RULES FOR CLASSIFICATION(STEEL SHIPS)

(Part 2 Materials and Welding)

- For external opinion inquiry -

2021.06.

Machinery Rule Development Team

- Main Amendments -

(1) Enter into force on 1 January 2022 (the date of application for certification of welding)

- Circular -

◉ To reflect IACS UR W32(Rev.1 Sep 2020)

Present	Amendment	reason
CHAPTER 1 <Omitted> **CHAPTER 2 WELDING** **Section 1 ~ Section 4 <Omitted>** **Section 5 Welders and Welder Performance Qualification Scheme *(2018)*** **501. General** **1. ~ 5.** <Omitted> **6.** Welders or welding operators qualified in accordance with national or international welder qualification standards may also be engaged in welding of hull structures at the discretion of the Society provided that the qualification testing, range of approval and revalidation requirements are considered equivalent to this Section.	**CHAPTER 1 <Same as the present Rules>** **CHAPTER 2 WELDING** **Section 1 ~ Section 4 <Same as the present Rules>** **Section 5 Welders and Welder Performance Qualification Scheme *(2018)*** **501. General** **1. ~ 5.** <Same as the present Rules> **6.** Welders or welding operators qualified in accordance with national or international welder qualification standards may also be engaged in welding of hull structures at the discretion of the Society provided that standard is considered equivalent to this Section from technical perspective covering examination, testing and range approval. Even if the requirements stipulated in the standards are applied, the requirement for revalidation of welders' qualification shall be in accordance with **504. 2**. And alternative welding standards or codes are to be applied in full, cross-mixing requirements of standards and codes is not permitted. *(2022)*	* To reflect IACS UR W32(Rev.1 Sep 2020)

Present

502. Grades, and range of qualification

1. <Omitted>

2. Welding processes

(1) The welding processes for welder's qualification are to be classified in **Table 2.2.19**.

Table 2.2.19 Welding processes for welder''s qualification *(2019)*

Symbol	Welding process in actual welding works(1)(2)		ISO 4063
M	Manual welding	Shield Metal Arc Welding(SMAW)	111
G	Gas welding	Gas Welding(GW)	31
S	Semi-automatic welding	(1) Metal Inert Gas welding(MIG)	131
		(2) Metal Active Gas welding(MAG)	135(solid wire), 138(metal cored wire)
		(3) Flux Cored Arc Welding(FCAW)	136
T	TIG welding	Gas Tungsten Arc Welding(GTAW)	141
A	Automatic welding	(1) Submerged Arc Welding(SAW)	12
		(2) Gravity Welding(GRW)	112
		(3) Electro-gas Welding(EGW)	73
		(4) Electro-slag Welding(ESW)	72

NOTES:

(1) Each testing normally qualifies only for one welding process. A change of welding process requires a new qualification test. Welders who have passed qualification tests for semi-automatic welding or TIG welding may be similarly regard as the welder responsible for setting up and/or adjusting of the welding process using an auto-carriage in the range of qualification for the qualification they qualified.

(2) It is permitted for a welder to be qualified for two or more welding processes by welding a single test piece with multi-process joint and sequence or by two or more separate qualification tests. The sequence of welding processes can not be changed.

Amendment

502. Grades, and range of qualification

1. <Same as the present Rules>

2. Welding processes

(1) The welding processes for welder's qualification are to be classified in **Table 2.2.19**.

Table 2.2.19 Welding processes for welder''s qualification *(2019) (2022)*

Symbol	Welding process in actual welding works(1)(2)		ISO 4063:2009
M	Manual welding	Shield Metal Arc Welding(SMAW)	111
G	Gas welding	Gas Welding(GW)	31
S	Semi-automatic welding	(1) Metal Inert Gas welding(MIG)	131
		(2) Metal Active Gas welding(MAG)	135(solid wire), 138(metal cored wire)
		(3) Flux Cored Arc Welding(FCAW)	136
T	TIG welding	Gas Tungsten Arc Welding(GTAW)	141
A	Automatic welding	(1) Submerged Arc Welding(SAW)	12
		(2) Gravity Welding(GRW)	112
		(3) Electro-gas Welding(EGW)	73
		(4) Electro-slag Welding(ESW)	72

NOTES:

(1) Each testing normally qualifies only for one welding process. A change of welding process requires a new qualification test. Welders who have passed qualification tests for semi-automatic welding or TIG welding may be similarly regard as the welder responsible for setting up and/or adjusting of the welding process using an auto-carriage in the range of qualification for the qualification they qualified.

(2) It is permitted for a welder to be qualified for two or more welding processes by welding a single test piece with multi-process joint and sequence or by two or more separate qualification tests. The sequence of welding processes can not be changed.

reason

* To reflect IACS UR W32(Rev.1 Sep 2020)

Present	Amendment	reason
3. ~ **7.** <Omitted>	**3.** ~ **7.** <Same as the present Rules>	
503. Testing procedure	**503. Testing procedure**	
1. ~ **2.** <Omitted>	**1.** ~ **2.** <Same as the present Rules>	
3. Examination and test	**3. Examination and test**	
(1) <Omitted>	(1) <Same as the present Rules>	
(2) **Visual examination**	(2) **Visual examination**	
(a) The welds should be visually examined prior to the cutting of the test specimen for the bend test.	(a) The welds should be visually examined prior to the cutting of the test specimen for the bend test.	* To reflect IACS UR W32(Rev.1 Sep 2020)
(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*, except for imperfection type such as excess weld metal, excess penetration, excessive convexity and excessive throat thickness for which level C applies.	(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*, except for imperfection type such as excess weld metal, excess penetration, excessive convexity and excessive throat thickness for which level C applies. *(2022)*	
(3) <Omitted>	(3) <Same as the present Rules>	
(4) **Radiographic test**	(4) **Radiographic test**	
(a) When radiographic testing is used in lieu of bend test, imperfections detected are to be assessed in accordance with (*KS B*) *ISO 5817*, level B.	(a) When radiographic testing is used in lieu of bend test, imperfections detected are to be assessed in accordance with (*KS B*) *ISO 5817:2014*, level B. *(2022)*	
(b) Where deemed the excess of the amount of heat input by visual inspection after welding, bend tests other than radiographic testing may be required additionally.	(b) Where deemed the excess of the amount of heat input by visual inspection after welding, bend tests other than radiographic testing may be required additionally.	
(5) **Fracture test ~~(Fillet welds)~~**	(5) **Fracture test**	
(a) When fracture test is used for butt welds, full test specimen in length is to be tested in accordance with *ISO 9017* and *ISO 9606-1*. Imperfections detected are to be assessed in accordance with (*KS B*) *ISO 5817*, level B.	(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*. Imperfections detected are to be assessed in accordance with (*KS B*) *ISO 5817:2014*, level B. *(2022)*	
(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	(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	
(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*, level B.	(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. *(2022)*	
(6) <Omitted>	(6) <Same as the present Rules>	
4. <Omitted>	**4.** <Same as the present Rules>	

Present	Amendment	reason
5. Certification (1) Qualification certificates are normally issued to shipbuilder or manufacturer when the welder has passed the qualification test by the Society. Each Shipyard and Manufacturer is to be responsible for the control of the validity of the certificate and the range of the approval. (2) ~ (3) <Omitted> **504. General requirements for qualification validity** **1.** <Omitted> **2. Maintenance of the approval** (1) Revalidation is to be carried out by the Society. The skill of the welder is to be periodically verified by one of the following: (a) The welder is to be tested every 3 years. The welder is to be performed the test for revalidation within 6 months before the expiration date of qualification. These tests revalidate the welder's qualifications for an additional 3 years. (b) Every 2 years, two welds made during the last 6 months of the 2 years validity period are to be tested by radiographic or ultrasonic testing or destructive testing and shall be recorded. The weld tested shall reproduce the initial test conditions except for the thickness and the outer diameter. These tests revalidate the welder's qualifications for an additional 2 years. (c) If the Society recognizes the equivalence, qualification shall be deemed to be revalidated. *(2020)* [See Guidance]	**5. Certification** (1) Qualification certificates are normally issued to shipbuilder or manufacturer when the welder has passed the qualification test in accordance with the Society's Rules. Each Shipyard and Manufacturer is to be responsible for the control of the validity of the certificate and the range of the approval. *(2022)* (2) ~ (3) <Same as the present Rules> **504. General requirements for qualification validity** **1.** <Same as the present Rules> **2. Maintenance of the approval** (1) Revalidation is to be carried out by the Society. The skill of the welder is to be periodically verified by one of the following (A) ~ (C) options. The chosen maintenance option scheme of qualification is in accordance with (A) or (B) or (C) shall be stated on the certificate at the time of issue: *(2022)* (A) The welder is to be re-tested every 3 years. The welder is to be performed the test for revalidation within 6 months before the expiration date of qualification. These tests revalidate the welder's qualifications for an additional 3 years. (B) Every 2 years, two welds made during the last 6 months of the 2 years validity period are to be tested by radiographic or ultrasonic testing or destructive testing and shall be recorded. The weld tested shall reproduce the initial test conditions except for the thickness and the outer diameter. These tests revalidate the welder's qualifications for an additional 2 years. (C) A welder's qualification for any certificate shall be valid as long as it is signed according to **1.** (2) above subject that all the following conditions are fulfilled. In this option, the fulfilment of all the conditions is to be verified by the Society. The frequency of verification by the Society is to be no longer than 3 years and is to be agreed between the Society and the shipyards/manufacturers. This can be replaced by a method recognized by the Society. *(2020)* [See Guidance]	* To reflect IACS UR W32(Rev.1 Sep 2020)

Present	Amendment	reason
	(a) The welder is working for the same shipyard/manufacturer which is responsible for production weld quality as indicated on his or her qualification certificate. (b) The Society shall verify that the welder quality management system of the shipyard/manufacturer includes as minimum: (i) A designated person responsible for the coordination of the welder quality management system. (ii) List of welders and welding supervisors in shipyard/manufacturer (iii) If applicable, list of subcontracted welders (iv) Qualification certificate of welders and description of the associated management system (v) Training requirements for welder qualification programme (vi) Identification system for welders and WPS used on welds (vii) Procedure describing the system in place to monitor each welder performance based on results of welds examination records(e.g. repair rate, etc.) including the criteria permitting the maintenance of the welder qualification without retesting. (c) The shipyards/manufacturers have to document at least once a year that the welder has produced acceptable welds in accordance with construction quality standards and Society's requirements in the welding positions, type of welds and backing conditions covered by its certificate. Which documents are required and how to document the evidences should be in agreement between the Society and the shipyards/manufacturers.	* To reflect IACS UR W32(Rev.1 Sep 2020)
(d) <Omitted> (2) ~ (3) <Omitted>	(D) <Same as the present Rules> (2) ~ (3) <Same as the present Rules>	

- Main Amendments -

(1) Enter into force on 1 July 2022 (the date of application for certification of material & welding or the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules
◉ To reflect IACS UR M68(Rev.3 Feb 2021)

Present	Amendment	reason

CHAPTER 1 MATERIALS

Section 1 ~ Section 3 <Omitted>
Section 4 Steel Tubes and Pipes

401. ~ 402. <Omitted>

403. Stainless steel pipes

1. ~ 3. <Omitted>

4. Chemical composition

The chemical composition of stainless steel pipes is to comply with the requirements given in **Table 2.1.62**.

