as the present Rules></p>	<p>- Allows to set the maximum strength value for steels in accordance with ammonia special requirements.</p>

Present	Amendment	reason
<p>309. Stainless clad steel plates</p> <p>1. ~ 2. <Omitted></p> <p>3. Structural metals</p> <p>(1) Base and clad materials for steel plates are to be <u>mild steel plates of rolled steels for hull specified in 301.</u> and steel plates of rolled stainless steels specified in 305., respectively. In case of overlay rolling or cast rolling, clad materials are to comply with the specified chemical composition of welding materials or stainless steel casting applied as a clad.</p> <p>(2) <Omitted></p> <p>4. <Omitted></p> <p>5. Mechanical properties [See Guidance]</p> <p>(1) The mechanical properties of steel plates are to comply with the requirements given in Table 2.1.38.</p>	<p>309. Stainless clad steel plates</p> <p>1. ~ 2. <Same as the present Rules></p> <p>3. Structural metals</p> <p>(1) Base and clad materials for steel plates are to be <u>mild & higher strength steel plates of rolled steels for hull specified in 301.</u> and steel plates of rolled stainless steels specified in 305., respectively. In case of overlay rolling or cast rolling, clad materials are to comply with the specified chemical composition of welding materials or stainless steel casting applied as a clad. (2023)</p> <p>(2) <Same as the present Rules></p> <p>4. <Same as the present Rules></p> <p>5. Mechanical properties [See Guidance]</p> <p>(1) The mechanical properties of steel plates are to comply with the requirements given in Table 2.1.38.</p>	<p>- To reflect KS D 3693:2014 and higher strength steel plates added</p>

<Present>

Table 2.1.38 Mechanical Properties

Grade	Tensile test ⁽¹⁾			Shearing strength test ⁽³⁾	Impact test
	Yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%)	Shearing strength (N/mm ²)	
A B D E	235 min.	σ_B min. ⁽²⁾	To be complied with requirement for base metal	200 min.	To be complied with requirement for base metal

NOTES:

(1) The tensile test specimen is to be R1B test specimen ($L=200\text{mm}$)

(2) σ_B is to be obtained from the following formula:

$$\sigma_B = \frac{t_1\sigma_1 + t_2\sigma_2}{t_1 + t_2}$$

where:

σ_B = Tensile strength of steel plates (N/mm²)

σ_1 = Specified minimum tensile strength of base metal (N/mm²)

σ_2 = Specified minimum tensile strength of clad material (N/mm²)

t_1 = Thickness of base metal (mm)

t_2 = Thickness of clad material (mm)

(3) Any requirement for the procedure of shear strength test is left to the discretion of the Society. In case of overlay rolling, shear strength test may be omitted.

<Amendment>

Table 2.1.38 Mechanical Properties (2023)

Grade	Tensile test ⁽¹⁾			Shearing strength test ⁽³⁾	Impact test
	Yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%)	Shearing strength (N/mm ²)	
<i>A</i> <i>B</i> <i>D</i> <i>E</i>	235 min.	σ_B min. ⁽²⁾	To be complied with requirement for base metal	200 min.	To be complied with requirement for base metal
<u>AH32, AH36,</u> <u>DH32, DH36,</u> <u>EH32, EH36,</u> <u>FH32, FH36</u>	σ_γ min. ⁽²⁾				

NOTES:

(1) The tensile test specimen is to be R1B test specimen ($L=200\text{mm}$)

(2) σ_γ and σ_B is to be obtained from the following formulas:

$$\sigma_\gamma = \frac{t_1\sigma_{\gamma 1} + t_2\sigma_{\gamma 2}}{t_1 + t_2}, \quad \sigma_B = \frac{t_1\sigma_1 + t_2\sigma_2}{t_1 + t_2}$$

where:

σ_γ = Yield strength of steel plates (N/mm²)

$\sigma_{\gamma 1}$ = Specified minimum yield strength of base metal (N/mm²)

$\sigma_{\gamma 2}$ = Specified minimum yield strength of clad material (N/mm²)

σ_B = Tensile strength of steel plates (N/mm²)

σ_1 = Specified minimum tensile strength of base metal (N/mm²)

σ_2 = Specified minimum tensile strength of clad material (N/mm²)

t_1 = Thickness of base metal (mm)

t_2 = Thickness of clad material (mm)

(3) Any requirement for the procedure of shear strength test is left to **Fig. 2.1.6** or the discretion of the Society. In case of overlay rolling, shear strength test may be omitted.

Present	Amendment	reason
<p>Fig. 2.1.6 <New></p> <p>(2) <Omitted> 6. ~ 10. <Omitted> 310. ~ 312. <Omitted></p>	<div data-bbox="1093 252 1747 774"> </div> <p>(Notes)</p> <ol style="list-style-type: none"> 1. The dimensions of jig can be adjusted. 2. The clad material is peeled from the base metal parallel to the bonding surface. 3. Shear strength is to be obtained from the following formula: $\sigma_s = \frac{P}{S}$ <p> σ_s : Shear strength for clad steel plates P : Load S : apparent bonding area(S=W x 25, see Fig. 2.1.7) </p> <p>Fig. 2.1.6 Test method for shear strength (2023)</p> <p>(2) <Same as the present Rules> 6. ~ 10. <Same as the present Rules> 310. ~ 312. <Same as the present Rules></p>	<p>- To reflect KS D 0234:1992</p>

Present	Amendment	reason
<p style="text-align: center;">Section 4 Steel Tubes and Pipes</p> <p>401. <Omitted></p> <p>402. Steel pipes for pressure piping</p> <p>1. ~ 4. <Omitted></p> <p>5. Mechanical properties</p> <p>The mechanical properties of steel pipes are to comply with the following requirements.</p> <p>(1) ~ (3) <Omitted></p> <p>(4) <New></p> <p>6. ~ 10. <Omitted></p> <p>11. Marking</p> <p>(1) <Omitted></p> <p>(2) The symbols indicating the method of manufacture are to comply with the requirement in 401. 10 (2).</p> <p>(3) <New></p>	<p style="text-align: center;">Section 4 Steel Tubes and Pipes</p> <p>401. <Same as the present Rules></p> <p>402. Steel pipes for pressure piping</p> <p>1. ~ 4. <Same as the present Rules></p> <p>5. Mechanical properties</p> <p>The mechanical properties of steel pipes are to comply with the following requirements.</p> <p>(1) ~ (3) <Same as the present Rules></p> <p>(4) In the case of steel pipes in accordance with Pt 7, Ch 5, Sec 17, 1712.(Special requirements for ammonia) of the Rules, the specified value of the maximum yield stress or proof stress may be limited after approval by the Society. (2023)</p> <p>6. ~ 10. <Same as the present Rules></p> <p>11. Marking</p> <p>(1) <Same as the present Rules></p> <p>(2) The symbols indicating the method of manufacture are to comply with the requirement in 401. 11 (2).</p> <p>(3) For steel pipes to which the requirements given in 5. (4), the specified value of the maximum yield stress or proof stress and “A” are to be suffixed to the markings. (e.g. <i>RST138-440A</i>) (2023)</p>	<p>- Allows to set the maximum strength value for steel pipes in accordance with ammonia special requirements.</p>

Present	Amendment	reason
<p>403. <Omitted></p> <p>404. Steel pipes for low temperature service</p> <p>1. ~ 4. <Omitted></p> <p>5. Mechanical properties</p> <p>(1) ~ (2) <Omitted></p> <p>(3) <New></p> <p>6. ~ 10. <Omitted></p> <p>11. Marking</p> <p>Marking for steel pipes is generally to comply with the requirements given in 402. 10. and in case the requirement in Note (5) of Table 2.1.67 has been applied, "impact test temperature T" is to be suffixed to the marking. (e.g. <i>RLPA-25T</i>)</p> <p>(3) <New></p> <p>405. <Omitted></p>	<p>403. <Same as the present Rules></p> <p>404. Steel pipes for low temperature service</p> <p>1. ~ 4. <Same as the present Rules></p> <p>5. Mechanical properties</p> <p>(1) ~ (2) <Same as the present Rules></p> <p>(3) In the case of steel pipes in accordance with Pt 7, Ch 5, Sec 17, 1712.(Special requirements for ammonia) of the Rules, the specified value of the maximum yield stress or proof stress may be limited after approval by the Society. <i>(2023)</i></p> <p>6. ~ 10. <Same as the present Rules></p> <p>11. Marking</p> <p>(1) Marking for steel pipes is generally to comply with the requirements given in 402. 10.</p> <p>(2) In case the requirement in Note (5) of Table 2.1.67 has been applied, "impact test temperature T" is to be suffixed to the marking. (e.g. <i>RLPA-25T</i>)</p> <p>(3) For steel pipes to which the requirements given in 5. (3), the specified value of the maximum yield stress or proof stress and "A" are to be suffixed to the markings. (e.g. <i>RLPB-440A</i>) <i>(2023)</i></p> <p>405. <Same as the present Rules></p>	<p>- Allows to set the maximum strength value for steel pipes in accordance with ammonia special requirements.</p>

Present	Amendment	reason
<p style="text-align: center;">Section 5 Castings</p> <p>501. Steel castings</p> <p>1. Application</p> <p>(1) The requirements in 501. are to apply to the steel castings intended to be used for the components specified in the relevant Parts of hull construction equipments and machinery, except that defined in 502., 503. and 504..</p> <p>(2) <New></p> <p>(3) <New></p> <p>(2) Steel castings having characteristics differing from those specified in 501. are to comply with the requirements in 101. 2.</p> <p>2. Kinds</p> <p>The steel castings are classified as specified in Table 2.1.73.</p>	<p style="text-align: center;">Section 5 Castings</p> <p>501. Steel castings</p> <p>1. Application</p> <p>(1) The requirements in 501. are to apply to the steel castings intended to be used for <u>ships and offshore units for world-wide services as</u> the components specified in the relevant Parts of hull construction equipments and machinery, except that defined in 502., 503. and 504.. <i>(2023)</i></p> <p>(2) <u>Additional requirements may be necessary, especially when the castings are intended for service at low or elevated temperatures, e.g. for ships with ice-class or for boilers.</u> <i>(2023)</i></p> <p>(3) <u>Additional requirements will typically be required for castings for offshore units depending on applicable service temperature and environment.</u> <i>(2023)</i></p> <p>(4) Steel castings having characteristics differing from those specified in 501. are to comply with the requirements in 101. 2.</p> <p>2. Kinds</p> <p>The steel castings are classified as specified in Table 2.1.73.</p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

<Present>

Table 2.1.73 Grades and Mechanical Properties (2019)

Kind	Grade	Yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%) ($L = 5.65 \sqrt{A}$)	Reduction of area (%)
<u>Carbon steel castings</u>	<u>RSC 410</u>	<u>205 min.</u>	<u>410 min.</u>	<u>24 min.</u>	<u>38 min.</u>
	<u>RSC 450</u>	<u>225 min.</u>	<u>450 min.</u>	<u>22 min.</u>	<u>29 min.</u>
	<u>RSC 480</u>	<u>245 min.</u>	<u>480 min.</u>	<u>20 min.</u>	<u>27 min.</u>
	<u>RSC 520</u>	<u>265 min.</u>	<u>520 min.</u>	<u>18 min.</u>	<u>25 min.</u>
	<u>RSC 560</u>	<u>305 min.</u>	<u>560 min.</u>	<u>15 min.</u>	<u>20 min.</u>
	<u>RSC 600</u>	<u>325 min.</u>	<u>600 min.</u>	<u>13 min.</u>	<u>20 min.</u>
<u>Low alloy steel castings</u>	<u>RSC 440A</u>	<u>245 min.</u>	<u>440 min.</u>	<u>22 min.</u>	<u>40 min.</u>
	<u>RSC 480A</u>	<u>275 min.</u>	<u>480 min.</u>	<u>17 min.</u>	<u>35 min.</u>
	<u>RSC 550A</u>	<u>345 min.</u>	<u>550 min.</u>	<u>16 min.</u>	<u>35 min.</u>
NOTES: 1. For intermediate values of the tensile strength, the minimum values for yield strength, elongation and reduction of area may be obtained by interpolation and the value at the first decimal place is to be subjected to the method of counting fractions over 1/2 as one and disregarding the rest.					