Table 2.1.62 Grades and Chemical Composition ***(2020)***

Grade	Solid solution treatment(℃)	Chemical Composition (%)								
		C	Si	Mn	P	S	Ni	Cr	Mo	Others
RST S 304 TP	1010 and over, quenching	0.080 max.	1.0 max.	2.00 max.	0.040 max.	0.030 max.	8.00~11.00	18.00~20.00	-	-
RST S 304 LTP	1010 and over, quenching	0.030 max.					9.00~13.00			
<Omitted>										

5. ~ 11. <Omitted>

404. ~ 405. <Omitted>

CHAPTER 1 MATERIALS

Section 1 ~ Section 3 <Same as the present Rules>
Section 4 Steel Tubes and Pipes

401. ~ 402. <Same as the present Rules>

403. Stainless steel pipes

1. ~ 3. <Same as the present Rules>

4. Chemical composition

The chemical composition of stainless steel pipes is to comply with the requirements given in **Table 2.1.62**.

Table 2.1.62 Grades and Chemical Composition ***(2020) (2022)***

Grade	Solid solution treatment(℃)	Chemical Composition (%)								
		C	Si	Mn	P	S	Ni	Cr	Mo	Others
RST S 304 TP	1010 and over, quenching	0.080 max.	1.0 max.	2.00 max.	0.040 max.	0.030 max.	8.00~11.00	18.00~20.00	-	-
RST S 304 LTP	1010 and over, quenching	0.030 max.					8.00~13.00			
<Same as the present Rules>										

5. ~ 11. <Same as the present Rules>

404. ~ 405. <Same as the present Rules>

- To reflect ASTM A269(Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service)

Present

Section 5 <Omitted>
Section 6 Steel Forgings

601. Steel forgings

1. ~ **17.** <Omitted>

18. Additional requirements for intermediated shaft material ***(2017)***

(1) For alloy steel which has a minimum specified tensile strength greater than 800 N/mm^2 but less than 950 N/mm^2 for use as intermediate shaft material, where special manufacturing processes are adopted to reduce shaft dimensions or higher permissible vibration stresses(refer to the requirements in **Pt 5, Ch 3, 203.** and **Ch 4, 202.**) is to be as follows.

(a) Torsional fatigue test instructed by the Society is to be performed for verifying the fatigue life at manufacturing process approval.

(b) The steels are to have a degree of cleanliness as shown in **Table 2.1.90** when cleanliness tested. Representative samples are to be obtained from each heat of forged or rolled products. The steels are generally to comply with particular attention given to minimising the concentrations of sulphur, phosphorus and oxygen in order to achieve the cleanliness requirements. The specific steel composition is required to be approved by the Society.

Table 2.1.90 Cleanliness requirements(ISO 4967 method A)

Inclusion group	Series	Limiting chart diagram index *I*
Type A	Fine	1 max.
	Thick	1 max.
Type B	Fine	1.5 max.
	Thick	1 max.
Type C	Fine	1 max.
	Thick	1 max.
Type D	Fine	1 max.
	Thick	1 max.
Type DS	-	1 max.

<hereafter in Ch 1, omitted>

Amendment

Section 5 <Same as the present Rules>
Section 6 Steel Forgings

601. Steel forgings

1. ~ **17.** <Same as the present Rules>

18. Additional requirements for intermediated shaft material ***(2017)***

(1) For alloy steel which has a minimum specified tensile strength greater than 800 N/mm^2 but less than 950 N/mm^2 for use as intermediate shaft material, where special manufacturing processes are adopted to reduce shaft dimensions or higher permissible vibration stresses(refer to the requirements in **Pt 5, Ch 3, 203.** and **Ch 4, 202.**) is to be as follows.

(a) Torsional fatigue test instructed by the Society is to be performed for verifying the fatigue life at manufacturing process approval.

(b) The steels are to have a degree of cleanliness as shown in **Table 2.1.90** when cleanliness tested. Representative samples are to be obtained from each heat of forged or rolled products. The steels are generally to comply with particular attention given to minimising the concentrations of sulphur, phosphorus and oxygen in order to achieve the cleanliness requirements. The specific steel composition is required to be approved by the Society.

Table 2.1.90 Cleanliness requirements(ISO 4967:2013 method A) ***(2022)***

Inclusion group	Series	Limiting chart diagram index *I*
Type A	Fine	1 max.
	Thick	1 max.
Type B	Fine	1.5 max.
	Thick	1 max.
Type C	Fine	1 max.
	Thick	1 max.
Type D	Fine	1 max.
	Thick	1 max.
Type DS	-	1 max.

<hereafter in Ch 1, same as the present Rules>

reason

* To reflect to IACS UR M68(Rev.3 Feb 2021)

Present

CHAPTER 2 WELDING

Section 1 ~ Section 2 <Omitted>
Section 3 Welding Work and Inspection

301. ~ 302. <Omitted>

303. Application of welding consumables

Welding consumables used for welded joints of hull structure are to be of the grades as specified in the relevant Articles of **Sec 6** according to the following requirements:

(1) Application of welding consumables for welded joints of various grades of steel is to be as specified in **Table 2.2.3**.

Table 2.2.3 Selection of welding consumables(rolled steel plates) ***(2017) (2019) (2021)***

Kind and grade of steel to be welded			Grade of applicable welding consumables (1)
Rolled steels for hull	Mild steel	<Omitted>	
	Higher strength low alloy steel	<Omitted>	
Rolled steels for low temperature services		*RL*235*A*	4*Y*, 4*Y*40, *L*1, *L*2, *L*3
		*RL*235*B*, *RL*325*A*, *RL*325*B*	5*Y*42, *L*2, *L*3(4)
		*RL*360	5*Y*42, *L*3
		*RL*5*N*390	*L*51, *L*91
		*RL*9*N*490	*L*91
High strength steels for welded structures(5)		<Omitted>	

NOTES :
(1) ~ (3) <Omitted>
(4) Welding consumables of "*L*3" is applicable to steel grade of *RL*325*B*.
(5) ~ (6) <Omitted>

Amendment

CHAPTER 2 WELDING

Section 1 ~ Section 2 <Same as the present Rules>
Section 3 Welding Work and Inspection

301. ~ 302. <Same as the present Rules>

303. Application of welding consumables

Welding consumables used for welded joints of hull structure are to be of the grades as specified in the relevant Articles of **Sec 6** according to the following requirements:

(1) Application of welding consumables for welded joints of various grades of steel is to be as specified in **Table 2.2.3**.

Table 2.2.3 Selection of welding consumables(rolled steel plates) ***(2017) (2019) (2021) (2022)***

Kind and grade of steel to be welded			Grade of applicable welding consumables (1)
Rolled steels for hull	Mild steel	<Same as the present Rules>	
	Higher strength low alloy steel	<Same as the present Rules>	
Rolled steels for low temperature services		*RL*235*A*	4*Y*, 4*Y*40, *L*1, *L*2, *L*3
		*RL*235*B*, *RL*325*A*, *RL*325*B*	5*Y*42(4), *L*2, *L*3
		*RL*360	5*Y*42, *L*3
		*RL*5*N*390	*L*51, *L*91
		*RL*9*N*490	*L*91
High strength steels for welded structures(5)		<Same as the present Rules>	

NOTES :
(1) ~ (3) <Same as the present Rules>
(4) Welding consumables of "5*Y*42" is applicable to steel grade of *RL*325*B*.
(5) ~ (6) <Same as the present Rules>

reason

- Typo

Present

Section 4 <Omitted>
Section 5 Welders and Welder Performance Qualification Scheme *(2018)*

501. <Omitted>

502. Grades, and range of qualification

1. ~ **5.** <Omitted>

6. Thickness and outer diameter of base metal

(1) <Omitted>

(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**.

Table 2.2.22-2 Qualified outer diameter range for pipe welds

Outer diameter *D* (mm) of the test piece(1)(2)	Qualified range d (mm)
D ≤ 25	D ≤ d ≤ 2D
25 < D	0.5D ≤ d (Min. 25 mm)

NOTES :

(1) Test assemblies for the pipes over 500 mm in diameter may be those for the plates.

(2) For non-circular hollow sections, D is the dimension of the smaller side.

7. Positions

The positions for qualification test and positions qualified for actual welding work are to comply with the **Table 2.2.23-1**.

Amendment

Section 4 <Same as the present Rules>
Section 5 Welders and Welder Performance Qualification Scheme *(2018)*

501. <Same as the present Rules>

502. Grades, and range of qualification

1. ~ **5.** <Same as the present Rules>

6. Thickness and outer diameter of base metal

(1) <Same as the present Rules>

(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**.

Table 2.2.22-2 Qualified outer diameter range for pipe welds

Outer diameter *D* (mm) of the test piece(1)(2)	Qualified range d (mm)
D ≤ 25	D ≤ d ≤ 2D
25 < D	0.5D ≤ d (Min. 25 mm)

NOTES :

(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)*

(2) For non-circular hollow sections, D is the dimension of the smaller side.

7. Positions

The positions for qualification test and positions qualified for actual welding work are to comply with the **Table 2.2.23-1**.

reason

- Added requirements on whether to substitute plate welding for tack welding test of pipes

<Present>

Table 2.2.23-1 Welding Positions for Welder Qualification

Test Positions[1][2]				Welding positions in actual welding work[1][2]																								
				Plates[3]													Pipes[4]												
				Butt joint					Fillet joint								Butt joint						Fillet joint						
				PA	PC	PE	PF	PG	PA	PB	PC	PD	PE	PF	PG		PA	PC	PH	PJ	PH -45	PJ -45	PA	PB	PD	PH	PJ	PH -45	PJ -45
Plates	Butt joint	Flat	PA	◉					◉	◉							◉						◉	◉					
		Horizontal	PC	◉	◉				◉	◉	◉						◉	◉					◉	◉					
		Overhead	PE	◉	◉	◉			◉	◉	◉	◉	◉				◉	◉					◉	◉	◉				
		Vertical-up	PF	◉			◉		◉	◉				◉			◉						◉	◉					
		Vertical-down	PG					◉							◉														
	Fillet joint	Flat	PA						◉														◉						
		Horizontal vertical	PB						◉	◉													◉	◉					
		Horizontal	PC						◉	◉	◉												◉	◉					
		Horizontal overhead	PD						◉	◉	◉	◉	◉										◉	◉	◉				
		Overhead	PE						◉	◉	◉	◉	◉										◉	◉	◉				
		Vertical-up	PF						◉	◉				◉									◉	◉					
		Vertical-down	PG												◉														
pipes	Butt joint	Flat	PA	◉					◉	◉							◉						◉	◉					
		Horizontal	PC	◉	◉				◉	◉	◉						◉	◉					◉	◉					
		Upwards	PH	◉		◉	◉		◉	◉		◉	◉	◉			◉		◉				◉	◉	◉	◉			
		Downwards	PJ	◉		◉		◉	◉	◉		◉	◉		◉		◉			◉			◉	◉	◉		◉		
		Inclined upwards	PH -45	◉	◉	◉	◉		◉	◉	◉	◉	◉	◉			◉	◉	◉		◉		◉	◉	◉	◉		◉	
		Inclined downwards	PJ -45	◉	◉	◉		◉	◉	◉	◉	◉	◉		◉		◉	◉		◉		◉	◉	◉	◉		◉		◉
	Fillet joint	Flat	PA						◉														◉						
		Horizontal vertical	PB						◉	◉													◉	◉					
		horizontal overhead	PD						◉	◉	◉	◉	◉										◉	◉	◉				
		Upwards	PH						◉	◉		◉	◉	◉									◉	◉	◉	◉			
		Downwards	PJ						◉	◉		◉	◉		◉								◉	◉	◉		◉		
		Inclined upwards	PH -45						◉	◉	◉	◉	◉	◉									◉	◉	◉	◉		◉	
		Inclined downwards	PJ -45						◉	◉	◉	◉	◉		◉								◉	◉	◉		◉		◉

NOTES:

(1) ◉ indicates those welding positions for which the welder is qualified.

(2) Test positions are to comply with **Table 2.2.23-2** and **Table 2.2.23-3**.

(3) The welders or welder operators only qualified for pipe over 25 mm in outer diameter are permitted the welding for plates.

(4) The welders or welder operators qualified for plates are only permitted the welding for pipe over 500 mm in outer diameter.

<Amended>

Table 2.2.23-1 Welding Positions for Welder Qualification

Test Positions[1][2]				Welding positions in actual welding work[1][2]																								
				Plates[3]													Pipes[4]												
				Butt joint					Fillet joint								Butt joint						Fillet joint						
				PA	PC	PE	PF	PG	PA	PB	PC	PD	PE	PF	PG		PA	PC	PH	PJ	PH -45	PJ -45	PA	PB	PD	PH	PJ	PH -45	PJ -45
Plates	Butt joint	Flat	PA	◉					◉	◉							◉						◉	◉					
		Horizontal	PC	◉	◉				◉	◉	◉						◉	◉					◉	◉					
		Overhead	PE	◉	◉	◉			◉	◉	◉	◉	◉				◉	◉					◉	◉	◉				
		Vertical-up	PF	◉			◉		◉	◉				◉			◉						◉	◉					
		Vertical-down	PG					◉							◉														
	Fillet joint	Flat	PA						◉														◉						
		Horizontal vertical	PB						◉	◉													◉	◉					
		Horizontal	PC						◉	◉	◉												◉	◉					
		Horizontal overhead	PD						◉	◉	◉	◉	◉										◉	◉	◉				
		Overhead	PE						◉	◉	◉	◉	◉										◉	◉	◉				
		Vertical-up	PF						◉	◉				◉									◉	◉					
		Vertical-down	PG												◉														
pipes	Butt joint	Flat	PA	◉					◉	◉							◉						◉	◉					
		Horizontal	PC	◉	◉				◉	◉	◉						◉	◉					◉	◉					
		Upwards	PH	◉		◉	◉		◉	◉		◉	◉	◉			◉		◉				◉	◉	◉	◉			
		Downwards	PJ	◉		◉		◉	◉	◉		◉	◉		◉		◉			◉			◉	◉	◉		◉		
		Inclined upwards	PH -45	◉	◉	◉	◉		◉	◉	◉	◉	◉	◉			◉	◉	◉		◉		◉	◉	◉	◉		◉	
		Inclined downwards	PJ -45	◉	◉	◉		◉	◉	◉	◉	◉	◉		◉		◉	◉		◉		◉	◉	◉	◉		◉		◉
	Fillet joint	Flat	PA						◉														◉						
		Horizontal vertical	PB						◉	◉													◉	◉					
		horizontal overhead	PD						◉	◉	◉	◉	◉										◉	◉	◉				
		Upwards	PH						◉	◉		◉	◉	◉									◉	◉	◉	◉			
		Downwards	PJ						◉	◉		◉	◉		◉								◉	◉	◉		◉		
		Inclined upwards	PH -45						◉	◉	◉	◉	◉	◉									◉	◉	◉	◉		◉	
		Inclined downwards	PJ -45						◉	◉	◉	◉	◉		◉								◉	◉	◉		◉		◉

NOTES:

(1) ◉ indicates those welding positions for which the welder is qualified.

(2) Test positions are to comply with **Table 2.2.23-2** and **Table 2.2.23-3**.

(3) The welders or welder operators only qualified for pipe over 25 mm in outer diameter are permitted the welding for plates.

(4) The welders or welder operators qualified for plates are only permitted the welding for pipe over 500 mm in outer diameter. However, the tack welders qualified for plates are permitted the tack welding for pipes regardless of the outer diameter of the pipe. *(2022)*

Present

503. Testing procedure

1. ~ **2.** <Omitted>

3. Examination and test

(1) Examination and test are as specified in **Table 2.2.24**.

Table 2.2.24 Examination and test for Welder Qualification

Kinds	Examination and test(6)
Butt welds	Visual inspection, Bend test(1)(2)(3)(4)
Fillet welds	Visual inspection, Fracture test(5)
Tack welds	Visual inspection, Fracture test

NOTES

(1) Radiographic test or fracture test may be carried out in lieu of bend test except the gas-shielded welding processes with solid wire or metal cored wire.

(2) For 9%nickel alloy in plates, longitudinal bend test specimens may be used as shown in **Fig 2.2.11**.

(3) For nickel alloy in tubes, radiographic tests or fracture test mayh be carried out in lieu of bend test notwithstanding (1) above.

(4) For pipe with outer diameters D ≤ 25 mm, the bend or fracture tests may be replaced by a notched tensile test of the complete test assemblies as shown in **Fig 2.2.20**.

(5) Two macro sections may be taken in lieu of the fracture test.

(6) Additional tests may be required, at the discretion of the Society. **【See Guidance】**

(2) ~ (6) <Omitted>

4. ~ **6.** <Omitted>

504. <Omitted>

Amendment

503. Testing procedure

1. ~ **2.** <Same as the present Rules>

3. Examination and test

(1) Examination and test are as specified in **Table 2.2.24**.

Table 2.2.24 Examination and test for Welder Qualification ***(2022)***

Kinds	Examination and test(6)
Butt welds	Visual inspection, Bend test(1)(2)(3)(4)
Fillet welds	Visual inspection, Fracture test(5)
Tack welds	Visual inspection, Fracture test

NOTES

(1) Radiographic test or fracture test may be carried out in lieu of bend test except the welding processes in the **Table** below.

Material	Welding process(see **Table 2.2.19**)
Carbon steels, Stainless steels	131, 135, 138, 311(Oxyacetylene welding)
Nickel alloys	131, 135
Aluminium alloys	131
Copper and copper alloy	All welding processes

(2) For 9%nickel alloy in plates, longitudinal bend test specimens may be used as shown in **Fig 2.2.11**.

(3) For nickel alloy in tubes, radiographic tests or fracture test mayh be carried out in lieu of bend test notwithstanding (1) above.

(4) For pipe with outer diameters D ≤ 25 mm, the bend or fracture tests may be replaced by a notched tensile test of the complete test assemblies as shown in **Fig 2.2.20**.

(5) Two macro sections may be taken in lieu of the fracture test.

(6) Additional tests may be required, at the discretion of the Society. **【See Guidance】**

(2) ~ (6) <Same as the present Rules>

4. ~ **6.** <Same as the present Rules>

504. <Same as the present Rules>

reason

- To reflect ISO 9606-1/2/3/4

- ISO 4063
  131: MIG
  135: MAG(solid wire)
  138: MAG(metal cored wire)
  31 : Oxyfuel gas welding
  311 : Oxyacetylene welding
  312 : Oxypropane welding
  313 : Oxyhydrogen welding

RULES FOR CLASSIFICATION(STEEL SHIPS)

(Part 2 Materials and Welding)

- For external opinion inquiry -

2021.08.

Machinery Rule Development Team

- Main Amendments -

(1) Enter into force on 1 July 2022 (the date of application for certification of material & welding or the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules

Present	Amendment	reason
CHAPTER 1 MATERIALS **Section 1** <Omitted> **Section 2 Test Specimens and Testing Procedures** **201. <Omitted>** **202. Form and dimension of test specimen** **1. Tensile test specimen** (1) <Omitted> (2) Tensile test specimens are to be of the forms and sizes given in **Fig 2.1.1**. 【See Guidance】 (3) ~ (5) <Omitted> **2. ~ 4. <Omitted>** **203. <Omitted>** **Section 3 ~ Section 4** <Omitted>	**CHAPTER 1 MATERIALS** **Section 1** <Same as the present Rules> **Section 2 Test Specimens and Testing Procedures** **201. <Same as the present Rules>** **202. Form and dimension of test specimen** **1. Tensile test specimen** (1) <Same as the present Rules> (2) Tensile test specimens are to be of the forms and sizes given in **Fig 2.1.1**. 【See Guidance】 (3) ~ (5) <Same as the present Rules> **2. ~ 4. <Same as the present Rules>** **203. <Same as the present Rules>** **Section 3 ~ Section 4** <Same as the present Rules>	- Reflect to IACS UR W25(Rev.5 June 2014)