<Amendment>

Table 2.1.73 Grades and Mechanical Properties (2019) (2023)

Kind		Grade	Yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%) ($L = 5.65 \sqrt{A}$)	Reduction of area (%)	Charpy V-notch impact test ⁽³⁾	
							Test temperature(°C)	Minimum average energy(J)
<u>Hull and general steel castings intended for welding</u>	<u>Carbon steel castings</u>	<u>RSC 400H</u>	<u>200 min.</u>	<u>400 min.</u>	<u>25 min.</u>	<u>40 min.</u>	<u>0</u>	<u>27</u>
		<u>RSC 440H</u>	<u>220 min.</u>	<u>440 min.</u>	<u>22 min.</u>	<u>30 min.</u>		
		<u>RSC 480H</u>	<u>240 min.</u>	<u>480 min.</u>	<u>20 min.</u>	<u>27 min.</u>		
		<u>RSC 520H</u>	<u>260 min.</u>	<u>520 min.</u>	<u>18 min.</u>	<u>25 min.</u>		
		<u>RSC 560H</u>	<u>300 min.</u>	<u>560 min.</u>	<u>15 min.</u>	<u>20 min.</u>		
		<u>RSC 600H</u>	<u>320 min.</u>	<u>600 min.</u>	<u>13 min.</u>	<u>20 min.</u>		
	<u>Alloy steel castings</u>	<u>RSC 550HA</u>	<u>355 min.</u>	<u>550 min.</u>	<u>18 min.</u>	<u>30 min.</u>		
		<u>RSC 600HA</u>	<u>400 min.</u>	<u>600 min.</u>	<u>16 min.</u>	<u>30 min.</u>		
		<u>RSC 650HA</u>	<u>450 min.</u>	<u>650 min.</u>	<u>14 min.</u>	<u>30 min.</u>		
		<u>RSC 700HA</u>	<u>540 min.</u>	<u>700 min.</u>	<u>12 min.</u>	<u>28 min.</u>		
<u>Machinery steel castings not intended for welding</u>	<u>Carbon steel castings</u>	<u>RSC 400M</u>	<u>200 min.</u>	<u>400 min.</u>	<u>25 min.</u>	<u>40 min.</u>	<u>AT⁽⁴⁾</u>	<u>27</u>
		<u>RSC 440M</u>	<u>220 min.</u>	<u>440 min.</u>	<u>22 min.</u>	<u>30 min.</u>		
		<u>RSC 480M</u>	<u>240 min.</u>	<u>480 min.</u>	<u>20 min.</u>	<u>27 min.</u>		
		<u>RSC 520M</u>	<u>260 min.</u>	<u>520 min.</u>	<u>18 min.</u>	<u>25 min.</u>		
		<u>RSC 560M</u>	<u>300 min.</u>	<u>560 min.</u>	<u>15 min.</u>	<u>20 min.</u>		
		<u>RSC 600M</u>	<u>320 min.</u>	<u>600 min.</u>	<u>13 min.</u>	<u>20 min.</u>		
	<u>Alloy steel castings</u>	<u>RSC 550MA</u>	<u>340 min.</u>	<u>550 min.</u>	<u>16 min.</u>	<u>35 min.</u>		
		<u>RSC 600MA</u>	<u>400 min.</u>	<u>600 min.</u>	<u>16 min.</u>	<u>35 min.</u>		
		<u>RSC 650MA</u>	<u>450 min.</u>	<u>650 min.</u>	<u>14 min.</u>	<u>32 min.</u>		
		<u>RSC 700MA</u>	<u>540 min.</u>	<u>700 min.</u>	<u>12 min.</u>	<u>28 min.</u>		

NOTES:

- (1) For intermediate values of the tensile strength, the minimum values for yield strength, elongation and reduction of area may be obtained by interpolation and the value at the first decimal place is to be subjected to the method of counting fractions over 1/2 as one and disregarding the rest.
- (2) A tensile strength range of 150 N/mm² may additionally be specified.
- (3) Special consideration may be given to alternative requirements for Charpy V-notch impact test, depending on design and application, and subject to agreement by the Society.
- (4) AT refers to Ambient Temperature(i.e. 23°C±5°C), which is specified in **ISO 148-1:2016**.

Present	Amendment	reason
<p>3. Manufacture</p> <p>(1) ~ (2) <Omitted></p> <p>(3) When two or more castings are joined by welding to form a composite component, the proposed welding procedure is to be submitted for approval to the Society. <u>If necessary, welding procedure qualification tests may be required.</u></p> <p>(4) <New></p> <p>(5) <New></p> <p>4. Chemical composition [See Guidance]</p> <p>(1) ~ (2) <Omitted></p> <p>(3) Unless otherwise required suitable grain refining elements such as aluminium may be used at the discretion of the manufacturer. <u>The content of such elements is to be reported in the ladle analysis.</u></p>	<p>3. Manufacture</p> <p>(1) ~ (2) <Same as the present Rules></p> <p>(3) When two or more castings are joined by welding to form a composite component, the proposed welding procedure is to be submitted for approval to the Society. <u>The welding procedure qualification tests are to be required. (2023)</u></p> <p>(4) <u>The welding procedure qualification test and welder qualification test are in accordance with Pt 2, Ch 2 of the Rules. (2023)</u></p> <p>(5) <u>Temporary welds made for operations such as lifting, handling, staging, etc., are to be in accordance with approved welding procedures and qualified welders, and are to be removed, ground and inspected using suitable NDT methods. (2023)</u></p> <p>4. Chemical composition [See Guidance]</p> <p>(1) ~ (2) <Same as the present Rules></p> <p>(3) <u>Suitable grain refining elements such as aluminium may be used at the discretion of the manufacturer or as agreed with the Society.</u></p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

<Present>

Table 2.1.74 Chemical Composition (%) (2017)

Steel Type	Application	Chemical composition (%)										
		C	Si	Mn	S	P	Cu	Cr	Ni	Mo	W	Total residuals
Carbon steel casting	Casting for non-welded construction	0.40 max.	0.60 max.	0.50–1.60	<u>0.040</u> max.	<u>0.040</u> max.	0.30 max. ⁽²⁾	0.30 max. ⁽²⁾	0.40 max. ⁽²⁾	0.15 max. ⁽²⁾	–	0.80 max.
	Casting for welded construction	0.23 max. ⁽¹⁾	0.60 max.	<u>1.60</u> max.	<u>0.040</u> max.	<u>0.040</u> max.	0.30 max. ⁽²⁾	0.30 max. ⁽²⁾	0.40 max. ⁽²⁾	0.15 max. ⁽²⁾	–	0.80 max.
<u>Low alloy steel casting</u>		0.25 max.	0.60 max.	0.50 – 0.80	0.030 max.	0.030 max.	0.50 max. ⁽²⁾	1.50 max. ⁽³⁾	0.50 max. ⁽²⁾	1.20 max. ⁽³⁾	0.10 max. ⁽²⁾	1.00 max.
NOTES : (1) The carbon content may be, subject to approval by the Society, increased above this level provided that the carbon equivalent (<i>Ceq</i>) is not more than 0.41 %. 【See Guidance】 (2) Elements are considered as residual elements. (3) One or more of the elements is to comply with the minimum content.												

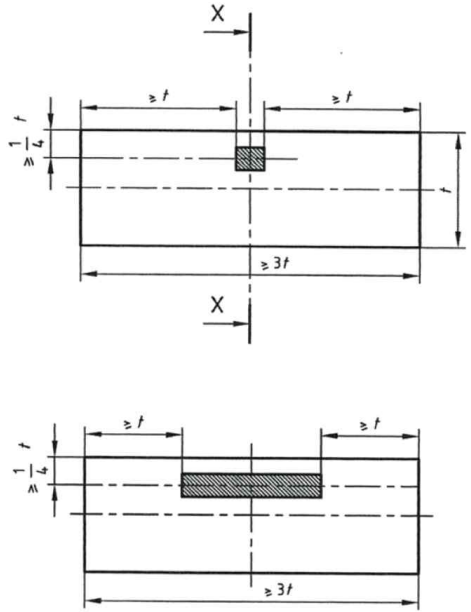
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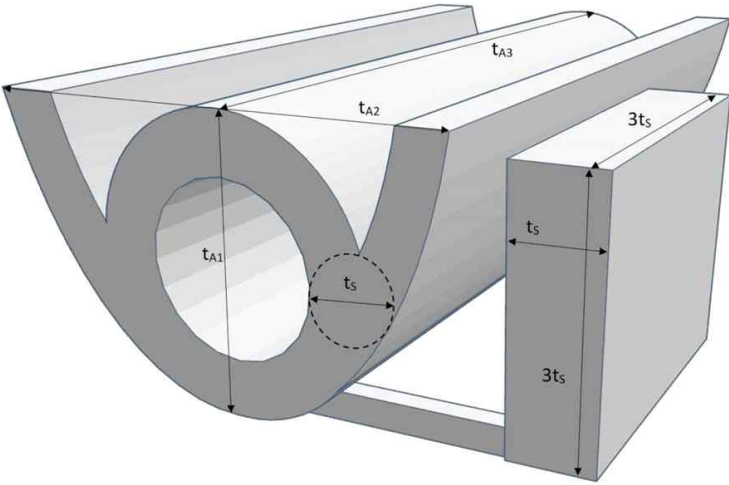
Table 2.1.74 Chemical Composition (%) (2017) (2023)

Steel Type	Application	Chemical composition (%)										
		C	Si	Mn	S	P	Cu	Cr	Ni	Mo	W	Total residuals
Carbon steel casting	Casting for non-welded construction	0.40 max.	0.60 max.	0.50–1.60	<u>0.035</u> max.	<u>0.035</u> max.	0.30 max. ⁽²⁾	0.30 max. ⁽²⁾	0.40 max. ⁽²⁾	0.15 max. ⁽²⁾	–	0.80 max.
	Casting for welded construction	0.23 max. ⁽¹⁾	0.60 max.	<u>0.50–1.60</u>	<u>0.035</u> max.	<u>0.035</u> max.	0.30 max. ⁽²⁾	0.30 max. ⁽²⁾	0.40 max. ⁽²⁾	0.15 max. ⁽²⁾	–	0.80 max.
Alloy steel casting	Casting for non-welded construction	<u>0.45</u> max.	<u>0.60</u> max.	<u>0.50 – 1.60</u>	<u>0.030</u> max.	<u>0.035</u> max.	<u>0.30</u> min. ⁽²⁾ — ⁽³⁾	<u>0.40</u> min. ⁽²⁾ — ⁽³⁾	<u>0.40</u> min. ⁽²⁾ — ⁽³⁾	<u>0.15</u> min. ⁽²⁾⁽³⁾	—	—
	Casting for welded construction	0.25 max.	0.60 max.	0.50 – 0.80	0.030 max.	0.030 max.	0.50 max. ⁽²⁾	1.50 max. ⁽³⁾	0.50 max. ⁽²⁾	1.20 max. ⁽³⁾	0.10 max. ⁽²⁾	1.00 max.
NOTES : (1) The carbon content may be, subject to approval by the Society, increased above this level provided that the carbon equivalent (<i>Ceq</i>) is not more than 0.41 %. 【See Guidance】 (2) Elements are considered as residual elements. (3) One or more of the elements is to comply with the minimum content.												

Present	Amendment	reason						
<p>5. Heat treatment</p> <p>(1) <u>Steel castings are to be fully annealed, normalized, normalized and tempered, or quenched and tempered.</u> No fully annealed casting is to be removed from the furnace until the temperature of the entire furnace charge has fallen to or below a temperature of 455°C. The tempering temperature is to be not less than 550°C. (2022)</p> <p><u>Table 2.1.75 <New></u></p> <p>(2) <u><New></u></p> <p>(2) If a casting is locally reheated or any straightening operation is performed after the final heat treatment, a subsequent stress relieving heat treatment may be required in order to avoid the possibility of harmful residual stresses. (2022)</p> <p>(3) ~ (5) <Omitted></p>	<p>5. Heat treatment</p> <p>(1) <u>Steel castings are to be supplied in one of the conditions given in Table 2.1.75.</u> No fully annealed casting is to be removed from the furnace until the temperature of the entire furnace charge has fallen to or below a temperature of 455°C. The tempering temperature is to be not less than 550°C. (2022) (2023)</p> <p>Table 2.1.75 Heat treatment (2023)</p> <table><tr><th><u>Steel Type</u></th><th><u>Heat treatment</u></th></tr><tr><td><u>Carbon steel casting</u></td><td><u>Fully Annealed</u> <u>Normalized</u> <u>Normalized and tempered</u> <u>Quenched and tempered</u></td></tr><tr><td><u>Alloy steel casting</u></td><td><u>Normalized</u> <u>Normalized and tempered</u> <u>Quenched and tempered</u></td></tr></table> <p>(2) <u>The delivery condition shall meet the design and application requirements. It is the manufacturers responsibility to select the appropriate heat treatment method to obtain the required mechanical properties. (2023)</u></p> <p>(3) <u>If a casting is locally reheated or any straightening operation is performed after the final heat treatment, a subsequent stress relieving heat treatment may be required in order to avoid the possibility of harmful residual stresses. The manufacturer shall have strict control of this temperature in order to avoid any detrimental effects to the final heat treatment and resultant microstructure and mechanical properties of the casting. (2022) (2023)</u></p> <p>(4) ~ (6) <Same as the present Rules></p>	<u>Steel Type</u>	<u>Heat treatment</u>	<u>Carbon steel casting</u>	<u>Fully Annealed</u> <u>Normalized</u> <u>Normalized and tempered</u> <u>Quenched and tempered</u>	<u>Alloy steel casting</u>	<u>Normalized</u> <u>Normalized and tempered</u> <u>Quenched and tempered</u>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>
<u>Steel Type</u>	<u>Heat treatment</u>							
<u>Carbon steel casting</u>	<u>Fully Annealed</u> <u>Normalized</u> <u>Normalized and tempered</u> <u>Quenched and tempered</u>							
<u>Alloy steel casting</u>	<u>Normalized</u> <u>Normalized and tempered</u> <u>Quenched and tempered</u>							

Present	Amendment	reason
<p>6. Mechanical properties</p> <p>(1) The mechanical properties of the steel castings are to comply with the requirements given in Table 2.1.73.</p> <p>(2) Impact tests should be required on carbon steel castings intended for welded construction such as cast sternframes, rudder horns and shoopieces. The results of impact test is to be in accordance with the Guidance relating to the Rules specified by the Society. [See Guidance]</p> <p>7. Selection of test specimens</p> <p>(1) At least one test <u>sample</u> is to be provided for each casting. Unless otherwise agreed these test samples are to be either integrally cast or gated to the castings and are to have a thickness of not less than 30 mm. Test material, sufficient for the required tests and for possible retest purposes is to be provided for each casting or batch of castings. One tensile test specimen is to be taken from each test sample.</p> <p>(2) <u><New></u></p> <p>(A) ~ (C) <u><New></u></p>	<p>6. Mechanical properties</p> <p>(1) The mechanical properties of the steel castings are to comply with the requirements given in Table 2.1.73.</p> <p>(2) Impact tests should be required on carbon steel castings intended for welded construction such as cast sternframes, rudder horns and shoopieces. The results of impact test is to be in accordance with the Guidance relating to the Rules specified by the Society. [See Guidance]</p> <p>7. Selection of test specimens</p> <p>(1) At least one test <u>block</u> is to be provided for each casting. Unless otherwise agreed these test <u>blocks</u> are to be either integrally cast or gated to the castings. <i>(2023)</i></p> <p>(2) The size of the test blocks for mechanical testing is to be such that the heat treatment and are to microstructure is representative for the section of the casting with the ruling section, i.e. the section for which the specified mechanical properties apply, see also ISO 683-1:2018 and ISO 683-2:2018, respectively.</p> <p>(A) For C, C-Mn steel castings this is in general to be achieved as follows: The test block shall have a thickness (t_s) of not less than the ruling section of the casting, or 30 mm, whichever is larger.</p> <p>(B) For large thickness castings other than stern tube, stern frame, anchor and rudder horn, t_s normally need not to exceed 150 mm. Length and width of the test block is normally to be at least three times t_s, unless otherwise agreed with the Society, as shown in Fig 2.1.13. (Note that longer or wider test blocks may be necessary in order to accommodate the required test specimens.) For castings for stern tube, stern frame, anchor and rudder horn the test block thickness t_s shall represent the ruling section.</p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason
<p><u>Fig 2.1.13 <New></u></p>	<p>(C) Shorter width or length may be accepted for test blocks where actual casting width or length (t_A) is in the range between t_S and $3t_S$. See the example below.</p> <p>(a) Example 1: For a general casting with dimensions 140 x 160 x 1250 mm the required test block size would typically be 140 x 160 x 420 mm (that is: $t_S \times t_A \times 3t_S$).</p> <p>(b) Example 2: For a stern tube casting with ruling section $t_S = 170$ mm and width/height/length $t_{A1}/t_{A2}/t_{A3} = 1000/600/1800$ mm, the required test block size would typically be 170 x 510 x 510 mm (that is: $t_S \times 3t_S \times 3t_S$) see Fig 2.1.14.</p>  <p>Fig. 2.1.13 Specimen positions relative to the test block in accordance with ISO 4990:2015* (2023)</p> <p>* The figure taken from ISO 4990:2015, Steel castings — General technical delivery requirements, is reproduced with the permission of the International Organization for Standardization, ISO. This standard can be obtained from any ISO member and from the website of the ISO Central Secretariat at the following address: www.iso.org. Copyright remains with ISO.</p>	<p>– To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason
<p>(3) <New></p> <p>(4) <New></p>	 <p>Fig. 2.1.14 Example 2: test block gated to stern tube casting (2023)</p> <p>(3) For alloy steel castings the manufacturer shall propose dimensions for the test block and demonstrate the representative nature of it. (2023)</p> <p>(4) For test blocks with thickness ≤ 56 mm, the longitudinal axis of the test specimens is to be located at ≥ 14 mm from the surface in the thickness direction. For test blocks with thickness > 56 mm, the longitudinal axis of the test specimens is to be located at $\geq \frac{1}{4} t_s$ from the surface. Test specimens shall be taken in such a way that no part of the gauge length is machined from material closer than t_s to any of the other surfaces. For impact testing, this requirement shall apply to the complete test specimen - refer to Fig 2.1.13 for location of test specimens in relation to the test block. (2023)</p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason
<p>(2) The test <u>samples</u> are to be heat treated together with the castings which they represent and are not to be detached from the casting until the specified heat treatment has been completed and they have been properly identified.</p> <p>(3) <Omitted></p> <p>(4) Number of test <u>specimens</u> is to comply with the requirements of Table 2.1.75.</p>	<p>(5) The test <u>blocks</u> are to be heat treated together with the castings which they represent and are not to be detached from the casting until the specified heat treatment has been completed and they have been properly identified. (2023)</p> <p>(6) <Same as the present Rules></p> <p>(7) Number of test <u>blocks</u> is to comply with the requirements of Table 2.1.76. (2023)</p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

<Present>

Table 2.1.75 Number of Test Specimens

Condition of casting	Number of test <u>specimens</u>
Where the weight of one steel casting is between 1 ton and 10 tons inclusive	1 for each casting ⁽¹⁾
Where the casting is of complex design or where the finished weight exceeds 10 tons	2 for each casting ⁽¹⁾
Where large castings are made from two or more casts which are not mixed in a ladle prior to pouring.	Two or more corresponding to the number of casts involved ⁽¹⁾
Where a number of small castings with a weight of 1 ton or less which are to be of similar type and dimensions, made from one cast and heat-treated in the same furnace charge.	1 for each batch of castings ⁽²⁾
NOTES: (1) These test <u>samples</u> are to be integrally cast at locations as widely separated as possible. (2) Test <u>sample</u> are to be separately casted and are to have suitable dimensions. (3) <New>	

<Amendment>

Table 2.1.76 Number of test blocks (2023)

Condition of casting	Number of test <u>blocks</u>
Where the weight of one steel casting is between 1 ton and 10 tons inclusive	1 for each casting ⁽¹⁾
Where the casting is of complex design or where the finished weight exceeds 10 tons	2 for each casting ⁽¹⁾⁽³⁾ —
Where large castings are made from two or more casts which are not mixed in a ladle prior to pouring.	Two or more corresponding to the number of casts involved ⁽¹⁾
Where a number of small castings with a weight of 1 ton or less which are to be of similar type and dimensions, made from one cast and heat-treated in the same furnace charge.	1 for each batch of castings ⁽²⁾
NOTES: (1) These test <u>blocks</u> are to be integrally cast at locations as widely separated as possible. (2) Test <u>blocks</u> are to be separately casted and are to have suitable dimensions. (3) Test blocks are from the heaviest section.	

Present	Amendment	reason
<p>8. ~ 10. <Omitted></p> <p>11. Repair of defects</p> <p>(1) <i>General</i></p> <p>(A) <u><New></u></p> <p>(i) The approval of the Society is to be obtained where steel castings from which defects were removed are to be used with or without weld repair.</p> <p>(C) <u><New></u></p> <p>(ii) Procedure of removal of defect and weld repair is to be in accordance with the Guidance relating to the Rules specified by the Society. 【See Guidance】</p> <p>(iii) <Omitted></p> <p>(iv) Shallow grooves or depressions resulting from the removal of defects may be accepted provided that they will cause no appreciable reduction in the strength of the casting. The resulting grooves or depressions are to be subsequently ground smooth and complete elimination of the defective material is to be verified by magnetic particle test or liquid penetrant test.</p> <p>(v) The manufacturer is to maintain full records detailing the extent and location of repairs made to each casting and details of weld procedures and heat treatments applied for repairs. These records are to be available to the Surveyor and copies provided on request.</p>	<p>8. ~ 10. <Same as the present Rules></p> <p>11. Repair of defects</p> <p>(1) <i>General</i></p> <p>(A) <u>Where castings are to be repaired, the manufacturer shall exercise robust controls of all repair operations regarding the repair of castings, with respect to dimensions, heat treatment, inspection and quality control. (2023)</u></p> <p>(B) The approval of the Society is to be obtained where steel castings from which defects were removed are to be used with or without weld repair.</p> <p>(C) <u>Defects and unacceptable indications must be repaired as indicated below. (2023)</u></p> <p>(a) <u>Defective parts of material may be removed by grinding, or by chipping and grinding, or by arc air-gouging and grinding.</u></p> <p>(b) <u>Thermal methods of metal removal shall only be allowed before the final heat treatment.</u></p> <p>(c) <u>All grooves shall have a bottom radius of approximately three times the groove depth and should be smoothly blended to the surface area with a finish equal to that of the adjacent surface.</u></p> <p>(D) <u>For crank throws and steel alloy castings, procedure of removal of defect and weld repair is to be in accordance with the Guidance relating to the Rules specified by the Society. (2023) 【See Guidance】</u></p> <p>(E) <Same as the present Rules></p> <p>(F) <u>Shallow grooves or depressions resulting from the removal of defects may be accepted provided that they will cause no appreciable reduction in the strength of the casting or affect the intended use, and the depth of defect removal is not over 15 mm or 10 % of wall thickness, whichever is less. The resulting grooves or depressions are to be subsequently ground smooth and complete elimination of the defective material is to be verified by magnetic particle test or liquid penetrant test. (2023)</u></p> <p>(v) <u><Move></u></p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason
<p>(2) <i>Weld repairs</i> When a casting can be repaired by welding, the following requirements apply:</p> <p>(A) <New></p> <p>(B) <New></p> <p>(i) Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted for approval.</p> <p>(C) <New></p>	<p>(2) <i>Weld repairs</i> <u>In addition to (1), when a casting can be repaired by welding, the following requirements apply: (2023)</u></p> <p>(A) <u>For C and C-Mn steel castings weld repairs shall be suitably classified as major or minor. For alloy steel castings, repair requires approval from the Society. (2023)</u></p> <p>(a) <u>Major repairs are those where:</u></p> <p>(i) <u>The depth is greater than 25 % of the wall thickness or 25 mm whichever is less, or</u></p> <p>(ii) <u>The total weld area on a casting exceeds 0.125 m² of the casting surface noting that where a distance between two welds is less than their average width, they are to be considered as one weld.</u></p> <p>(b) <u>Minor weld repairs:</u> <u>Weld repairs not classified as major are considered as minor and need to be carried out in accordance with a qualified welding procedure.</u></p> <p>(B) <u>The following is required for major repairs: (2023)</u></p> <p>(a) <u>Shall be carried out before the final delivery heat treatment condition</u></p> <p>(b) <u>Shall comply with the requirements in (D) below</u></p> <p>(c) <u>Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted for approval.</u></p> <p>(C) <u>The following is required for minor repairs: (2023)</u></p> <p>(a) <u>Shall be carried out before the final delivery heat treatment condition</u></p> <p>(b) <u>Shall comply with the requirements in (D) below</u></p> <p>(c) <u>With the exception of alloy steels, do not require prior approval by the Classification Society, except as given in (d)</u></p> <p>(d) <u>The Society may request minor repairs in critical areas to be treated as major repairs.</u></p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason
<p>(D) <New></p> <p>(ii) All castings in low-alloy steels and all castings for crankshafts are to be suitably pre-heated prior to welding. Castings in carbon steel may also require to be pre-heated depending on their chemical composition, the dimensions and position of the weld repairs.</p> <p>(b) <New></p> <p>(iii) ~ (iv) <Omitted></p> <p>(v) After welding has been completed the castings are to be given either a suitable heat treatment in accordance with the requirements of previous 5 (1) or a stress relieving heat treatment at a temperature of not less than 550°C. The type of heat treatment employed will be dependent on the chemical composition of the casting and the dimensions, positions and nature of the repairs.</p> <p>(vi) <Omitted></p> <p>(vii) On completion of heat treatment the weld repairs and adjacent material are to be ground smooth and examined by magnetic particle or liquid penetrant testing. Supplementary examination by ultrasonics or radiography may also be required depending on the dimensions and nature of the original defect. Satisfactory results are to be obtained from all forms of non-destructive testing used.</p> <p>(h) <New></p>	<p>(D) The following requirements apply for all weld repairs (major and minor):</p> <p>(a) All castings in alloy steels and all castings for crankshafts are to be suitably pre-heated prior to welding. Castings in carbon steel may also require to be pre-heated depending on their chemical composition, the dimensions and position of the weld repairs.</p> <p>(b) <u>Welding procedures are to be qualified and shall match the delivery condition of the casting. Qualification of welding procedures shall follow Pt 2, Ch 2, Sec 4 of the Rules or a recognised standard. (2023)</u></p> <p>(c) ~ (d) <Same as the present Rules></p> <p>(e) After welding has been completed the castings are to be given either a suitable heat treatment in accordance with the requirements of previous 5 (1) or a stress relieving heat treatment at a temperature of not less than 550°C for C and C-Mn steel castings. For alloy steel castings, the heat treatment has to be <u>agreed with the Society. The type of heat treatment employed will be dependent on the chemical composition of the casting and the dimensions, positions and nature of the repairs, and should not affect the properties of the casting. (2023)</u></p> <p>(f) <Same as the present Rules></p> <p>(g) On completion of heat treatment the weld repairs and adjacent material are to be ground smooth and examined by magnetic particle or liquid penetrant testing. Supplementary examination by ultrasonics or radiography <u>ultrasonic or radiographic testing</u> may also be required depending on the dimensions and nature of the original defect. Satisfactory results are to be obtained from all forms of non-destructive testing used. (2023)</p> <p>(h) <u>The manufacturer is to maintain full records detailing the extent and location of repairs made to each casting and details of weld procedures and heat treatments applied for repairs. These records are to be available to the Surveyor and copies provided on request. (2023)</u></p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason
<p>(3) <New></p> <p>12. ~ 15. <Omitted></p>	<p>(3) Recommendation for welding</p> <p>For steels with $C \geq 0.23$ or $C_{eq} \geq 0.45$, the WPQT on which the WPS is based, should be qualified on a base material having a C_{eq} as follows: the C_{eq} of the base material should not fall below more than 0.02 of the material to be welded. (Example: WPQT for a material with actual $C_{eq} = 0.50$ may be qualified on a material with $C_{eq} \geq 0.48$.) (2023)</p> <p>12. ~ 15. <Same as the present Rules></p>	<p>- To reflect IACS UR W8(Rev.3 Mar 2022)</p>