<Present>

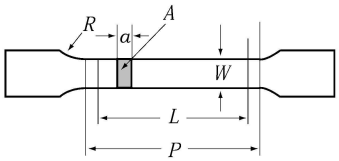
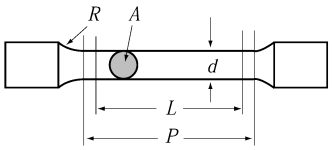
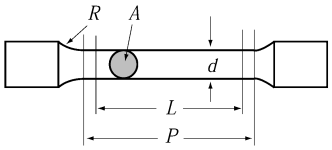
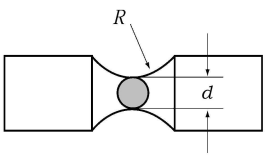
Shapes	Kind	Type	Forms of specimen[1]	Size of specimen[2]	Materials to be applied
Flat[3]	Proportional	*R* 14*B*		$a = t$ $W = 25$ mm $L = 5.65\sqrt{A}$ [4] $P \cong L + 2\sqrt{A}$ $R = 25$ mm	Rolled steels 3 mm thick or more, ~~Aluminium alloy 12.5mm thick or less~~
	Standard	*R* 1*A*		$a = t$ $W = 40$ mm $L = 200$ mm $P \cong 220$ mm $R = 25$ mm	Rolled steel plates for boiler, Rolled steel plates for pressure vessel
		R 1*B*		$a = t$ $W = 25$ mm $L = 200$ mm $P \cong 212.5$ mm $R = 25$ mm	Rolled steels 3 mm thick or more,
		R 5		$a = t$ $W = 25$ mm $L = 50$ mm $P \cong 60$ mm $R = 15$ mm	Rolled steel plates for pressure vessel
		R 13*B*		$a = t$ $W = 12.5$ mm $L = 50$ mm $P \cong 60$ mm $R = 25$ mm	Rolled steels less than 3 mm thick
Round	Proportional	*R* 14*A*		$L = 5\ d$ [5] $P \cong L + 0.5d$ $R = 10$ mm[6]	Rolled steels, Castings, Forgings, Spheroidal or nodular graphite iron castings, Copper alloy Aluminium alloy 12.5mm thick or more
	Standard	*R* 4		$d = 14$ mm $L = 50$ mm $P \cong 60$ mm $R = 15$ mm	Rolled steel plates for pressure vessel
		R 10		$d = 12.5$ mm $L = 50$ mm $P \cong 60$ mm $R = 15$ mm	Rolled steel plates for boiler
		R 8*C*		$d = 20$ mm $R = 25$ mm	Grey iron castings

Fig 2.1.1 Types and forms of tensile test specimens (unit : mm)

<Amended>

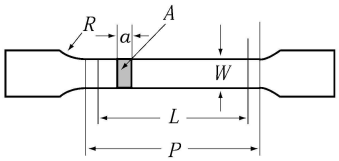
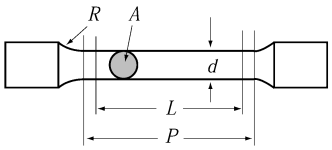
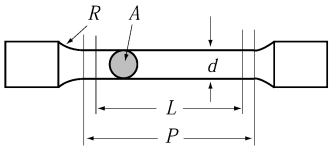
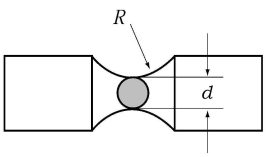
Shapes	Kind	Type	Forms of specimen[1]	Size of specimen[2]	Materials to be applied
Flat[3]	Proportional	*R* 14*B*		$a = t$ $W = 25$ mm $L = 5.65\sqrt{A}$ [4] $P \cong L + 2\sqrt{A}$ $R = 25$ mm	Rolled steels 3 mm thick or more
	Standard	*R* 1*A*		$a = t$ $W = 40$ mm $L = 200$ mm $P \cong 220$ mm $R = 25$ mm	Rolled steel plates for boiler, Rolled steel plates for pressure vessel
		R 1*B*		$a = t$ $W = 25$ mm $L = 200$ mm $P \cong 212.5$ mm $R = 25$ mm	Rolled steels 3 mm thick or more,
		R 5		$a = t$ $W = 25$ mm $L = 50$ mm $P \cong 60$ mm $R = 15$ mm	Rolled steel plates for pressure vessel, Aluminium alloy 12.5mm thick or less
		R 13*B*		$a = t$ $W = 12.5$ mm $L = 50$ mm $P \cong 60$ mm $R = 25$ mm	Rolled steels less than 3 mm thick, Aluminium alloy 12.5mm thick or less
Round	Proportional	*R* 14*A*		$L = 5\ d$ [5] $P \cong L + 0.5d$ $R = 10$ mm[6]	Rolled steels, Castings, Forgings, Spheroidal or nodular graphite iron castings, Copper alloy Aluminium alloy 12.5mm thick or more
	Standard	*R* 4		$d = 14$ mm $L = 50$ mm $P \cong 60$ mm $R = 15$ mm	Rolled steel plates for pressure vessel, Aluminium alloy 12.5mm thick or less
		R 10		$d = 12.5$ mm $L = 50$ mm $P \cong 60$ mm $R = 15$ mm	Rolled steel plates for boiler, Aluminium alloy 12.5mm thick or less
		R 8*C*		$d = 20$ mm $R = 25$ mm	Grey iron castings

Fig 2.1.1 Types and forms of tensile test specimens (unit : mm) ***(2022)***

Present	Amendment	reason
Section 5 Castings	**Section 5 Castings**	
501. Steel castings	**501. Steel castings**	- Reflect to IACS UR W8(Rev.2 May 2004)
1. ~ **4.** <Omitted>	**1.** ~ **4.** <Same as the present Rules>	
5. Heat treatment	**5. Heat treatment**	
(1) Steel castings are to be annealed, normalized, normalized and tempered, or quenched and tempered. No 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℃. The tempering temperature is to be not less than 550℃.	(1) Steel castings are to be fully annealed, normalized, normalized and tempered, or quenched and tempered. No 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℃. The tempering temperature is to be not less than 550℃. *(2022)*	- W8.5.1
(2) Steel castings which are locally heated or subjected to any cold work after heat treatment, are to be stress-relieved.	(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)*	- W8.5.4
(3) ~ (5) <Omitted>	(3) ~ (5) <Same as the present Rules>	
6. ~ **15.** <Omitted>	**6.** ~ **15.** <Same as the present Rules>	
502. ~ **507. <Omitted>**	**502.** ~ **507. <Same as the present Rules>**	
Section 6 ~ Section 7 <Omitted>	**Section 6 ~ Section 7** <Same as the present Rules>	

Present	Amendment	reason
Section 8 Aluminium Alloys **801. Aluminium alloys** **1.** ~ **4.** <Omitted> **5. Mechanical properties** (1) The mechanical properties in tension tests are to comply with the requirements given in **Tables 2.1.105** and **2.1.106**. (2) <Omitted> **6.** ~ **14.** <Omitted>	**Section 8 Aluminium Alloys** **801. Aluminium alloys** **1.** ~ **4.** <Same as the present Rules> **5. Mechanical properties** (1) The mechanical properties in tension tests are to comply with the requirements given in **Tables 2.1.105** and **2.1.106**. (2) <Same as the present Rules> **6.** ~ **14.** <Same as the present Rules>	- Reflect to IACS UR W25(Rev.5 June 2014)

<Present>

Table 2.1.105 Mechanical Properties for Rolled Products[1] *(2021)*

Grades	Temper condition[2]	Thickness, t (mm)	Tensile test			
			Yield strength (N/mm^2)	Tensile strength (N/mm^2)	Elongation(%)	
					($L=5.65\sqrt{A}$)	($L=5d$)
5083P	*O*	$3 \le t \le 50$	125 min.	275～350	16 min.	14 min.
	*H*111	$3 \le t \le 50$	125 min.	275～350	16 min.	14 min.
	*H*112	$3 \le t \le 50$	125 min.	275 min.	12 min.	10 min.
	*H*116	$3 \le t \le 50$	215 min.	305 min.	10 min.	10 min.
	*H*321	$3 \le t \le 50$	215～295	305～385	12 min.	10 min.
5383P	*O*	$3 \le t \le 50$	145 min.	290 min.	-	17 min.
	*H*111	$3 \le t \le 50$	145 min.	290 min.	-	17 min.
	*H*116 or *H*321	$3 \le t \le 50$	220 min.	305 min.	10 min.	10 min.
5059P	*O*	$3 \le t \le 50$	160 min.	330 min.	-	24 min.
	*H*111	$3 \le t \le 50$	160 min.	330 min.	-	24 min.
	*H*116 or *H*321	$3 \le t \le 20$	270 min.	370 min.	10 min.	10 min.
		$20 < t \le 50$	260 min.	360 min.	10 min.	10 min.
5086P	*O*	$3 \le t \le 50$	95 min.	240～305	16 min.	14 min.
	*H*111	$3 \le t \le 50$	95 min.	240～305	16 min.	14 min.
	*H*112	$3 \le t \le 12.5$	125 min.	250 min.	8 min.	-
		$12.5 < t \le 50$	105 min.	240 min.	-	9 min.
	*H*116	$3 \le t \le 50$	195 min.	275 min.	10 min.[3]	9 min.
5754P	*O*	$3 \le t \le 50$	80 min.	190～240	18 min.	17 min.
	*H*111	$3 \le t \le 50$	80 min.	190～240	18 min.	17 min.
5456P	*O*	$3 \le t \le 6.3$	130～205	290～365	16 min.	-
		$6.3 < t \le 50$	125～205	285～360	16 min.	14 min.
	*H*116	$3 \le t \le 30$	230 min.	315 min.	10 min.	10 min.
		$30 < t \le 40$	215 min.	305 min.	-	10 min.
		$40 < t \le 50$	200 min.	285 min.	-	10 min.
	*H*321	$3 \le t \le 12.5$	230～315	315～405	12 min.	-
		$12.5 < t \le 40$	215～305	305～385	-	10 min.
		$40 < t \le 50$	200～295	285～370	-	10 min.

NOTES :

(1) Aluminium alloy may be subject to any other standards in lieu of the requirements given in this Table where they are approved by the Society.

(2) Symbols used in temper condition are as follows **【See Guidance】**:

O : Annealing

*H*111, *H*112, *H*116 : Work hardened

H321 : Stabilizing treatment after work hardened

(3) 8 % for thicknesses up to and including 6.3 mm.