Present	Amendment	reason												
<div>Section 6 Steel Forgings</div> <div>601. Steel forgings</div> <div>1. ~ 2. <Omitted></div> <div>3. Manufacturing process</div> <div>(1) ~ (6) <Omitted></div> <div>(7) When two or more forgings are joined by welding to form a composite component, the proposed welding procedure specification is to be submitted for approval to the Society. Welding procedure qualification tests may be required.</div> <div>(8) <New></div> <div>4. Heat treatment</div> <div>(1) Except as provided in (5), after completion of all hot working operations, forgings are to be supplied in one of the conditions given in Table 2.1.86. to refine the grain structure and to obtain the required mechanical properties. No annealed forging is to be removed from the furnace until the temperature of the entire furnace charge has fallen to or below a temperature of 455°C. The tempering temperature is to be not less than 550°C. 【See Guidance】</div> <div>Table 2.1.86 Heat Treatment</div> <table><tr><th>Kind</th><th>Heat treatment</th></tr><tr><td>Carbon steels</td><td>Annealed Normalized Normalized and tempered Quenched and tempered</td></tr><tr><td>Alloy steels</td><td>Quenched and tempered</td></tr></table>	Kind	Heat treatment	Carbon steels	Annealed Normalized Normalized and tempered Quenched and tempered	Alloy steels	Quenched and tempered	<div>Section 6 Steel Forgings</div> <div>601. Steel forgings</div> <div>1. ~ 2. <Same as the present Rules></div> <div>3. Manufacturing process</div> <div>(1) ~ (6) <Same as the present Rules></div> <div>(7) When two or more forgings are joined by welding to form a composite component, the proposed welding procedure specification is to be submitted for approval to the Society. Welding procedure qualification tests and welder qualification test are to be required. (2023)</div> <div>(8) The welding procedure qualification test and welder qualification test are in accordance with Pt 2, Ch 2 of the Rules. (2023)</div> <div>4. Heat treatment</div> <div>(1) Except as provided in (5) and (6), after completion of all hot working operations, forgings are to be supplied in one of the conditions given in Table 2.1.86. to refine the grain structure and to obtain the required mechanical properties. No fully annealed forging is to be removed from the furnace until the temperature of the entire furnace charge has fallen to or below a temperature of 455°C. The tempering temperature is to be not less than 550°C. Where forgings for gearing are not intended for surface hardening, lower tempering temperature may be allowed. (2023) 【See Guidance】</div> <div>Table 2.1.86 Heat Treatment (2023)</div> <table><tr><th>Kind</th><th>Heat treatment</th></tr><tr><td>Carbon steels</td><td>Fully Annealed Normalized Normalized and tempered Quenched and tempered</td></tr><tr><td>Alloy steels</td><td>Normalized Normalized and tempered Quenched and tempered</td></tr></table>	Kind	Heat treatment	Carbon steels	Fully Annealed Normalized Normalized and tempered Quenched and tempered	Alloy steels	Normalized Normalized and tempered Quenched and tempered	<div>- To reflect IACS UR W7(Rev.4 Feb 2022)</div>
Kind	Heat treatment													
Carbon steels	Annealed Normalized Normalized and tempered Quenched and tempered													
Alloy steels	Quenched and tempered													
Kind	Heat treatment													
Carbon steels	Fully Annealed Normalized Normalized and tempered Quenched and tempered													
Alloy steels	Normalized Normalized and tempered Quenched and tempered													

Present	Amendment	reason
<p>(2) <u>Alternatively, alloy steel forgings may be supplied in the normalized and tempered condition, in which case the specified mechanical properties are to be agreed with the Society.</u></p> <p>(3) <Omitted></p> <p>(4) If a forging is locally reheated or any straightening operation is performed after the final heat treatment, consideration is to be given to a subsequent stress relieving heat treatment.</p> <p>(5) ~ (9) <Omitted></p> <p>5. Chemical composition</p> <p>(1) The chemical composition of steel forgings is to comply with the requirements given in Table 2.1.87.</p> <p>(2) ~ (3) <Omitted></p>	<p>(2) <u>The delivery condition shall meet the design and application requirements, it is the manufacturers responsibility to select the appropriate heat treatment method to obtain the required mechanical properties. (2023)</u></p> <p>(3) <Same as the present Rules></p> <p>(4) If a forging is locally reheated or any straightening operation is performed after the final heat treatment, consideration is to be given to a subsequent stress relieving heat treatment. <u>The manufacturer shall have strict control of this temperature in order to avoid any detrimental effects to the final heat treatment and resultant microstructure and mechanical properties of the forging. (2023)</u></p> <p>(5) ~ (9) <Same as the present Rules></p> <p>5. Chemical composition</p> <p>(1) The chemical composition of steel forgings is to comply with the requirements given in Table 2.1.87.</p> <p>(2) ~ (3) <Same as the present Rules></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022)</p>

<Present>

Table 2.1.87 Chemical Composition (2017) (2021)

Steel type		Chemical composition (%)									
		C	Si	Mn	P	S	Cr	Mo	Ni	Cu ⁽³⁾	Total residual
Hull and General purpose steel forging ⁽⁴⁾	Carbon steel	0.23 ⁽¹⁾⁽²⁾ max.	0.45 max.	0.30-1.50	0.035 max.	0.035 max.	0.30 ⁽³⁾ max.	0.15 ⁽³⁾ max.	0.40 ⁽³⁾ max.	0.30 max.	0.85 max.
	Alloy steel	0.23 max.	0.45 max.	0.30-1.00	0.035 max.	0.035 max.	0.40 ⁽⁶⁾ min.	0.15 ⁽⁶⁾ min.	0.40 ⁽⁶⁾ min.	0.30 max.	-
Machinery steel forging	Carbon steel	0.65 ⁽¹⁾ max.	0.45 max.	0.30-1.50	0.035 max.	0.035 max.	0.30 ⁽³⁾ max.	0.15 ⁽³⁾ max.	0.40 ⁽³⁾ max.	0.30 max.	0.85 max.
	Alloy steel ⁽⁵⁾	0.45 max.	0.45 max.	0.30-1.00	0.035 max.	0.035 max.	0.40 ⁽⁶⁾ min.	0.15 ⁽⁶⁾ min.	0.40 ⁽⁶⁾ min.	0.30 max.	-
NOTES : (1) The carbon content of carbon steel forgings intended for welded construction is to be 0.23 % maximum. The carbon content may be increased above this level provided that the carbon equivalent (Ceq) is not more than 0.41 %. (2) The carbon content of carbon steel forgings not intended for welded construction may be 0.65 % maximum. (3) Elements are considered as residual elements. (4) Rudder stocks and pintles should be of weldable quality. (5) Where alloy steel forgings are intended for welded constructions, the proposed chemical composition is subject to approval by the Society. (6) One or more of the elements is to comply with the minimum content.											

<Amendment>

Table 2.1.87 Chemical Composition (2017) (2021) (2023)

Steel type		Chemical composition (%)									
		C	Si	Mn	P	S	Cr	Mo	Ni	Cu ⁽³⁾	Total residual
Hull and General purpose steel forging ⁽⁴⁾	Carbon steel	0.23 ⁽¹⁾⁽²⁾ max.	0.45 max.	0.30-1.50	0.035 max.	0.035 max.	0.30 ⁽³⁾ max.	0.15 ⁽³⁾ max.	0.40 ⁽³⁾ max.	0.30 max.	0.85 max.
	Alloy steel	0.23 max.	0.45 max.	0.30-1.00	0.035 max.	0.035 max.	0.40 ⁽⁶⁾ min.	0.15 ⁽⁶⁾ min.	0.40 ⁽⁶⁾ min.	0.30 max.	-
Machinery steel forging	Carbon steel	0.23 ⁽¹⁾⁽²⁾ max.	0.45 max.	0.30-1.50	0.035 max.	0.035 max.	0.30 ⁽³⁾ max.	0.15 ⁽³⁾ max.	0.40 ⁽³⁾ max.	0.30 max.	0.85 max.
	Alloy steel ⁽⁵⁾	0.45 max.	0.45 max.	0.30-1.00	0.035 max.	0.035 max.	0.40 ⁽⁶⁾ min.	0.15 ⁽⁶⁾ min.	0.40 ⁽⁶⁾ min.	0.30 max.	-
NOTES : (1) The carbon content may be increased above this level provided that the carbon equivalent (Ceq) is not more than 0.41 %. (2) The carbon content of carbon steel forgings not intended for welded construction may be 0.65 % maximum. (3) Elements are considered as residual elements. (4) Rudder stocks and pintles should be of weldable quality. (5) Where alloy steel forgings are intended for welded constructions, the proposed chemical composition is subject to approval by the Society. (6) One or more of the elements is to comply with the minimum content.											

Present	Amendment	reason
<p>6. Mechanical properties</p> <p>(1) The mechanical properties of steel forgings are to comply with the requirements given in Table 2.1.88 and 2.1.89.</p> <p>(2) ~ (3) <Omitted></p>	<p>6. Mechanical properties</p> <p>(1) The mechanical properties of steel forgings are to comply with the requirements given in Table 2.1.88 and 2.1.89.</p> <p>(2) ~ (3) <Same as the present Rules></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022)</p>

<Present>

Table 2.1.88 Kinds and Mechanical Properties for Hull Steel Forgings (2017)

Steel type	grades	Tensile test					
		Tensile strength (N/mm ²)	Yield strength (N/mm ²)	Elongation(%) ($L = 5.65 \sqrt{A}$) (minimum)		Reduction of area(%) (minimum)	
				L	T	L	T
Carbon steel forgings	<i>RSF 400H</i>	400 min.	200 min.	26	19	50	35
	<i>RSF 440H</i>	440 min.	220 min.	24	18	50	35
	<i>RSF 480H</i>	480 min.	240 min.	22	16	45	30
	<i>RSF 520H</i>	520 min.	260 min.	21	15	45	30
	<i>RSF 560H</i>	560 min.	280 min.	20	14	40	27
	<i>RSF 600H</i>	600 min.	300 min.	18	13	40	27
Alloy steel forgings	<i>RSF 550AH</i>	550 min.	350 min.	20	14	50	35
	<i>RSF 600AH</i>	600 min.	400 min.	18	13	50	35
	<i>RSF 650AH</i>	650 min.	450 min.	17	12	50	35

Notes ;

(1) Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation and the value at the first decimal place is to be subjected to the method of counting fractions over 1/2 as one and dis-regarding the rest.

(2) For the upper limit of tensile strength, the following ranges for tensile strength may be additionally speci-fied:

Specified minimum tensile strength (N/mm ²)	Range of upper limit(N/mm ²)
< 600	120
≥ 600	150

(3) In the case of large forgings requiring two tension tests, the range of tensile strength is not to exceed 70 N/mm²

(4) L (or T) denotes that the longitudinal axis of the test specimen is arranged parallel (or tangential) to the direction of forging.

(5) For rudder stocks intended for ships with ice class notation **except the lowest one(Grade ID)**, Charpy V-notch impact testing is to be carried out for all steel types at -10℃ and the average energy value is to be minimum 27 J (longitudinal test).

(6) **<New>**

<Amendment>

Table 2.1.88 Kinds and Mechanical Properties for Hull Steel Forgings (2017) (2023)

Steel type	grades	Tensile test						Charpy V-notch impact test ⁽⁶⁾		
		Tensile strength (N/mm ²)	Yield strength (N/mm ²)	Elongation(%) ($L = 5.65 \sqrt{A}$) (minimum)		Reduction of area(%) (minimum)		Test temper- ature(°C)	Minimum average en- ergy(J)	
				<i>L</i>	<i>T</i>	<i>L</i>	<i>T</i>		<i>L</i> ⁽⁴⁾	<i>T</i> ⁽⁴⁾
Carbon steel forgings	<i>RSF 400H</i>	400 min.	200 min.	26	19	50	35	0	27	18
	<i>RSF 440H</i>	440 min.	220 min.	24	18	50	35			
	<i>RSF 480H</i>	480 min.	240 min.	22	16	45	30			
	<i>RSF 520H</i>	520 min.	260 min.	21	15	45	30			
	<i>RSF 560H</i>	560 min.	280 min.	20	14	40	27			
	<i>RSF 600H</i>	600 min.	300 min.	18	13	40	27			
Alloy steel forgings	<i>RSF 550AH</i>	550 min.	350 min.	20	14	50	35			
	<i>RSF 600AH</i>	600 min.	400 min.	18	13	50	35			
	<i>RSF 650AH</i>	650 min.	450 min.	17	12	50	35			

Notes ;

- (1) Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation and the value at the first decimal place is to be subjected to the method of counting fractions over 1/2 as one and disregarding the rest.
- (2) For the upper limit of tensile strength, the following ranges for tensile strength may be additionally specified:

Specified minimum tensile strength (N/mm ²)	Range of upper limit(N/mm ²)
< 600	120
≥ 600	150

- (3) In the case of large forgings requiring two tension tests, the range of tensile strength is not to exceed 70 N/mm²
- (4) *L* (or *T*) denotes that the longitudinal axis of the test specimen is arranged parallel (or tangential) to the direction of forging.
- (5) For rudder stocks intended for ships with ice class notation(Grade IA Super, IA, IB and IC), Charpy V-notch impact testing is to be carried out for all steel types at -10°C and the average energy value is to be minimum 27 J (longitudinal test).
- (6) Special consideration may be given to alternative requirements for Charpy V-notch test, depending on design and application and subject to agreement by the Society.

<Present>

Table 2.1.89 Kinds and mechanical properties for machinery steel forgings (2017)

Steel type	Grades	Tensile test						Hardness test
		Tensile strength (N/mm ²)	Yield strength (N/mm ²)	Elongation(%) ($L = 5.65 \sqrt{A}$) (minimum)		Reduction of area(%) (minimum)		Hardness (H _{BW})
				L	T	L	T	
Carbon steel forgings	RSF 400M	400 min.	200 min.	26	19	50	35	110 - 150
	RSF 440M	440 min.	220 min.	24	18	50	35	125 - 160
	RSF 480M	480 min.	240 min.	22	16	45	30	135 - 175
	RSF 520M	520 min.	260 min.	21	15	45	30	150 - 185
	RSF 560M	560 min.	280 min.	20	14	40	27	160 - 200
	RSF 600M	600 min.	300 min.	18	13	40	27	175 - 215
	RSF 640M	640 min.	320 min.	17	12	35	27	185 - 230
	RSF 680M	680 min.	340 min.	16	12	35	24	200 - 240
	RSF 720M	720 min.	360 min.	15	11	35	24	210 - 250
	RSF 760M	760 min.	380 min.	14	10	35	24	225 - 265
Alloy steel forgings	RSF 600AM	600 min.	360 min.	18	14	50	35	175 - 215
	RSF 700AM	700 min.	420 min.	16	12	45	30	205 - 245
	RSF 800AM	800 min.	480 min.	14	10	40	27	235 - 275
	RSF 900AM	900 min.	630 min.	13	9	40	27	260 - 320
	RSF 1000AM	1000 min.	700 min.	12	8	35	24	290 - 365
	RSF 1100AM	1100 min.	770 min.	11	7	35	24	320 - 385

NOTES :

- (1) Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation and the value at the first decimal place is to be subjected to the method of counting fractions over 1/2 as one and disregarding the rest.
- (2) For the upper limit of tensile strength, the following ranges for tensile strength may be additionally specified:

Specified minimum tensile strength (N/mm ²)	Range of upper limit (N/mm ²)
< 900	150
≥ 900	200

- (3) *L* (or *T*) denotes that the longitudinal axis of the test specimen is arranged parallel (or tangential) to the direction of forging.
- (4) For propeller shafts intended for ships with ice class notation except the lowest one(Grade ID), Charpy V-notch impact testing is to be carried out for all steel types at -10℃ and the average energy value is to be minimum 27J (longitudinal test). One individual value may be less than the required average value provided that it is not less than 70 % of this average value. and, The impact test for important components for machinery is to be in accordance with the Guidance relating to the Rules specified by the Society. [See Guidance]
- (5) The hardness values are typical and are given for information purposes only.

<Amendment>

Table 2.1.89 Kinds and mechanical properties for machinery steel forgings (2017) (2023)

Steel type	Grades	Tensile test						Hardness test ⁽⁵⁾	Charpy V-notch impact test ⁽⁴⁾⁽⁶⁾		
		Tensile strength ⁽²⁾ (N/mm ²)	Yield strength (N/mm ²)	Elongation(%) ($L = 5.65 \sqrt{A}$) (minimum)		Reduction of area(%) (minimum)		Hardness (H _{BW})	Test temperature(°C)	Minimum average energy(J)	
				L ⁽³⁾	T ⁽³⁾	L ⁽³⁾	T ⁽³⁾			L ⁽³⁾	T ⁽³⁾
Carbon steel forgings	RSF 400M	400 min.	200 min.	26	19	50	35	110 - 150	AT ⁽⁷⁾	27	18
	RSF 440M	440 min.	220 min.	24	18	50	35	125 - 160			
	RSF 480M	480 min.	240 min.	22	16	45	30	135 - 175			
	RSF 520M	520 min.	260 min.	21	15	45	30	150 - 185			
	RSF 560M	560 min.	280 min.	20	14	40	27	160 - 200			
	RSF 600M	600 min.	300 min.	18	13	40	27	175 - 215			
	RSF 640M	640 min.	320 min.	17	12	35	27	185 - 230			
	RSF 680M	680 min.	340 min.	16	12	35	24	200 - 240			
	RSF 720M	720 min.	360 min.	15	11	35	24	210 - 250			
	RSF 760M	760 min.	380 min.	14	10	35	24	225 - 265			
Alloy steel forgings	RSF 600AM	600 min.	360 min.	18	14	50	35	175 - 215			
	RSF 700AM	700 min.	420 min.	16	12	45	30	205 - 245			
	RSF 800AM	800 min.	480 min.	14	10	40	27	235 - 275			
	RSF 900AM	900 min.	630 min.	13	9	40	27	260 - 320			
	RSF 1000AM	1000 min.	700 min.	12	8	35	24	290 - 365			
	RSF 1100AM	1100 min.	770 min.	11	7	35	24	320 - 385			

NOTES :

- (1) Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation and the value at the first decimal place is to be subjected to the method of counting fractions over 1/2 as one and disregarding the rest.
- (2) For the upper limit of tensile strength, the following ranges for tensile strength may be additionally specified:

Specified minimum tensile strength (N/mm ²)	Range of upper limit (N/mm ²)
< 900	150
≥ 900	200

- (3) *L* (or *T*) denotes that the longitudinal axis of the test specimen is arranged parallel (or tangential) to the direction of forging.
- (4) For materials used for machinery exposed to sea water temperature, such as propeller shafts and shaft bolts, intended for ships with ice class notation(Grade IA Super, IA, IB and IC), Charpy V-notch impact testing is to be carried out for all steel types at -10 °C and the average energy value is to be minimum 20 J (longitudinal test). One individual value may be less than the required average value provided that it is not less than 70% of this average value. Impact test for important components as crankshaft and gears for machinery is to be in accordance with the Guidance relating to the Rules specified by the Society. **[See Guidance]**
- (5) The hardness values are typical and are given for information purposes only.
- (6) Special consideration may be given to alternative requirements for Charpy V-notch test, depending on design and application and subject to agreement by the Society.
- (7) AT refers to Ambient Temperature (i.e. 23°C ± 5°C), which is specified in **ISO 148-1:2016**.

Present	Amendment	reason
<p>7. Selection of test specimens</p> <p>(1) ~ (3) <Omitted></p> <p>(4) Unless otherwise agreed, the longitudinal axis of test specimens is to be positioned as follows. However the axis of transverse specimens may be located close to the surface of the forgings</p> <p>(a) <u>for thickness or diameter up to maximum 50 mm, the axis of test specimens is to be at the mid-thickness or the center of the cross section.</u></p> <p>(b) <u>for thickness or diameter greater than 50 mm, the axis is to be at one quarter thickness (mid-radius) or 80 mm, whichever is less, below any heat treated surface.</u></p> <p>(C) <New></p>	<p>7. Selection of test specimens</p> <p>(1) ~ (3) <Same as the present Rules></p> <p>(4) <u>The test specimen is to be positioned as follows. (2023)</u></p> <p>(A) <u>For forgings having a thickness, t, or diameter D up to maximum 50 mm, the longitudinal axis of the test specimen is to be located at a distance of t/2 or D/2 below the heat treated surfaces.</u></p> <p>(B) <u>For forgings having a thickness, t, or diameter D greater than 50 mm, the longitudinal axis of the test specimen is to be located at a distance of t/4 or D/4 (mid-radius) or 80mm, whichever is less, below any heat treated surface. Test specimen is to be located with its longitudinal axis at a distance from any heat treated surface as shown in Fig 2.1.17.</u></p> <p>(C) <u>For ring and disc forgings (noting that the test specimen locations for these shaped forgings may be different to elongated or free form forgings), tangential sample shall be taken at t/2 for thickness ≤ 25mm and 12.5 mm below the surface for thickness >25 mm, in both the vertical and horizontal direction. Where achievable, for thickness > 25 mm, no part of the test material shall be closer than 12.5 mm to any heat treated surface, as shown in Fig 2.1.17.</u></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022)</p>

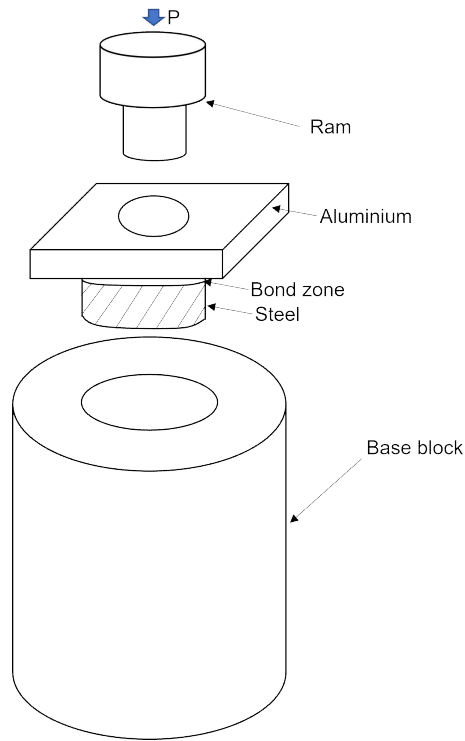
Present	Amendment	reason
<p>(5) <New></p> <p>(5) Except as provided in (10), the number and direction of tests is to be as given in (a) through (h) of the following requirements: (a) ~ (d) <Omitted></p>	<div data-bbox="1120 199 1736 694" data-label="Image"> </div> <p>(Notes) (1) “a” is the distance from the test specimen to heat treated surface based on the above (B) or (C).</p> <p>Fig 2.1.17 Position of the test specimen</p> <p>(5) Where the manufacturer can demonstrate that a proposed testing location or orientation is more representative of the required mechanical properties of a component, this may be agreed with the Society. In such cases, the heat treatment process, a proposed testing location or orientation, and technical justification shall be submitted to the Society for approval.</p> <p>(6) Except as provided in (11), the number and direction of tests is to be as given in (A) through (I) of the following requirements: (A) ~ (D) <Same as the present Rules></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022)</p>

Present	Amendment	reason
<p>(e) Rims intended for reduction gears and for cam shaft driving gears of diesel engine (see Pt 5, Ch 2 201.1) are to comply with the following requirements.</p> <p>(i) Where the finished diameter exceeds 2.5 m or the mass (as heat treated <u>excluding</u> test material) exceeds 3 tonnes, two sets of tests are to be taken from diametrically opposite positions (test positions A and B in Fig 2.1.22). The mechanical properties for longitudinal test are to be applied.</p> <p>(ii) <Omitted></p> <p>(f) ~ (h) <Omitted></p> <p>(I) <New></p> <p>(6) ~ (11) <Omitted></p>	<p>(E) Rims intended for reduction gears and for cam shaft driving gears of diesel engine (see Pt 5, Ch 2 201.1) are to comply with the following requirements.</p> <p>(i) Where the finished diameter exceeds 2.5 m or the mass (as heat treated <u>including</u> test material) exceeds 3 tonnes, two sets of tests are to be taken from diametrically opposite positions (test positions A and B in Fig 2.1.22). The mechanical properties for longitudinal test are to be applied. (2023)</p> <p>(ii) <Same as the present Rules></p> <p>(F) ~ (H) <Same as the present Rules></p> <p>(I) <i>Forged Rings (such as slewing rings)</i> : One set of tests is to be taken from each forging in a tangential direction (test positions are shown in Fig 2.1.26). Where the finished diameter exceeds 2.5 m or the mass (as heat treated, including test material) exceeds 3 tonnes then two sets of tests are to be taken diametrically opposite positions. (2023)</p> <div data-bbox="1160 786 1664 1281"> <p>Examples of acceptable tangential test positions</p> </div> <p>Fig 2.1.26 Forged rings (2023)</p> <p>(7) ~ (12) <Same as the present Rules></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022)</p>

Present	Amendment	reason
<p>8. Surface inspection [See Guidance]</p> <p>(1) When heat treatment and final machining are completed and, if necessary, at a proper time during machining, surface inspection is to be carried out. Where applicable, this is to include the examination of internal surfaces and bores. Testing methods and acceptance criteria are to be in accordance with the Guidance relating to the Rules specified by the Society.</p> <p>(2) <Omitted></p> <p>9. ~ 10. <Omitted></p> <p>11. Repair of defects</p> <p>(1) ~ (3) <Omitted></p> <p>(4) Repair welding of forgings except crankshaft forgings may be permitted subject to prior approval of the Society. In such cases, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted for the approval. [See Guidance]</p> <p>(5) <Omitted></p> <p>12. <Omitted></p> <p>13. Marking</p> <p>(1) Steel forgings which have satisfactorily complied with the required tests are to be marked with the identification mark in accordance with the requirements in 110.</p> <p>(2) ~ (5) <Omitted></p> <p>14. ~ 18. <Omitted></p> <p>602. ~ 604. <Omitted></p> <p>Section 7 <Omitted></p>	<p>8. Surface inspection [See Guidance]</p> <p>(1) <u>All forgings should be subjected to a 100% visual examination of all accessible surfaces by the manufacturer and made available to the Surveyor. Where applicable, this visual examination is to include the examination of internal surfaces and bores. Testing methods and acceptance criteria are to be in accordance with the Guidance relating to the Rules specified by the Society. (2023)</u></p> <p>(2) <Same as the present Rules></p> <p>9. ~ 10. <Same as the present Rules></p> <p>11. Repair of defects</p> <p>(1) ~ (3) <Same as the present Rules></p> <p>(4) Repair welding of forgings except <u>those subjected to torsional fatigue, such as crankshaft forgings and propeller shaft forgings,</u> may be permitted subject to prior approval of the Society. In such cases, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted for the approval. (2023) [See Guidance]</p> <p>(5) <Same as the present Rules></p> <p>12. <Same as the present Rules></p> <p>13. Marking</p> <p>(1) Steel forgings which have satisfactorily complied with the required tests are to be marked with the identification mark in accordance with the requirements in 110.. <u>And it should also include follows. (2023)</u></p> <p><u>(A) Test pressure where applicable</u></p> <p><u>(B) Date of final inspection</u></p> <p>(2) ~ (5) <Same as the present Rules></p> <p>14. ~ 18. <Same as the present Rules></p> <p>602. ~ 604. <Same as the present Rules></p> <p>Section 7 <Same as the present Rules></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022)</p>

Present	Amendment	reason
<p align="center">Section 8 Aluminium Alloys</p> <p>801. <Omitted></p> <p>802. <New></p>	<p align="center">Section 8 Aluminium Alloys</p> <p>801. <Same as the present Rules></p> <p>802. Aluminium/steel transition joints (2023)</p> <p>1. Application</p> <p>(1) The requirements in 802. are to apply to bonded composite aluminium/steel transition joints used for connecting aluminium structures to steel structures in the ships.</p> <p>(2) Aluminium/steel transition joints having characteristics differing from those specified in 802. are to comply with the requirements in 101. 2.</p> <p>2. Process of manufacture</p> <p>(1) The main method of manufacturing transition joints is an explosion bonding.</p> <p>(2) Transition joints are to be manufactured by an approved manufacturer in accordance with an approved procedure that includes the maximum allowable welding temperature.</p> <p>(3) Transition joints can use two bonding materials by using an intermediate bonding material that connects the base metal and bonding material.</p> <p>(4) Application of any other process of manufacture than those specified in (1) is left to the discretion of the Society. 【See Guidance】</p> <p>3. Structural metals</p> <p>(1) Base and bonding materials for steel plates are to be rolled steels for hull specified in 301. and aluminium alloys specified in 801., respectively.</p> <p>(2) Materials other than those specified in Pt 2 of the Rules are permitted for the intermediate bonding material connecting the base metal and the bonding material, and it is in accordance with the approved manufacturing process.</p> <p>(3) The material grade marks are to be signified by a combination of base metal and bonding material. (ex. <i>A + 5083P</i>)</p> <p>4. Heat treatment</p> <p>The transition joints are to comply with the requirements for heat treatment of the base metal.</p>	<p>– The requirements for Aluminium/steel transition joints are newly established.</p>