(4) <New>

<Amendment>

Table 2.1.105 Mechanical Properties for Rolled Products[1] *(2021) (2022)*

Grades	Temper condition[2]	Thickness, t (mm)	Tensile test			
			Yield strength (N/mm^2)	Tensile strength (N/mm^2)	Elongation(%)[4]	
					($L=50$)	($L=5d$)
5083P	*O*	$3 \le t \le 50$	125 min.	275～350	16 min.	14 min.
	*H*111	$3 \le t \le 50$	125 min.	275～350	16 min.	14 min.
	*H*112	$3 \le t \le 50$	125 min.	275 min.	12 min.	10 min.
	*H*116	$3 \le t \le 50$	215 min.	305 min.	10 min.	10 min.
	*H*321	$3 \le t \le 50$	215～295	305～385	12 min.	10 min.
5383P	*O*	$3 \le t \le 50$	145 min.	290 min.	-	17 min.
	*H*111	$3 \le t \le 50$	145 min.	290 min.	-	17 min.
	*H*116 or *H*321	$3 \le t \le 50$	220 min.	305 min.	10 min.	10 min.
5059P	*O*	$3 \le t \le 50$	160 min.	330 min.	-	24 min.
	*H*111	$3 \le t \le 50$	160 min.	330 min.	-	24 min.
	*H*116 or *H*321	$3 \le t \le 20$	270 min.	370 min.	10 min.	10 min.
		$20 < t \le 50$	260 min.	360 min.	10 min.	10 min.
5086P	*O*	$3 \le t \le 50$	95 min.	240～305	16 min.	14 min.
	*H*111	$3 \le t \le 50$	95 min.	240～305	16 min.	14 min.
	*H*112	$3 \le t \le 12.5$	125 min.	250 min.	8 min.	-
		$12.5 < t \le 50$	105 min.	240 min.	-	9 min.
	*H*116	$3 \le t \le 50$	195 min.	275 min.	10 min.[3]	9 min.
5754P	*O*	$3 \le t \le 50$	80 min.	190～240	18 min.	17 min.
	*H*111	$3 \le t \le 50$	80 min.	190～240	18 min.	17 min.
5456P	*O*	$3 \le t \le 6.3$	130～205	290～365	16 min.	-
		$6.3 < t \le 50$	125～205	285～360	16 min.	14 min.
	*H*116	$3 \le t \le 30$	230 min.	315 min.	10 min.	10 min.
		$30 < t \le 40$	215 min.	305 min.	-	10 min.
		$40 < t \le 50$	200 min.	285 min.	-	10 min.
	*H*321	$3 \le t \le 12.5$	230～315	315～405	12 min.	-
		$12.5 < t \le 40$	215～305	305～385	-	10 min.
		$40 < t \le 50$	200～295	285～370	-	10 min.

NOTES :

(1) Aluminium alloy may be subject to any other standards in lieu of the requirements given in this Table where they are approved by the Society.

(2) Symbols used in temper condition are as follows **【See Guidance】**:

O : Annealing

*H*111, *H*112, *H*116 : Work hardened

H321 : Stabilizing treatment after work hardened

(3) 8 % for thicknesses up to and including 6.3 mm.

(4) Elongation in $L=50$ apply for thicknesses up to and including 12.5 mm and in $L=5d$ for thicknesses over 12.5 mm

<Present>

Table 2.1.106 Mechanical Properties for Extruded Shapes(1)

Grades	Temper condition(2)	Thickness, t (mm)	Tensile test			
			Yield strength (N/mm^2)	Tensile strength (N/mm^2)	Elongation(%)(3)	
					($L=5.65\sqrt{A}$)	($L=5d$)
5083S	O	$3 \le t \le 50$	110 min.	270～350	14 min.	12 min.
	H111	$3 \le t \le 50$	165 min.	275 min.	12 min.	10 min.
	H112	$3 \le t \le 50$	110 min.	270 min.	12 min.	10 min.
5383S	O/H111	$3 \le t \le 50$	145 min.	290 min.	17 min.	17 min.
	H112	$3 \le t \le 50$	190 min.	310 min.	-	13 min.
5059S	H112	$3 \le t \le 50$	200 min.	330 min.	-	10 min.
5086S	O	$3 \le t \le 50$	95 min.	240～315	14 min.	12 min.
	H111	$3 \le t \le 50$	145 min.	250 min.	12 min.	10 min.
	H112	$3 \le t \le 50$	95 min.	240 min.	12 min.	10 min.
6005AS	T5	$3 \le t \le 50$	215 min.	260 min.	9 min.	8 min.
	T6	$3 \le t \le 10$	215 min.	260 min.	8 min.	6 min.
		$10 < t \le 50$	200 min.	250 min.	8 min.	6 min.
6061S	T6	$3 \le t \le 50$	240 min.	260 min.	10 min.	8 min.
6082S	T5	$3 \le t \le 50$	230 min.	270 min.	8 min.	6 min.
	T6	$3 \le t \le 5$	250 min.	290 min.	6 min.	-
		$5 < t \le 50$	260 min.	310 min.	10 min.	8 min.

NOTES :

(1) Aluminium alloy may be subject to any other standards in lieu of the requirements given in this Table where they are approved by the Society.

(2) Symbols used in temper condition are as follows **【See Guidance】**:

O : Annealing

*H*111 : Work hardened

*H*112 : Work hardened

*T*5 : Artificial age hardening treatment after elevated temperature working and succeeding cooling

*T*6 : Artificial age hardening treatment after solution treatment

(3) The values are applicable for longitudinal and transverse tensile test specimens as well.

(4) <New>

<Amendment>

Table 2.1.106 Mechanical Properties for Extruded Shapes[1] ***(2022)***

Grades	Temper condition[2]	Thickness, t (mm)	Tensile test			
			Yield strength (N/mm^2)	Tensile strength (N/mm^2)	Elongation(%)[3][4]	
					($L=50$)	($L=5d$)
5083S	O	$3 \le t \le 50$	110 min.	270～350	14 min.	12 min.
	H111	$3 \le t \le 50$	165 min.	275 min.	12 min.	10 min.
	H112	$3 \le t \le 50$	110 min.	270 min.	12 min.	10 min.
5383S	O/H111	$3 \le t \le 50$	145 min.	290 min.	17 min.	17 min.
	H112	$3 \le t \le 50$	190 min.	310 min.	-	13 min.
5059S	H112	$3 \le t \le 50$	200 min.	330 min.	-	10 min.
5086S	O	$3 \le t \le 50$	95 min.	240～315	14 min.	12 min.
	H111	$3 \le t \le 50$	145 min.	250 min.	12 min.	10 min.
	H112	$3 \le t \le 50$	95 min.	240 min.	12 min.	10 min.
6005AS	T5	$3 \le t \le 50$	215 min.	260 min.	9 min.	8 min.
	T6	$3 \le t \le 10$	215 min.	260 min.	8 min.	6 min.
		$10 < t \le 50$	200 min.	250 min.	8 min.	6 min.
6061S	T6	$3 \le t \le 50$	240 min.	260 min.	10 min.	8 min.
6082S	T5	$3 \le t \le 50$	230 min.	270 min.	8 min.	6 min.
	T6	$3 \le t \le 5$	250 min.	290 min.	6 min.	-
		$5 < t \le 50$	260 min.	310 min.	10 min.	8 min.

NOTES :

(1) Aluminium alloy may be subject to any other standards in lieu of the requirements given in this Table where they are approved by the Society.

(2) Symbols used in temper condition are as follows **【See Guidance】**:

O : Annealing

*H*111 : Work hardened

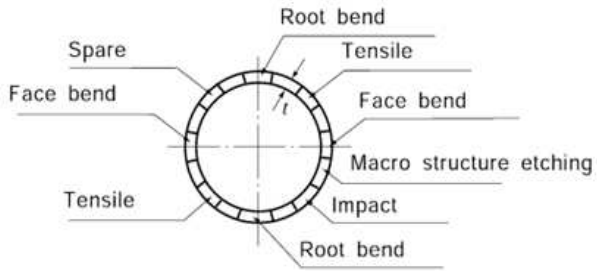
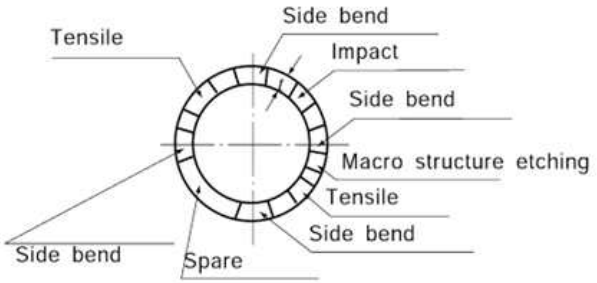
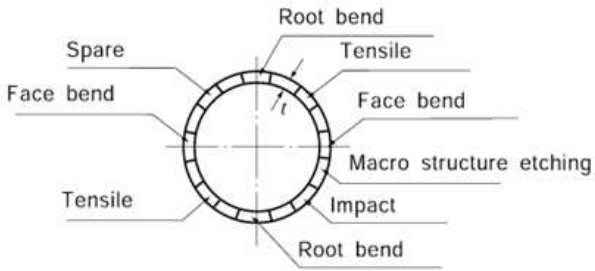
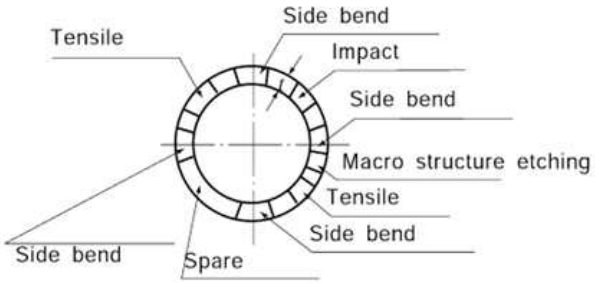
*H*112 : Work hardened

*T*5 : Artificial age hardening treatment after elevated temperature working and succeeding cooling

*T*6 : Artificial age hardening treatment after solution treatment

(3) The values are applicable for longitudinal and transverse tensile test specimens as well.