Present	Amendment	reason
<p>802. <New></p>	<p><u>5. Mechanical properties</u></p> <p>(1) <u>Tensile test</u> (A) <u>Two test specimens are taken from one test sample and tensile test is to comply with the requirements given in Table 2.1.108.</u> (B) <u>The test specimens are to be determined according to Fig 2.1.28. The size and dimensions of test specimens are in accordance with national/international standards recognized by the Society.</u></p> <p>(2) <u>Shear test</u> (A) <u>Two test specimens are taken from one test sample and tensile test is to comply with the requirements given in Table 2.1.108.</u> (B) <u>The size and dimensions of the test specimens, are to be determined according to 309. 7.</u></p> <p>(3) <u>Bend test</u> <u>Two test specimens are taken from one test sample and tensile test is to comply with the requirements given in Table 2.1.108.</u></p>	<p>– The requirements for Aluminium/steel transition joints are newly established.</p>

Present	Amendment	reason
<p>802. <New></p>	 <p>Fig 2.1.28 Ram tensile test (2023)</p>	<p>– The requirements for Aluminium/steel transition joints are newly established.</p>

<New>

Table 2.1.108 Mechanical properties

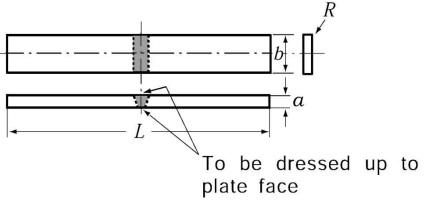
<u>Condition of specimens</u>	<u>Tensile test</u>		<u>Shear test</u>		<u>Bend test⁽¹⁾</u>	
	<u>Test method</u>	<u>Tensile strength (N/mm²)</u>	<u>Test method</u>	<u>Shear strength (N/mm²)</u>	<u>Test method</u>	<u>Acceptance criteria</u>
<u>As manufactured condition</u>	<u>Ram tensile test at room temperature according to Figure 2.1.28⁽²⁾</u>	<u>min. 75</u>	<u>In accordance with Pt 2, Ch 1, 309. 5 of the Rules.</u>	<u>min. 60</u>	<u>Two side bend test specimens (Minimum bend degree with 90° and diameter of former with 6T)</u>	<u>No separation of the bonding material or no cracks.</u>
<u>For considering welding heat (After maintaining 15 minutues with 300 °C)</u>					<u>=</u>	<u>=</u>
<u>(Notes)</u>						
<u>(1) In case of special request at order, it is carried out.</u>						
<u>(2) The test procedure is in accordance with national/international standards recognized by the Society.</u>						

Present	Amendment	reason															
<p>802. <New></p>	<p>6. Selection of test samples</p> <p>(1) <u>One test sample is to be taken from each steel plate, being from the same manufacturing process, which belong to the plate as rolled from a slab or ingot of a certain base metal.</u></p> <p>(2) <u>The requirements specified in 301. 6 (4) are to be applied to the selection of the test samples.</u></p> <p>7. Surface inspection and verification of dimensions</p> <p><u>The minus tolerance for the nominal thickness of plates is left to the discretion of the Society. [See Guidance]</u></p> <p>8. Quality and repair of defects [See Guidance]</p> <p>(1) <u>Each steel plate is to be subjected to ultrasonic testing 100%. Any requirement for the test procedure is left to the discretion of the Society.</u></p> <p>(2) <u>Unbonded areas are not acceptable and any unbonded area plus 25 mm of surrounding sound material is to be discarded.</u></p> <p>9. Marking</p> <p>(1) <u>The test certificates are to comply with the requirements given in 107. and are to contain the particulars as to the process of manufacture of steel plates and the thickness of the bonding material.</u></p> <p>(2) <u>Steel plates which have satisfactorily complied with the required tests are to be suffixed with the following marks relating to the process of manufacture of the steel plates, in addition to the marks showing the kinds of the base and bonding materials. (e.g. A + 5083P - B)</u></p> <table border="0"> <tr> <td>Rolling</td> <td>:</td> <td>[-R]</td> </tr> <tr> <td>Cast rolling</td> <td>:</td> <td>[-ER]</td> </tr> <tr> <td>Explosive bonding</td> <td>:</td> <td>[-B]</td> </tr> <tr> <td>Explosive rolling</td> <td>:</td> <td>[-BR]</td> </tr> <tr> <td>Overlay rolling</td> <td>:</td> <td>[-WR]</td> </tr> </table>	Rolling	:	[-R]	Cast rolling	:	[-ER]	Explosive bonding	:	[-B]	Explosive rolling	:	[-BR]	Overlay rolling	:	[-WR]	<p>- The requirements for Aluminium/steel transition joints are newly established.</p>
Rolling	:	[-R]															
Cast rolling	:	[-ER]															
Explosive bonding	:	[-B]															
Explosive rolling	:	[-BR]															
Overlay rolling	:	[-WR]															

Present	Amendment	reason
<p align="center">CHAPTER 2 WELDING</p> <p align="center">Section 1 <Omitted></p> <p>Section 2 Test Specimens and Testing Procedures</p> <p>201. ~ 202. <Omitted></p> <p>203. Size and dimensions of test specimens</p> <p>1. <Omitted></p> <p>2. Bend test specimens</p> <p>(1) Bend test specimens are to be of size and dimensions given in Table 2.2.2 according to the kind of test assemblies.</p> <p>(2) ~ (3) <Omitted></p> <p>3. ~ 4. <Omitted></p>	<p align="center">CHAPTER 2 WELDING</p> <p align="center">Section 1 <Same as the present Rules></p> <p>Section 2 Test Specimens and Testing Procedures</p> <p>201. ~ 202. <Same as the present Rules></p> <p>203. Size and dimensions of test specimens</p> <p>1. <Same as the present Rules></p> <p>2. Bend test specimens</p> <p>(1) Bend test specimens are to be of size and dimensions given in Table 2.2.2 according to the kind of test assemblies.</p> <p>(2) ~ (3) <Same as the present Rules></p> <p>3. ~ 4. <Same as the present Rules></p>	<p>– Harmonization with the provisions of Pt 2, Ch 2, Section 5 (Table 2.2.2 of next page)</p>

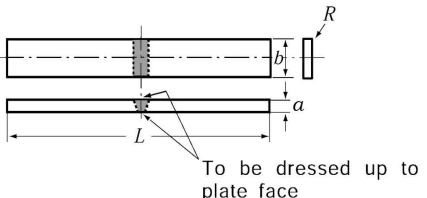
<Present>

Table 2.2.2 Size and Dimensions of Bend Test Specimens (Unit : mm)

Used for	Type	Size of specimen	Dimensions ⁽¹⁾	Intended for
<Omitted>				
Welder's qualification test	Face and root bend specimen	RB 7	 $t < 12$ $a = t$ $b = \underline{40}$ $L \cong 150$ $R \leq 1.5$	Butt weld bend test for pipe
<Omitted>				

<Amendment>

Table 2.2.2 Size and Dimensions of Bend Test Specimens (Unit : mm) (2023)

Used for	Type	Size of specimen	Dimensions ⁽¹⁾	Intended for
<Same as the present Rules>				
Welder's qualification test	Face and root bend specimen	RB 7	 $t < 12$ $a = t$ $b = \underline{30}$ $L \cong 150$ $R \leq 1.5$	Butt weld bend test for pipe
<Same as the present Rules>				

Present	Amendment	reason
<p style="text-align: center;">Section 3 <Omitted></p> <p>Section 4 Welding Procedure Qualification Tests</p> <p>401. ~ 403. <Omitted></p> <p>404. Tests for butt welded joints</p> <p>1. <Omitted></p> <p>2. Kinds of test</p> <p>According to the materials to be tested, kinds of test and number of test specimens are to be given in Table 2.2.4. Additional test may be required where found necessary by the Society.</p> <p>[See Guidance]</p> <p>3. ~ 7. <Omitted></p> <p>8. Visual & Non-destructive inspection</p> <p>(1) ~ (4) <Omitted></p> <p>(5) For aluminium alloys, imperfections detected by visual or non-destructive testing should be assessed in accordance with ISO 10042, level B, except for excess weld metal or convexity, excess throat thickness and excess of penetration for which the level C applies. (2022)</p> <p>9. ~ 10. <Omitted></p>	<p style="text-align: center;">Section 3 <Same as the present Rules></p> <p>Section 4 Welding Procedure Qualification Tests</p> <p>401. ~ 403. <Same as the present Rules></p> <p>404. Tests for butt welded joints</p> <p>1. <Same as the present Rules></p> <p>2. Kinds of test</p> <p>According to the materials to be tested, kinds of test and number of test specimens are to be given in Table 2.2.4 and Table 2.2.5. Additional test may be required where found necessary by the Society.</p> <p>[See Guidance]</p> <p>3. ~ 7. <Same as the present Rules></p> <p>8. Visual & Non-destructive inspection</p> <p>(1) ~ (4) <Same as the present Rules></p> <p>(5) For aluminium alloys, imperfections detected by visual or non-destructive testing should be assessed in accordance with ISO 10042:2018, level B, except for excess weld metal or convexity, excess throat thickness and excess of penetration for which the level C applies. (2022)</p> <p>9. ~ 10. <Same as the present Rules></p>	<p>- To fill in the missing</p> <p>- To reflect IACS Rec.70(Rev.2 Sep 2021)</p> <p>- The requirement for bend test has been clarified by reflecting the opinions of the Materials&Welding Technical Sub-Committee in 2021. (Table 2.2.5 of next page)</p>

<Present>

Table 2.2.5 Kinds of Test for Pipes with Butt Welded Joints (2019)

Grades and material symbols of test specimens		Kinds and number of specimens for test ⁽¹⁾⁽²⁾⁽³⁾						
		Visual insp.	Tensile test	Bend test ⁽⁵⁾	Impact test ⁽⁶⁾	Macro-structure insp.	Hard. test	Non-destructive insp.
The pipes for ordinary piping	<i>RSTH 35, RSTH 42, RSTH 52, RSTH 12, RSTH 22, RSTH 23, RSTH 24,</i>	Welding positions of whole length	2	4	-	1	1	Welding positions of whole length ⁽⁹⁾
The pipes used for high temperature and high pressure ⁽⁴⁾	<i>RST 138, RST 142, RST 238, RST 242, RST 249, RST 338, RST 342, RST 349, RST 412, RST 422, RST 423, RST 424, RBH 1, RBH 2, RBH 3, RBH 4, RBH 5, RBH 6, etc.</i>				(7)			
Steel pipes for low temperature service	<i>RLPA, RLPB, RLPC, RLP 2, RLP 3, RLP 9</i>				(8)			
Stainless steel pipes	<i>RSTS 304TP, RSTS 304LTP, RSTS 309STP, RSTS 310STP, RSTS 316TP, RSTS 316LTP, RSTS 317TP, RSTS 317LTP, RSTS 321TP, RSTS 347TP</i>				-		-	Welding positions of whole length ⁽¹⁰⁾

Notes :

- (1) Where found necessary by the Society, microscopic test, hardness test and tests other than these may be required. **[See Guidance]**
- (2) Regardless of the above, as for those of less than 50 mm in outer diameter, test assemblies are to be prepared by two sets, one for tensile test, the other for macro, micro structure and hardness distribution examinations to be carried out respectively.
- (3) For the welding procedure qualification tests on materials used at high temperature, the Society may require a creep test or high temperature tensile test.
- (4) For steam pipes and flanges to be used in the place where the design pressure is not less than 30 kgf/cm² and the design temperature exceeds 400℃.
- (5) Where preparation of the above test specimens is not possible depending on pipe's diameter, test specimens for face bend test and root bend test may be reduced to one set each for those of 12 mm thickness or less, and for side bend test may be reduced to one set for those of over 12 mm. (2022)
- (6) In a case where preparation of impact test specimens is not possible depending on pipe's dimensions or in case where welding is made with a base metal having no impact value required, impact test may be omitted subject to the approval of the Society.
- (7) The position of notch is "a" in Fig 2.2.7.
- (8) Position of notch is as shown in Fig 2.2.7.
- (9) For those with an outer diameter of 130 mm or above, and with a design working pressure 30 kgf/cm² or above, and further with maximum design temperature over 400℃. However, even for the pipes having an outer diameter of less than 130 mm, radiographic examination depending on material and working condition may be required.
- (10) Internal inspections by radiographic examination or ultrasonic examination and surface inspections by magnetic particle examination or liquid penetrant examination are to be carried out.