(4) Elongation in $L=50$ apply for thicknesses up to and including 12.5 mm and in $L=5d$ for thicknesses over 12.5 mm

Present	Amendment	reason
CHAPTER 2 WELDING **Section 1 ~ Section 3 <Omitted>** **Section 4 Welding Procedure Qualification Tests** **401. ~ 403. <Omitted>** **404. Tests for butt welded joints** **1. ~ 2. <Omitted>** **3. Test assemblies** (1) <Omitted> (2) The dimensions and types of test assembly are to be as indicated in **Fig 2.2.6**.  (B) Test assembly for pipes less than 19mm in thickness  (C) Test assembly for pipes 19mm and over in thickness **Fig 2.2.6 Welding procedure test assembly** (Unit : mm)	**CHAPTER 2 WELDING** **Section 1 ~ Section 3 <Same as the present Rules>** **Section 4 Welding Procedure Qualification Tests** **401. ~ 403. <Same as the present Rules>** **404. Tests for butt welded joints** **1. ~ 2. <Same as the present Rules>** **3. Test assemblies** (1) <Sams as the present Rules> (2) The dimensions and types of test assembly are to be as indicated in **Fig 2.2.6**.  (B) Test assembly for pipes less than 12mm in thickness  (C) Test assembly for pipes 12mm and over in thickness **Fig 2.2.6 Welding procedure test assembly** (Unit : mm) *(2022)*	- Reflect to ISO 15614-1

Present	Amendment	reason
(3) ~ (5) <Omitted> **4.** <Omitted> **5. Bend tests** (1) The number of bend test specimens taken from each test assembly is to be as shown in **Table 2.2.4,** and the position of specimen is to be as shown in **Fig 2.2.6**. (2) ~ (3) <Omitted> **6.** ~ **7.** <Omitted> **8. Visual & Non-destructive inspection** (1) ~ (4) <Omitted> (5) <New> **9.** ~ **10.** <Omitted> **405. Tests for fillet welded joints** **1.** ~ **3.** <Omitted> **4. Visual & non-destructive inspection** (1) ~ (3) <Omitted> (4) The imperfections detected by visual or non-destructive testing are to be assessed in accordance with *ISO* 5817, class B, except for imperfection type such as excessive convexity and excessive throat thickness for which level C applies *(2019)* **5.** ~ **6.** <Omitted> **7. Fracture tests** 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. **406.** ~ **407.** **<Omitted>**	(3) ~ (5) <Same as the present Rules> **4.** <Same as the present Rules> **5. Bend tests** (1) The number of bend test specimens taken from each test assembly is to be as shown in **Table 2.2.4** and **Table 2.2.5**, and the position of specimen is to be as shown in **Fig 2.2.6**. (2) ~ (3) <Same as the present Rules> **6.** ~ **7.** <Same as the present Rules> **8. Visual & Non-destructive inspection** (1) ~ (4) <Same as the present Rules> (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)* **9.** ~ **10.** <Same as the present Rules> **405. Tests for fillet welded joints** **1.** ~ **3.** <Same as the present Rules> **4. Visual & non-destructive inspection** (1) ~ (3) <Same as the present Rules> (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)* **5.** ~ **6.** <Same as the present Rules> **7. Fracture tests** 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)* **406.** ~ **407.** **<Same as the present Rules>**	-Typo - Reflect to ISO 15614-1 - Reflect to IACS Rec70 - Reflect to IACS Rec70 - Reflect to IACS Rec70

<Present>

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

<table>
<tr><th colspan="2" rowspan="2">Grades and material symbols of test specimens</th><th colspan="7">Kinds and number of specimens for test(1)(2)(3)</th></tr>
<tr><th>Visual insp.</th><th>Tensile test</th><th>Bend test(5)</th><th>Impact test(6)</th><th>Macro-structure insp.</th><th>Hard. test</th><th>Non-destructive insp.</th></tr>
<tr><td>The pipes for ordinary piping</td><td rowspan="2">RSTH 35, RSTH 42, RSTH 52, RSTH 12, RSTH 22, RSTH 23, RSTH 24,
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.</td><td rowspan="4">Welding positions of whole length</td><td rowspan="4">2</td><td rowspan="4">4</td><td>-</td><td rowspan="4">1</td><td rowspan="3">1</td><td rowspan="2">Welding positions of whole length(9)</td></tr>
<tr><td>The pipes used for high temperature and high pressure(4)</td><td>(7)</td></tr>
<tr><td>Steel pipes for low temperature service</td><td>RLPA, RLPB, RLPC, RLP 2, RLP 3, RLP 9</td><td>(8)</td><td rowspan="2">Welding positions of whole length(10)</td></tr>
<tr><td>Stainless steel pipes</td><td>RSTS 304TP, RSTS 304LTP, RSTS 309STP, RSTS 310STP, RSTS 316TP, RSTS 316LTP, RSTS 317TP, RSTS 317LTP, RSTS 321TP, RSTS 347TP</td><td>-</td><td>-</td></tr>
<tr><td colspan="9">Notes :
(1) ~ (4) <Omitted>
(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 19 mm thickness or less, and for side bend test may be reduced to one set for those of over 19 mm.
(6) ~ (10) <Omitted></td></tr>
</table>

<Amendment>

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

<table>
<tr><th colspan="2" rowspan="2">Grades and material symbols of test specimens</th><th colspan="7">Kinds and number of specimens for test(1)(2)(3)</th></tr>
<tr><th>Visual insp.</th><th>Tensile test</th><th>Bend test(5)</th><th>Impact test(6)</th><th>Macro-structure insp.</th><th>Hard. test</th><th>Non-destructive insp.</th></tr>
<tr><td>The pipes for ordinary piping</td><td rowspan="2">RSTH 35, RSTH 42, RSTH 52, RSTH 12, RSTH 22, RSTH 23, RSTH 24,
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.</td><td rowspan="4">Welding positions of whole length</td><td rowspan="4">2</td><td rowspan="4">4</td><td>-</td><td rowspan="4">1</td><td rowspan="3">1</td><td rowspan="2">Welding positions of whole length(9)</td></tr>
<tr><td>The pipes used for high temperature and high pressure(4)</td><td>(7)</td></tr>
<tr><td>Steel pipes for low temperature service</td><td>RLPA, RLPB, RLPC, RLP 2, RLP 3, RLP 9</td><td>(8)</td><td rowspan="2">Welding positions of whole length(10)</td></tr>
<tr><td>Stainless steel pipes</td><td>RSTS 304TP, RSTS 304LTP, RSTS 309STP, RSTS 310STP, RSTS 316TP, RSTS 316LTP, RSTS 317TP, RSTS 317LTP, RSTS 321TP, RSTS 347TP</td><td>-</td><td>-</td></tr>
<tr><td colspan="9">Notes :
(1) ~ (4) <Same as the present Rules>
(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) ~ (10) <Same as the present Rules></td></tr>
</table>

Present

Section 5 Welders and Welder Performance Qualification Scheme *(2018)*

501. ~ 502. <Omitted>

503. Testing procedure

1. ~ 2. <Omitted>

3. Examination and test

(1) Examination and test are as specified in **Table 2.2.24**.

Table 2.2.24 Examination and test for Welder Qualification

Kinds	Examination and test[6]
Butt welds	Visual inspection, Bend test[1][2][3][4]
Fillet welds	Visual inspection, Fracture test[5]
Tack welds	Visual inspection, Fracture test

NOTES

(1) Radiographic test or fracture test may be carried out in lieu of bend test except the gas-shielded welding processes with solid wire or metal cored wire.

(2) ~ (6) <Omitted>

Amendment

Section 5 Welders and Welder Performance Qualification Scheme *(2018)*

501. ~ 502. <Same as the present Rules>

503. Testing procedure

1. ~ 2. <Same as the present Rules>

3. Examination and test

(1) Examination and test are as specified in **Table 2.2.24**.

Table 2.2.24 Examination and test for Welder Qualification *(2022)*

Kinds	Examination and test[6]
Butt welds	Visual inspection, Bend test[1][2][3][4]
Fillet welds	Visual inspection, Fracture test[5]
Tack welds	Visual inspection, Fracture test

NOTES

(1) Radiographic test or fracture test may be carried out in lieu of bend test except the welding processes in the **Table** below.

Material	Welding process(see **Table 2.2.19**)
Carbon steels, Stainless steels	131, 135, 138, 311(Oxyacetylene welding)
Nickel alloys	131, 135
Aluminium alloys	131
Copper and copper alloy	All welding processes

And the radiographic test may be replaced by ultrasonic test for thickness 8 mm or above on ferritic steels(e.g. carbon steel, etc.) only.

(2) ~ (6) <Same as the present Rules>

reason

- To reflect ISO 9606-1/2/3/4

- ISO 4063
  131: MIG
  135: MAG(solid wire)
  138: MAG(metal cored wire)
  31 : Oxyfuel gas welding
  311 : Oxyacetylene welding
  312 : Oxypropane welding
  313 : Oxyhydrogen welding

* Besides RT, UT can be performed for welder test to reflect ISO 9606-1. (External opinion inquiry item)

Present	Amendment	reason
(2) **Visual examination** (a) The welds should be visually examined prior to the cutting of the test specimen for the bend test. (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*, except for imperfection type such as excess weld metal, excess penetration, excessive convexity and excessive throat thickness for which level C applies	(2) **Visual examination** (a) The welds should be visually examined prior to the cutting of the test specimen for the bend test. (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**(**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)*	- Reflect to IACS Rec105
(3) <Omitted>	(3) <Same as the present Rules>	
(4) **Radiographic test** (a) When radiographic testing is used in lieu of bend test, imperfections detected are to be assessed in accordance with (*KS B*) *ISO 5817*, level B.	(4) **Non-destructive testing** (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**, level B(**ISO 10042**, class B for aluminium alloys). *(2022)*	- Reflect to IACS Rec105
(b) <Omitted>	(b) <Same as the present Rules>	
(5) **Fracture test ~~(Fillet welds)~~** (a) When fracture test is used for butt welds, full test specimen in length is to be tested in accordance with *ISO 9017* and *ISO 9606-1*. Imperfections detected are to be assessed in accordance with (*KS B*) *ISO 5817*, level B.	(5) **Fracture test** (a) When fracture test is used for butt welds, full test specimen in length is to be tested in accordance with **ISO 9017** and **ISO 9606-1/2/3/4**. Imperfections detected are to be assessed in accordance with **(KS B) ISO 5817**, level B(**ISO 10042**, class B for aluminium alloys). *(2022)*	- Reflect to IACS Rec105
(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	(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	
(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*, level B.	(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**, level B(**ISO 10042**, class B for aluminium alloys). *(2022)*	- Reflect to IACS Rec105
(6) <Omitted>	(6) <Same as the present Rules>	
4. ~ 5. <Omitted>	**4. ~ 5. <Same as the present Rules>**	
504. <Omitted>	**504. <Same as the present Rules>**	
<hereafter, omitted>	<hereafter, same as the present Rules>	

GUIDANCE RELATING TO THE RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Guidance Part 2 Materials and Welding)

- For external opinion inquiry -

2021. 06.

Machinery Rule Development Team

- Main Amendments -

(1) Enter into force on 1 January 2022 (the date of application for certification of welding)
- Circular -

◉ To reflect IACS UR W32(Rev.1 Sep 2020)

Present	Amendment	reason
CHAPTER 1 <Omitted> **CHAPTER 2 WELDING** **Section 1 ~ Section 4 <Omitted>** **Section 5 Welders and Welder Performance Qualification Scheme *(2018)*** **503. <Omitted>** **504. General requirements for qualification validity** **1. Maintenance of the approval *(2019)* [See Rule]** (1) "If the Society recognizes the equivalence", of **504. 2** (1) (c) means the followings. (a) Quality system of shipyards/manufacturer is to comply with **ISO 3834-2** or equivalent requirements. (b) Quality system of shipyards/manufacturers is to be approved and maintained by third party. (2) This revalidate the welder's qualifications for an additional 3 years.	**CHAPTER 1 <Same as the present Guidance>** **CHAPTER 2 WELDING** **Section 1 ~ Section 4 <Same as the present Guidance>** **Section 5 Welders and Welder Performance Qualification Scheme *(2018)*** **503. <Same as the present Guidance>** **504. General requirements for qualification validity** **1. Maintenance of the approval *(2019) (2022)* [See Rule]** (1) When **504. 2** (1) (C) of the Rules is selected as the method of revalidation for welder qualification, it may be replaced by the followings. (A) Quality system of shipyards/manufacturer is to comply with **ISO 3834-2** or equivalent requirements and is to be approved and maintained by third party. (B) It is to be confirmed by the Society that **504. 2** (1) (C) (a) and (c) of the Rules are satisfied. (C) Through the confirmation of (A) and (B) above, this revalidates the welder's qualifications for an additional 3 years.	- To reflect the method of revalidation for welder qualification(ISO 3834-2) by reflecting the IACS UR W32 (Rev. 1 Sep 2020) in Pt2 of the Rules

- Main Amendments -

(1) Enter into force on 1 July 2022 (the date of application for certification of material & welding or the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules
◉ To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
Annex 2-5 Guidance for non-destructive examination of hull and machinery steel forgings	**Annex 2-5 Guidance for non-destructive examination of hull and machinery steel forgings**	
1. Application	**1. Application**	
(1) The requirements in this Guidance is intended to give general guidance on the extent, methods and recommended quality levels applicable to the non-destructive examinations (NDE) of steel forgings(hereinafter referred to as "forgings") specified in **Ch 1, 601. 8** and **10** of the Rules.	(1) The requirements in this Guidance is intended to give general guidance on the extent, methods and recommended quality levels applicable to the non-destructive examinations (NDE) of steel forgings(hereinafter referred to as "forgings") specified in **Ch 1, 601. 8** and **10** of the Rules.	
(2) For steel forgings(e.g. components for couplings, gears, boilers and pressure vessels) other than those specified in this Guidance, the requirements in this Guidance may apply correspondingly considering their materials, kinds, shapes and stress conditions being subjected.	(2) For steel forgings(e.g. components for couplings, gears, boilers and pressure vessels) other than those specified in this Guidance, the requirements in this Guidance may apply correspondingly considering their materials, kinds, shapes and stress conditions being subjected.	- To reflect IACS Rec 68(Rev.1 Apr 2021)
(3) <New>	(3) The requirements in this Guidance may be also applied to the testing of austenitic stainless steel and ferritic-austenitic (duplex) stainless steel forgings. *(2022)*	
(3) Forgings should be examined in the final delivery condition. Where intermediate inspections have been performed the manufacturer shall furnish a documentation of the results upon the request of the Surveyor.	(4) Forgings should be examined in the final delivery condition. Where intermediate inspections have been performed the manufacturer should provide reports of the results upon the request of the Surveyor. *(2022)*	
(4) Where a forging is supplied in semi finished condition, the manufacturer shall take into consideration the quality level of final finished machined components.	(5) Where a forging is supplied in semi finished condition, the manufacturer should take into consideration the quality level of final finished machined components.	
(5) NDE personnel requirements and inspection plans are to comply with the requirements specified in **Annex 2-2, 2** and **4** (2), (a) of this Guidance.	(6) NDE personnel requirements and inspection plans are to comply with the requirements specified in **Annex 2-2, 2** and **4** (2), (a) of this Guidance.	
(7) <New>	(7) Where advanced ultrasonic testing methods are applied, e.g. PAUT or TOFD, reference is made to **Annex 2-12** for general approach in adopting and application of these advanced methods. Acceptance levels regarding accept/reject criteria should be as per the applicable requirements in this Guidance. *(2022)*	

Present	Amendment	reason
2. Surface Inspections (1) **General** (a) Surface inspections in this Guidance are to be carried out by visual examination and magnetic particle testing or liquid penetrant testing. (b) The testing procedures, apparatus and conditions of magnetic particle testing and liquid penetrant testing are to comply with the recognized national or international standards. (c) Personnel engaged in visual examination is to have sufficient knowledge and experience. Personnel engaged in magnetic particle testing or liquid penetrant testing is to be qualified in accordance with the Society's Rules. The qualification is to be verified by certificates. (2) **Products** (A) The steel forgings specified in **Pt 2, Ch 1, 601.** shall be subjected to a 100 % visual examination by the Surveyor. For mass produced forgings the extent of examination is to be as deemed appropriate by the Society. (B) ~ (D) <New>	**2. Surface Inspections** (1) **General** (a) Surface inspections in this Guidance should be carried out by visual examination and magnetic particle testing or penetrant testing, for the purpose of detecting relevant indications and assessing them against accept/reject criteria stated herein. Personnel engaged in visual examination should have sufficient knowledge and experience, however, may be exempted from formal qualification requirements in this Guidance. *(2022)* (b) The testing procedures, apparatus and conditions of magnetic particle testing and liquid penetrant testing should comply with the recognized national or international standards. (c) Other surface inspection methods, e.g. eddy current testing, may be required by the Society as a supplementary method, e.g. for confirming the presence of indications, or for detecting the presence of undocumented weld repairs. This Guidance does not include accept/reject criteria for this purpose and is mentioned here for information only. *(2022)* (2) **Products** (A) The steel forgings specified in **Pt 2, Ch 1, 601.** should be subjected to a 100 % visual examination of all accessible surfaces by the manufacturer and made available to the Surveyor. For mass produced forgings the extent of examination is to be as deemed appropriate by the Society. *(2022)* (B) It is noted that **Pt 2, Ch 1, 601.** does not include every forged component type that may be subject to Classification(for example, forged slewing rings). In such cases where the particular component or type is not included, either in **Pt 2, Ch 1, 601.** or this Guidance, appropriate national/international standards, or relevant Rules may be applied, to determine the appropriate testing regime and defect acceptance criteria. *(2022)*	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
	(C) Austenitic stainless steel and ferritic-austenitic(duplex) stainless steel forgings acceptance criteria details are included in this Guidance for surface and volumetric inspections, however, other acceptance criteria and national or Austenitic international standards may be applied, upon agreement with the Society. *(2022)* (D) Where such standards are used or referenced as a basis for accept and reject criteria, the quality level should provide reasonable equivalence to the allowable criteria stated in the appropriate tables within this Guidance. The quality levels would normally be the highest or most stringent, to provide reasonable equivalence with this Guidance. *(2022)*	- To reflect IACS Rec 68(Rev.1 Apr 2021)
(B) Surface inspections by magnetic particle and/or ~~liquid~~ penetrant methods generally apply to the following steel forgings: (a) crankshafts ~~with minimum crankpin diameter not less than 100 mm;~~ (b) propeller shafts, intermediate shafts, thrust shafts and rudder stocks with minimum diameter not less than 100 mm; (c) connecting rods, piston rods and crosshead ~~with minimum diameter not less than 75 mm or equivalent cross section,~~ (d) bolts with minimum diameter not less than 50 mm, which are subjected to dynamic stresses such as cylinder cover bolts, tie rods, crankpin bolts, main bearing bolts, ~~propeller blade fastening bolts.~~ (e) <New>	(E) Surface inspections by magnetic particle and/or penetrant methods generally apply to the following steel forgings: (a) All crankshafts; (b) Propeller shafts, intermediate shafts, thrust shafts and rudder stocks with minimum diameter not less than 100 mm; (c) Cylinder heads, connecting rods, piston rods and crosshead, as per the engine type and size requirements in **Pt 5** of the Rules. *(2022)* (d) Bolts with minimum diameter not less than 50 mm, which are subjected to dynamic stresses such as cylinder cover bolts, coupling bolts for crankshafts, tie rods, crankpin bolts, main bearing bolts and other items as per the engine type and size requirements in **Pt 5** of the Rules. *(2022)* (e) Propeller blade fastening bolts which are subjected to dynamic stresses. *(2022)*	

Present	Amendment	reason
(3) **Zones for Surface Inspections** Magnetic particle or where permitted ~~liquid~~ penetrant testing, shall be carried out in the zones I and II as indicated in **Figs 1** to **4.** (4) **Surface Condition** The surfaces of forgings to be examined are to be free from scale, dirt, grease or paint. (5) **Surface Inspection** (a) Where indicated by **Figs 1** to **4**, magnetic particle inspection will be carried out with the following exceptions, when ~~liquid~~ penetrant testing will be permitted : - austenitic stainless steels; - interpretation of open visual or magnetic particle indications, - at the instruction of the Surveyor. (b) Unless otherwise specified in the order, the magnetic particle test shall be performed on a forging in the final machined surface condition and final thermally treated condition ~~or within 0.3 mm of the final machined surface condition for *AC* techniques (0.8 mm for *DC* techniques)~~. (c) Unless otherwise agreed, the surface inspection is to be carried out in the presence of the Surveyor. The surface inspection is to be carried out before the shrink fitting, where applicable. (d) For magnetic particle testing, attention is to be paid to the contact between the forging and the clamping devices of stationary magnetization benches in order to avoid local overheating or burning damage in its surface. Prods shall not be permitted on finished machined items. (e) When indications were detected as a result of the surface inspection, acceptance or rejection is to be decided in accordance with clause (6)	(3) **Zones for Surface Inspections** Magnetic particle, or where permitted penetrant testing, should be carried out in zones I, II and III(as applicable) as indicated in **Figs 1** to **4.** *(2022)* (4) **Surface Condition** The surfaces of forgings to be examined should be free from scale, dirt, grease or paint. (5) **Surface Inspection** *(2022)* (a) Where indicated by **Figs 1** to **4**, magnetic particle inspection should be carried out with the following exceptions, when penetrant testing would be permitted : - austenitic and ferritic-austenitic(duplex) stainless steels; - interpretation of open visual or magnetic particle indications, - at the instruction of the Surveyor. (b) Unless otherwise detailed in the specification, the magnetic particle test should be performed on a forging in the final machined surface condition and final thermally treated condition. (c) Unless otherwise agreed, the surface inspection should be carried out in the presence of the Surveyor. The surface inspection should be carried out before the shrink fitting, where applicable. (d) For magnetic particle testing, attention should be paid to the contact between the forging and the clamping devices of stationary magnetization benches in order to avoid local overheating or burning damage in its surface. Prods should not be permitted on finished machined items. (e) When indications are detected as a result of the surface inspection, acceptance or rejection is to be decided in accordance with clause (6)	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
(6) **Acceptance Criteria and Rectification of Defects**	(6) **Acceptance Criteria and Rectification of Defects** *(2022)*	
(A) *Acceptance Criteria Visual Inspection*	(A) *Acceptance Criteria Visual Inspection*	
(a) All forgings shall be free of cracks, crack-like indications, laps, seams, folds, or other injurious indications. At the request of the Surveyor, additional magnetic particle, ~~liquid~~ penetrant and ultrasonic testing may be required for a more detailed evaluation of surface irregularities.	(a) All forgings should be free of cracks, crack-like indications, laps, seams, folds, or other detrimental indications. At the request of the Surveyor, additional magnetic particle, penetrant and ultrasonic testing may be required for a more detailed evaluation of surface irregularities.	- To reflect IACS Rec 68(Rev.1 Apr 2021)
(b) The bores of hollow propeller shafts are to be visually examined for imperfections uncovered by the machining operation. ~~Machining marks are to be ground to a smooth profile.~~	(b) The bores of hollow propeller shafts should be visually examined for imperfections uncovered by the machining operation.	
(B) *Acceptance Criteria Magnetic Particle Testing and ~~Liquid~~ Penetrant Testing*	(B) *Acceptance Criteria Magnetic Particle Testing and Penetrant Testing*	
(a) The following definitions relevant to indications apply:	(a) The following definitions relevant to indications apply:	
(i) Linear indication : an indication in which the length is at least three times the width;	(i) Linear indication : an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3\ w$).	
(ii) Nonlinear indication : an indication of circular or elliptical shape with a length less than three times the width;	(ii) Nonlinear indication : an indication with a largest dimension less than three times its smallest dimension (i.e. $l < 3w$).	
(iii) Aligned indication : three or more indications in a line, separated by 2 mm or less edge-to-edge;	(iii) Aligned indication : - Non-linear indications form an alignment when the distance between indications is less than 2mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment. - Linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.	
(iv) Open indication : an indication visible after removal of the magnetic particles or that can be detected by the use of contrast dye penetrant;	(iv) Open indication : an indication visible after removal of the magnetic particles or that can be detected by the use of penetrant testing;	
(v) Non-open indication : an indication that is not visually detectable after removal of the magnetic particles or that cannot be detected by the use of contrast dye penetrant,	(v) Non-open indication : an indication that is not visually detectable after removal of the magnetic particles or that cannot be detected by the use of penetrant testing,	
(vi) Relevant indication : an indication that is caused by a condition or type of discontinuity that requires evaluation. Only indications which have any dimension greater than 1.5 mm shall be considered relevant.	(vi) Relevant indication : an indication that is caused by a condition or type of discontinuity that requires evaluation. Only indications which have any dimension greater than 1.5 mm shall be considered relevant for the categorization of indications.	