<Amendment>

Table 2.2.5 Kinds of Test for Pipes with Butt Welded Joints (2019)

Grades and material symbols of test specimens		Kinds and number of specimens for test ⁽¹⁾⁽²⁾⁽³⁾						
		Visual insp.	Tensile test	Bend test ⁽⁵⁾	Impact test ⁽⁶⁾	Macro-structure insp.	Hard. test	Non-destructive insp.
The pipes for ordinary piping	<i>RSTH 35, RSTH 42, RSTH 52, RSTH 12, RSTH 22, RSTH 23, RSTH 24,</i>	Welding positions of whole length	2	4	-	1	1	Welding positions of whole length ⁽⁹⁾
The pipes used for high temperature and high pressure ⁽⁴⁾	<i>RST 138, RST 142, RST 238, RST 242, RST 249, RST 338, RST 342, RST 349, RST 412, RST 422, RST 423, RST 424, RBH 1, RBH 2, RBH 3, RBH 4, RBH 5, RBH 6, etc.</i>				(7)			
Steel pipes for low temperature service	<i>RLPA, RLPB, RLPC, RLP 2, RLP 3, RLP 9</i>				(8)			
Stainless steel pipes	<i>RSTS 304TP, RSTS 304LTP, RSTS 309STP, RSTS 310STP, RSTS 316TP, RSTS 316LTP, RSTS 317TP, RSTS 317LTP, RSTS 321TP, RSTS 347TP</i>				-		-	Welding positions of whole length ⁽¹⁰⁾

Notes :

- (1) Where found necessary by the Society, microscopic test, hardness test and tests other than these may be required. **[See Guidance]**
- (2) Regardless of the above, as for those of less than 50 mm in outer diameter, test assemblies are to be prepared by two sets, one for tensile test, the other for macro, micro structure and hardness distribution examinations to be carried out respectively.
- (3) For the welding procedure qualification tests on materials used at high temperature, the Society may require a creep test or high temperature tensile test.
- (4) For steam pipes and flanges to be used in the place where the design pressure is not less than 30 kgf/cm² and the design temperature exceeds 400℃.
- (5) Two root and two face bend specimens are to be tested. For thickness 12 mm and over, four side bend specimens may alternatively be tested. Where preparation of the above test specimens is not possible depending on pipe's diameter, test specimens for face bend test and root bend test may be reduced to one specimen each for those of 12 mm thickness or less, and for side bend test may be reduced to two specimens for those of over 12 mm. (2022) (2023)
- (6) In a case where preparation of impact test specimens is not possible depending on pipe's dimensions or in case where welding is made with a base metal having no impact value required, impact test may be omitted subject to the approval of the Society.
- (7) The position of notch is "a" in Fig 2.2.7.
- (8) Position of notch is as shown in Fig 2.2.7.
- (9) For those with an outer diameter of 130 mm or above, and with a design working pressure 30 kgf/cm² or above, and further with maximum design temperature over 400℃. However, even for the pipes having an outer diameter of less than 130 mm, radiographic examination depending on material and working condition may be required.
- (10) Internal inspections by radiographic examination or ultrasonic examination and surface inspections by magnetic particle examination or liquid penetrant examination are to be carried out.

Present	Amendment	reason															
<p>405. Tests for fillet welded joints</p> <p>1. <Omitted></p> <p>2. Kinds of test</p> <p>Fillet weld joints are to be subjected to visual inspection, surface crack detection, macro-structure inspection, hardness test and fracture test. The kinds of test for machinery installations are to be in accordance with Table 2.2.11. Additional tests may be required if found necessary by the Society. (2019) [See Guidance]</p> <p>Table 2.2.11 <New></p>	<p>405. Tests for fillet welded joints</p> <p>1. <Same as the present Rules></p> <p>2. Kinds of test</p> <p>The kinds of test and number of test specimens are to be given in Table 2.2.11 and Table 2.2.12. The kinds of test for machinery installations are to be in accordance with Table 2.2.11. Additional tests may be required if found necessary by the Society. (2019) (2023) [See Guidance]</p> <p>Table 2.2.11 Kinds of Test for fillet welded joints⁽¹⁾ (2023)</p> <table><tr><th colspan="5">Kinds and number of specimens for test</th></tr><tr><th>Visual insp.</th><th>Surface crack detection</th><th>Macro-structure insp.</th><th>Hard. test⁽²⁾</th><th>fracture test</th></tr><tr><td>Welding positions of whole length</td><td>Welding positions of whole length :NDT for surface (MT or PT)</td><td>1⁽³⁾</td><td>1</td><td>2</td></tr></table> <p>(Notes)</p> <p>(1) Kinds of test for machinery installation’s fillet welded joints are in accordance with Table 2.2.12.</p> <p>(2) The materials required hardness test in Table 2.2.4 are to be tested.</p> <p>(3) In case of rolled steels for hull structural, weldable high strength steel, and aluminium alloy, two specimens are to be taken.</p>	Kinds and number of specimens for test					Visual insp.	Surface crack detection	Macro-structure insp.	Hard. test ⁽²⁾	fracture test	Welding positions of whole length	Welding positions of whole length :NDT for surface (MT or PT)	1 ⁽³⁾	1	2	<p>- New table for easy understanding (Table 2.2.11)</p> <p>- Newly added low-temperature service steel pipes/stainless pipes and surface non-destructive testing (Table 2.2.12 of next page)</p>
Kinds and number of specimens for test																	
Visual insp.	Surface crack detection	Macro-structure insp.	Hard. test ⁽²⁾	fracture test													
Welding positions of whole length	Welding positions of whole length :NDT for surface (MT or PT)	1 ⁽³⁾	1	2													

<Present>

Table 2.2.11 Kinds of Test for machinery installations's fillet welded joints (2019)

Divisions		Kinds of test and number of specimens taken from test assemblies ⁽¹⁾⁽²⁾		
		Macro-structure inspection	Visual insp.	Fracture test
Welding of boiler and pressure vessel	Boiler and class 1 pressure vessel	1	<u>welding position</u>	2
	Class 2 pressure vessel			
	Class 3 pressure vessel	The tests may be omitted according to the discretion of the Surveyor.		
Welding of piping	The pipes for ordinary piping	<u>1</u>	-	2
	The pipes used for high temperature and high pressure ⁽³⁾			

Notes :

(1) In a case where special materials are used, special welding procedure is employed or where deemed necessary by the Society, the other tests or test conditions than those specified in this Section for the welding procedure qualification may be required

(2) For the welding procedure qualification tests on materials used at high temperature, the Society may require a creep test or high temperature tensile test.

(3) For steam pipes and flanges to be used in the place where the design pressure is not less than 30 kgf/cm² and the design temperature exceeds 400 °C.

<Amendment>

Table 2.2.12 Kinds of Test for machinery installations's fillet welded joints (2019) (2023)

Divisions		Kinds of test and number of specimens taken from test assemblies ⁽¹⁾⁽²⁾				
		Macro-structure inspection	Visual insp.	<u>Surface crack detection</u>	<u>Hard. test</u>	Fracture test
Welding of boiler and pressure vessel	Boiler and class 1 pressure vessel	1	<u>Welding positions of whole length</u>	<u>Welding positions of whole length</u>	-	2
	<u>:NDT for surface (MT or PT)</u>					
	Class 2 pressure vessel	The tests may be omitted according to the discretion of the Surveyor.				
Class 3 pressure vessel						
Welding of piping	<u>The steel pipes for low temperature service</u>	<u>2</u>	<u>Welding positions of whole length</u>	<u>Welding positions of whole length</u>	<u>1</u>	2
	<u>Stainless steel pipes</u>			<u>:NDT for surface (MT or PT)</u>	-	
	The pipes for ordinary piping					
	The pipes used for high temperature and high pressure ⁽³⁾					

Notes :

(1) In a case where special materials are used, special welding procedure is employed or where deemed necessary by the Society, the other tests or test conditions than those specified in this Section for the welding procedure qualification may be required

(2) For the welding procedure qualification tests on materials used at high temperature, the Society may require a creep test or high temperature tensile test.

(3) For steam pipes and flanges to be used in the place where the design pressure is not less than 30 kgf/cm² and the design temperature exceeds 400℃.

Present	Amendment	reason
<p>3. Test assemblies and welding</p> <p>(1) <Omitted></p> <p>(2) Dimensions and type of test assembly are to be as indicated Fig 2.2.10.</p> <p>(3) ~ (5) <Omitted></p> <p>4. Visual & non-destructive inspection</p> <p>(1) ~ (3) <Omitted></p> <p>(4) The imperfections detected by visual or non-destructive testing are to be assessed in accordance with ISO 5817, class B(ISO 10042, class B for aluminium alloys), except for imperfection type such as excessive convexity and excessive throat thickness for which level C applies (2019) (2022)</p> <div data-bbox="414 758 750 1013"> </div> <p>NOTES :</p> <ol style="list-style-type: none"> The length of test specimen is as follows : <ol style="list-style-type: none"> Manual and semi-automatic welding : Width $W=3 \times t$, min.150 mm, Length $L=6 \times t$, min.350 mm Automatic welding : Width $W=3 \times t$, min.150 mm, Length $L=$ min.1000 mm Thickness of webs and flanges of the test assembly, t_1 and t_2 are to be of ordinary thicknesses used in the actual work. Tack weld may be applied to the test assembly. The fillet length is to be of ordinary length used in the actual work. <p>Fig 2.2.10 Test assembly for fillet weld joint (unit : mm)</p>	<p>3. Test assemblies and welding</p> <p>(1) <Same as the present Rules></p> <p>(2) Dimensions and type of test assembly are to be as indicated Fig 2.2.10 and Fig 2.2.11.</p> <p>(3) ~ (5) <Same as the present Rules></p> <p>4. Visual & non-destructive inspection</p> <p>(1) ~ (3) <Same as the present Rules></p> <p>(4) The imperfections detected by visual or non-destructive testing are to be assessed in accordance with ISO 5817, class B(ISO 10042:2018, class B for aluminium alloys), except for imperfection type such as excessive convexity and excessive throat thickness for which level C applies (2019) (2022) (2023)</p> <div data-bbox="1254 790 1590 1045"> </div> <p>NOTES :</p> <ol style="list-style-type: none"> The length of test specimen is as follows : <ol style="list-style-type: none"> Manual and semi-automatic welding : Width $W=3 \times t$, min.150 mm, Length $L=6 \times t$, min.350 mm Automatic welding : Width $W=3 \times t$, min.150 mm, Length $L=$ min.1000 mm Thickness of webs and flanges of the test assembly, t_1 and t_2 are to be of ordinary thicknesses used in the actual work. Tack weld may be applied to the test assembly. The fillet length is to be of ordinary length used in the actual work. <p>Fig 2.2.10 Test assembly for plates with fillet weld joint (unit : mm) (2023)</p>	<p>- To reflect IACS Rec.70(Rev.2 Sep 2021)</p> <p>- Newly added Fig 2.2.11(next page) by reflecting AWS D1.1(modified)</p>

<New>

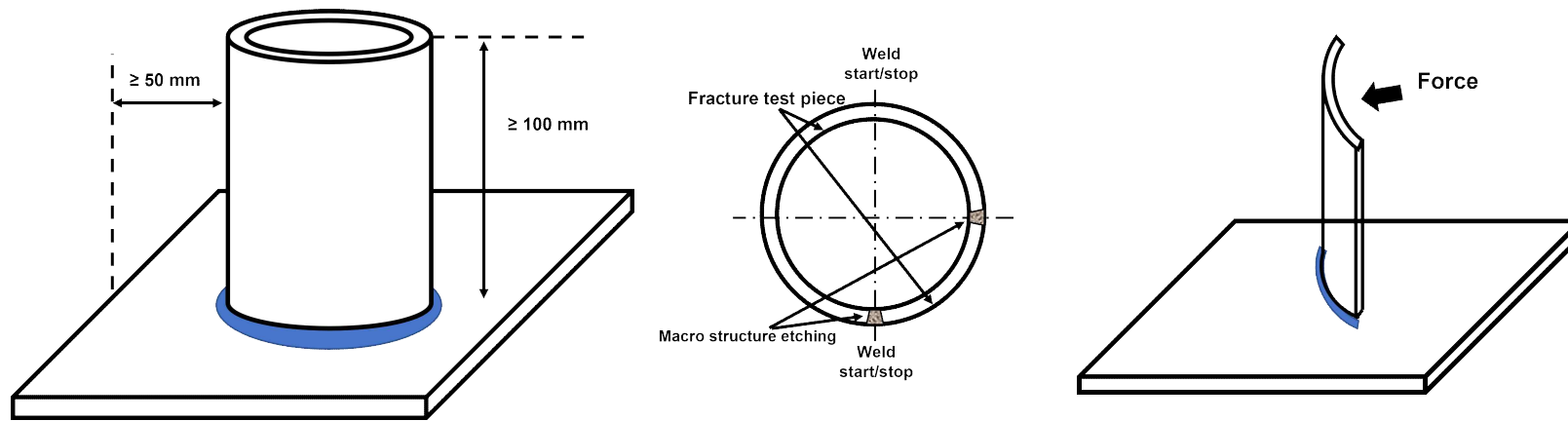
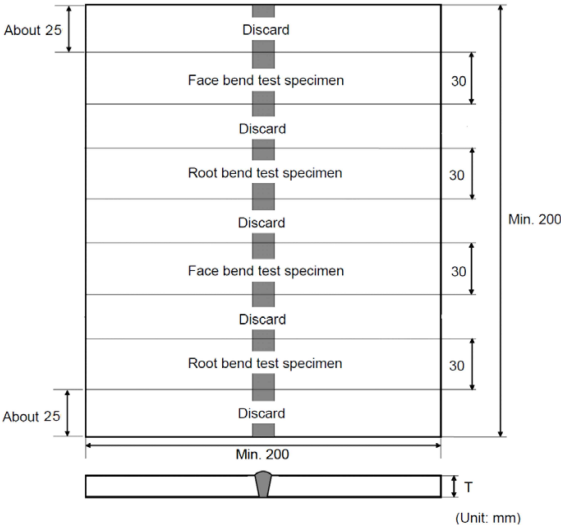
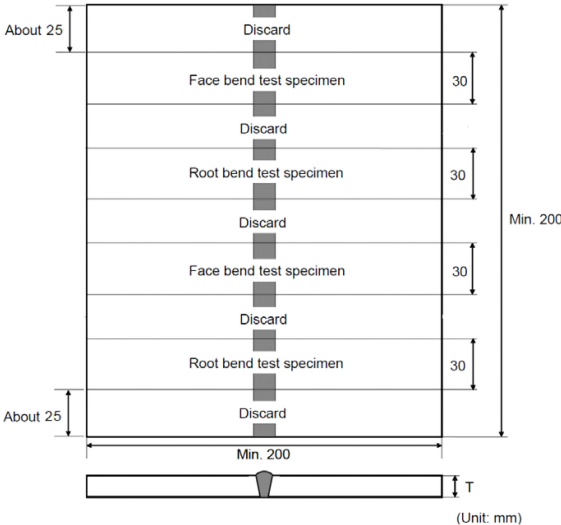


Fig 2.2.11 Test assembly for pipes with fillet weld joint (2023)

Present	Amendment	reason
<p>5. Macro-structure inspection</p> <p>(1) The test specimen is to be taken from the position in Fig 2.2.10. However, in case of rolled steels for hull structural, weldable high strength steel, and aluminium alloy, two specimens are to be taken. For manual welding and semi-automatic welding, one of the macro etched specimens is to be from the stop/restart position, if present.</p> <p>(2) ~ (3) <Omitted></p> <p>6. <Omitted></p> <p>7. Fracture tests</p> <p>The remaining test assemblies after the macro-structure test specimen has been removed are to be broken by pressing as shown in Fig 2.2.8 and it shall be evaluated cracks, blow holes, poor penetrations and any other injurious defects in the fractured surface. And imperfections that are detected should be assessed in accordance with (KS B) ISO 5817, class B(ISO 10042, class B for aluminium alloys). (2022)</p> <p>406. <Omitted></p> <p>407. Validity of qualified welding procedure specification</p> <p>1. <Omitted></p> <p>2. Validity of variables for qualified WPS is as follows. However, it may be considered as equivalent for the requirements of the standard internationally recognized(AWS, ASME etc.) are applied.</p> <p>(1) Base metal Kind of base metal and their validity are as follows. Other materials not specified herein is to be in accordance with the requirements of the standard internationally recognized as deemed appropriate by the Society. 【See Guidance】</p> <p>(a) <Omitted></p>	<p>5. Macro-structure inspection</p> <p>(1) The test specimen is to be taken from the position in Fig 2.2.10 and Fig 2.2.11. However, in case of rolled steels for hull structural, weldable high strength steel, and aluminium alloy, two specimens are to be taken. For manual welding and semi-automatic welding, one of the macro etched specimens is to be from the stop/restart position, if present.</p> <p>(2) ~ (3) <Same as the present Rules></p> <p>6. <Same as the present Rules></p> <p>7. Fracture tests</p> <p>The remaining test assemblies after the macro-structure test specimen has been removed are to be broken by pressing as shown in Fig 2.2.8 and it shall be evaluated cracks, blow holes, poor penetrations and any other injurious defects in the fractured surface. And imperfections that are detected should be assessed in accordance with (KS B) ISO 5817, class B(ISO 10042:2018, class B for aluminium alloys). (2022) (2023)</p> <p>406. <Same as the present Rules></p> <p>407. Validity of qualified welding procedure specification</p> <p>1. <Same as the present Rules></p> <p>2. Validity of variables for qualified WPS is as follows. However, it may be considered as equivalent for the requirements of the standard internationally recognized(AWS, ASME etc.) are applied.</p> <p>(1) Base metal Kind of base metal and their validity are as follows. Other materials not specified herein is to be in accordance with the requirements of the standard internationally recognized as deemed appropriate by the Society. 【See Guidance】</p> <p>(a) <Same as the present Rules></p>	<p>- To reflect IACS Rec.70(Rev.2 Sep 2021)</p>

Present	Amendment	reason
<p>(b) Weldable high strength steels (Pt 2, Ch 1, 308. of the Rules) or equivalent structural steels with minimum specified yield strength 365~960 N/mm².</p> <p>(i) ~ (iii)</p> <p>(iv) <u>For each heat treatment of weldable high strength steels, welding procedures are not applicable other heat treatment. (2017)</u></p> <p>(c) ~ (i) <Omitted></p> <p>(2) ~ (9) <Omitted></p> <p>3. <Omitted></p>	<p>(b) Weldable high strength steels (Pt 2, Ch 1, 308. of the Rules) or equivalent structural steels with minimum specified yield strength 365~960 N/mm².</p> <p>(i) ~ (iii)</p> <p>(iv) <u>The approval of quenched and tempered steels does not quality thermo-mechanically rolled steels (TMCP steels) and vice versa. (2017) (2023)</u></p> <p>(c) ~ (i) <Same as the present Rules></p> <p>(2) ~ (9) <Same as the present Rules></p> <p>3. <Same as the present Rules></p>	<p>- To reflect IACS UR W28</p>

Present	Amendment	reason												
<p>Section 5 Welders and Welder Performance Qualification Scheme (2018)</p> <p>501. <Omitted></p> <p>502. Grades, and range of qualification</p> <p>1. ~ 5. <Omitted></p> <p>6. Thickness and outer diameter of base metal</p> <p>(1) <Omitted></p> <p>(2) The welder qualification carried out on a pipe test assembly is valid for the outer diameter range given in Table 2.2.22-2.</p> <p>Table 2.2.22-2 Qualified outer diameter range for pipe welds</p> <table><tr><th>Outer diameter <i>D</i> (mm) of the test piece⁽¹⁾⁽²⁾</th><th>Qualified range <i>d</i> (mm)</th></tr><tr><td>$D \leq 25$</td><td>$D \leq d \leq 2D$</td></tr><tr><td>$25 < D$</td><td>$0.5D \leq d$ (Min. 25 mm)</td></tr></table> <p>NOTES :</p> <p>(1) Test assemblies for the pipes over 500 mm in diameter may be those for the plates. However, test assemblies for tack welding of the pipes may be those for the plates regardless of the outer diameter of the pipe. (2022)</p> <p>(2) For non-circular hollow sections, <i>D</i> is the dimension of the smaller side.</p> <p>7. <Omitted></p>	Outer diameter <i>D</i> (mm) of the test piece ⁽¹⁾⁽²⁾	Qualified range <i>d</i> (mm)	$D \leq 25$	$D \leq d \leq 2D$	$25 < D$	$0.5D \leq d$ (Min. 25 mm)	<p>Section 5 Welders and Welder Performance Qualification Scheme (2018)</p> <p>501. <Same as the present Rules></p> <p>502. Grades, and range of qualification</p> <p>1. ~ 5. <Same as the present Rules></p> <p>6. Thickness and outer diameter of base metal</p> <p>(1) <Same as the present Rules></p> <p>(2) The welder qualification carried out on a pipe test assembly is valid for the outer diameter range given in Table 2.2.22-2.</p> <p>Table 2.2.22-2 Qualified outer diameter range for pipe welds</p> <table><tr><th>Outer diameter <i>D</i> (mm) of the test piece⁽¹⁾⁽²⁾</th><th>Qualified range <i>d</i> (mm)</th></tr><tr><td>$D \leq 25$</td><td>$D \leq d \leq 2D$</td></tr><tr><td>$25 < D$</td><td>$0.5D \leq d$ (Min. 25 mm)</td></tr></table> <p>NOTES :</p> <p>(1) Test assemblies for the pipes <u>with 500 mm and</u> over 500 mm in diameter may be those for the plates. However, test assemblies for tack welding of the pipes may be those for the plates regardless of the outer diameter of the pipe. (2022)</p> <p>(2) For non-circular hollow sections, <i>D</i> is the dimension of the smaller side.</p> <p>7. <Same as the present Rules></p>	Outer diameter <i>D</i> (mm) of the test piece ⁽¹⁾⁽²⁾	Qualified range <i>d</i> (mm)	$D \leq 25$	$D \leq d \leq 2D$	$25 < D$	$0.5D \leq d$ (Min. 25 mm)	<p>- To reflect ISO 9606-1</p>
Outer diameter <i>D</i> (mm) of the test piece ⁽¹⁾⁽²⁾	Qualified range <i>d</i> (mm)													
$D \leq 25$	$D \leq d \leq 2D$													
$25 < D$	$0.5D \leq d$ (Min. 25 mm)													
Outer diameter <i>D</i> (mm) of the test piece ⁽¹⁾⁽²⁾	Qualified range <i>d</i> (mm)													
$D \leq 25$	$D \leq d \leq 2D$													
$25 < D$	$0.5D \leq d$ (Min. 25 mm)													

Present	Amendment	reason
<p>503. Testing procedure</p> <p>1. <Omitted></p> <p>2. Test assemblies</p> <p>(1) Test assemblies for butt welds and for fillet welds are to be prepared as shown in Fig 2.2.12 to Fig 2.2.19 in each qualification test.</p>  <p>Fig 2.2.12 Dimensions and types of test assembly for butt welds (T<12mm)</p>	<p>503. Testing procedure</p> <p>1. <Same as the present Rules></p> <p>2. Test assemblies</p> <p>(1) Test assemblies for butt welds and for fillet welds are to be prepared as shown in Fig 2.2.12 to Fig 2.2.19 in each qualification test.</p>  <p>Fig 2.2.12 Dimensions and types of test assembly for butt welds</p>	<p>– “(T<12mm)” was deleted for clarity.</p>

Present	Amendment	reason
<p>3. Examination and test</p> <p>(1) <Omitted></p> <p>(2) Visual examination</p> <p>(a) The welds should be visually examined prior to the cutting of the test specimen for the bend test.</p> <p>(b) The result of the examination is to show the absence of cracks or other serious imperfections. Imperfections detected are to be assessed in accordance with quality level B in (KS B) ISO 5817:2014(ISO 10042, class B for aluminium alloys), except for imperfection type such as excess weld metal, excess penetration, excessive convexity and excessive throat thickness for which level C applies. (2022)</p> <p>(3) <Omitted></p> <p>(4) Non-destructive testing</p> <p>(a) When radiographic testing or ultrasonic testing is used in lieu of bend test, imperfections detected are to be assessed in accordance with (KS B) ISO 5817:2014, level B(ISO 10042, class B for aluminium alloys). (2022)</p> <p>(b) <Omitted></p> <p>(5) Fracture test</p> <p>(a) When fracture test is used for butt welds, full test specimen in length is to be tested in accordance with ISO 9017:2017 and ISO 9606-1:2012, 9606-2/3/4. Imperfections detected are to be assessed in accordance with (KS B) ISO 5817:2014, level B(ISO 10042, class B for aluminium alloys). (2022)</p> <p>(b) The fracture test of fillet welds is to be carried out in accordance with the requirements specified in Pt 2, Ch 2, 405. 8 of the Rules</p> <p>(c) Evaluation should concentrate on cracks, porosity and pores, inclusions, lack of fusion and incomplete penetration. Imperfections that are detected should be assessed in accordance with (KS B) ISO 5817:2014, level B(ISO 10042, class B for aluminium alloys). (2022)</p> <p>(6) <Omitted></p> <p>4. ~ 5. <Omitted></p>	<p>3. Examination and test</p> <p>(1) <Same as the present Rules></p> <p>(2) Visual examination</p> <p>(a) The welds should be visually examined prior to the cutting of the test specimen for the bend test.</p> <p>(b) The result of the examination is to show the absence of cracks or other serious imperfections. Imperfections detected are to be assessed in accordance with quality level B in (KS B) ISO 5817:2014(ISO 10042:2018, class B for aluminium alloys), except for imperfection type such as excess weld metal, excess penetration, excessive convexity and excessive throat thickness for which level C applies. (2022) (2023)</p> <p>(3) <Same as the present Rules></p> <p>(4) Non-destructive testing</p> <p>(a) When radiographic testing or ultrasonic testing is used in lieu of bend test, imperfections detected are to be assessed in accordance with (KS B) ISO 5817:2014, level B(ISO 10042:2018, class B for aluminium alloys). (2022) (2023)</p> <p>(b) <Same as the present Rules></p> <p>(5) Fracture test</p> <p>(a) When fracture test is used for butt welds, full test specimen in length is to be tested in accordance with ISO 9017:2017 and ISO 9606-1:2012, 9606-2/3/4. Imperfections detected are to be assessed in accordance with (KS B) ISO 5817:2014, level B(ISO 10042:2018, class B for aluminium alloys). (2022) (2023)</p> <p>(b) The fracture test of fillet welds is to be carried out in accordance with the requirements specified in Pt 2, Ch 2, 405. 8 of the Rules. Evaluation should concentrate on cracks, porosity and pores, inclusions, lack of fusion and incomplete penetration. Imperfections that are detected should be assessed in accordance with (KS B) ISO 5817:2014, level B(ISO 10042:2018, class B for aluminium alloys). (2022)</p> <p>(6) <Same as the present Rules></p> <p>4. ~ 5. <Same as the present Rules></p>	<p>- To reflect IACS Rec.105(Rev.1 Sep 2021)</p>

Present	Amendment	reason
<p>504. General requirements for qualification validity</p> <p>1. <Omitted></p> <p>2. Maintenance of the approval</p> <p>(1) ~ (2) <Omitted></p> <p>(3) Welders who are not engaged in plates welding for hull structural may omit the revalidation of qualifications. At this time, the manufacturer(shipbuilder) is to distinguish between the welders engaged in hull structural plate welding and the other welders. (2019)</p> <p><hereafter, omitted></p>	<p>504. General requirements for qualification validity</p> <p>1. <Same as the present Rules></p> <p>2. Maintenance of the approval</p> <p>(1) ~ (2) <Same as the present Rules></p> <p>(3) Welders who are not engaged in plates(<u>including steel castings and forgings</u>) welding for hull structural may omit the revalidation of qualifications. At this time, the manufacturer(shipbuilder) is to distinguish between the welders engaged in hull structural plate(<u>including steel castings and forgings</u>) welding and the other welders. (2019) (2023)</p> <p><hereafter, same as the present Rules></p>	<p>- To reflect IACS UR W7(Rev.4 Feb 2022):2.9 및 W8(Rev.3 Mar 2022):2.5</p>