Present	Amendment	reason
(b) For the purpose of evaluating indications, the surface is to be divided into reference areas of 225 cm^2. The area shall be taken in the most unfavorable location relative to the indication being evaluated. (c) The allowable number and size of indications in the reference area is given in **Table 1** for crankshaft forgings and in **Table 2** for other forgings, respectively. Cracks are not acceptable. Irrespective of the results of non-destructive examination, the Surveyor may reject the forging if the total number of indications is excessive. (C) *Rectification of Defects* (a) Defects and unacceptable indications must be rectified as indicated below and detailed in (i) thru (v) (i) Defective parts of material may be removed by grinding, or by chipping and grinding. 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 the adjacent surface. (ii) To depress is to flatten or relieve the edges of a non-open indication with a fine pointed abrasive stone with the restriction that the depth beneath the original surface shall be 0.08 mm minimum to 0.25 mm maximum and that the depressions be blended into the bearing surface. A depressed area is not considered a groove and is made only to prevent galling of bearings. (iii) Non-open indications evaluated as segregation need not be rectified. (iv) Complete removal of the defect is to be proved by magnetic particle testing or penetrant testing, as appropriate. (v) Repair welding is not permitted for crankshafts. Repair welding of other forgings is subjected to prior approval of the individual Class Society.	(b) For the purpose of evaluating indications, the surface should be divided into reference areas of 225 cm^2. The area shall be taken in the most unfavourable location relative to the indication being evaluated. (c) The allowable number and size of indications in the reference area is given in **Table 1** for crankshaft forgings and in **Table 2** for other forgings(including austenitic stainless steel and ferritic-austenitic(duplex) stainless steel forgings), respectively. Cracks are not acceptable. Irrespective of the results of non-destructive examination, the Surveyor may reject the forging if the total number of indications is excessive. (C) *Rectification of Defects* (a) Defects and unacceptable indications must be rectified as indicated below and detailed in (i) thru (v). Generally it may be permissible to remove shallow indications by light grinding to a maximum depth of 1.5 mm. (i) Defective parts of material may be removed by grinding, or by chipping and grinding. 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 the adjacent surface. (ii) To depress is to flatten or relieve the edges of a non-open indication with a fine pointed abrasive stone with the restriction that the depth beneath the original surface shall be 0.08 mm minimum to 0.25 mm maximum and that the depressions be blended into the bearing surface. A depressed area is not considered a groove and is made only to prevent galling of bearings. (iii) Non-open indications evaluated as segregation need not be rectified. (iv) Complete removal of the defect should be proved by magnetic particle testing or penetrant testing, as appropriate. (v) Repair welding should not be permitted for crankshafts or rotating items subjected to torsional fatigue(such as propeller shafts). Repair welding of other forgings should be subject to prior approval of the individual Class Society.	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present

(vi) <New>

(b) *Zone I in crankshaft forgings*
Neither indications nor repair are permitted in this zone.

(c) *Zone II in crankshaft forgings*

(i) Indications must be removed by grinding to a depth no greater than 1.5 mm.

(ii) Indications detected in the journal bearing surfaces must be removed by grinding to a depth no greater than 3.0 mm. The total ground area shall be less than 1 % of the total bearing surface area concerned.

(iii) Non-open indications, except those evaluated as segregation, shall be depressed but need not be removed.

Table 1 Crankshaft forgings ; Allowable number and size of indications in a reference area of 225 cm^2

Inspection Zone	Max. number of indications	Type of indication	Max. number for each type	Max. dimension (mm)
I (critical fillet area)	0	Linear Nonlinear Aligned	0 0 0	- - -
II (important fillet area)	3	Linear Nonlinear Aligned	0 3 0	- 3.0 -
III (journal surfaces)	3	Linear Nonlinear Aligned	0 3 0	- 5.0 -

Amendment

(vi) Grinding is not permitted in way of finished machined threads.

(b) *Zone I in crankshaft forgings*
Neither indications nor repair are permitted in this zone.

(c) *Zone II in crankshaft forgings*

(i) Indications must be removed by grinding to a depth no greater than 1.5 mm.

(ii) Indications detected in the journal bearing surfaces must be removed by grinding to a depth no greater than 3.0 mm. The total ground area shall be less than 1 % of the total bearing surface area concerned.

(iii) Non-open indications, except those evaluated as segregation, shall be depressed but need not be removed.

Table 1 Crankshaft forgings ; Allowable number and size of surface indications in a reference area of 225 cm^2 ***(2022)***

Inspection Zone	Max. number of indications	Type of indication	Max. number for each type	Max. dimension (mm)
I (critical fillet area)	0	Linear Nonlinear Aligned	0 0 0	- - -
II (important fillet area)	3	Linear Nonlinear Aligned	0 3 0	- 3.0 -
III (journal surfaces)	3	Linear Nonlinear Aligned	0 3 0	- 5.0 -

reason

- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
Table 2 Steel forgings excluding crankshaft forgings ; Allowable number and size of indications in a reference area of 225 cm^2	**Table 2 Steel forgings excluding crankshaft forgings ; Allowable number and size of surface indications in a reference area of 225 cm^2** ***(2022)***	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Inspection Zone	Max. number of indications	Type of indication	Max. number for each type	Max. dimension (mm)
I	3	Linear Nonlinear Aligned	0(1) 3 0(1)	- 3.0 -
II	10	Linear Nonlinear Aligned	3(1) 7 3(1)	3.0 5.0 3.0

Note:
(1) Linear or aligned indications are not permitted on bolts, which receive a direct fluctuating load, e.g. main bearing bolts, connecting rod bolts, crosshead bearing bolts, cylinder cover bolts.

(d) *Zone I in other forgings*
Indications must be removed by grinding to a depth no greater than 1.5 mm. ~~However, grinding is not permitted in way of finished machined threads.~~

(e) *Zone II in other forgings*
Indications must be removed by grinding to a depth no greater than 2 % of the diameter or 4.0 mm, whichever is smaller.

(f) *Zones other than I and II in all forgings*
Defects detected by visual inspection must be removed by grinding to a depth no greater than 5 % of the diameter or 10mm, whichever is smaller. The total ground area shall be less than 2 % of the forging surface area.

Inspection Zone	Max. number of indications	Type of indication	Max. number for each type	Max. dimension (mm)
I	3	Linear Nonlinear Aligned	0(1) 3 0(1)	- 3.0 -
II	10	Linear Nonlinear Aligned	3(1) 7 3(1)	3.0 5.0 3.0

Note:
(1) Linear or aligned indications are not permitted on bolts, which receive a direct fluctuating load, e.g. main bearing bolts, connecting rod bolts, crosshead bearing bolts, cylinder cover bolts.

(d) *Zone I in other forgings*
Indications must be removed by grinding to a depth no greater than 1.5 mm. *(2022)*

(e) *Zone II in other forgings*
Indications must be removed by grinding to a depth no greater than 2 % of the diameter or 4.0 mm, whichever is smaller.

(f) *Zones other than I and II in all forgings*
Defects detected by visual inspection must be removed by grinding to a depth no greater than 5 % of the diameter or 10mm, whichever is smaller. The total ground area shall be less than 2 % of the forging surface area.

Present	Amendment	reason
(7) **Record** Test results of surface inspections are to be recorded at least with the following items: (a) Date of testing; (b) Names and qualification level of inspection personnel; (c) Kind of testing method; - for ~~liquid~~ penetrant testing : test media combination - for magnetic particle testing : method of magnetizing, test media ~~and~~ magnetic field strength (d) Kind of product; (e) Product number for identification; (f) Grade of steel; (g) Heat treatment; (h) Stage of testing; (i) Position (zone) of testing; (j) Surface condition; (k) Test standards used; (l) Testing condition; (m) Results; (n) Statement of acceptance/non acceptance, (o) Details of weld repair including sketch;	(7) **Reporting** *(2022)* Test results of surface inspections should be recorded at least with the following items: (a) Date of testing; (b) Names, signature(s) and qualification level of inspection personnel; (c) Testing method and testing details, including procedure number; - for liquid penetrant testing : the penetrant system used and viewing conditions(as appropriate to the penetrant technique and media used) - for magnetic particle testing : method of magnetizing, test media, magnetic field strength, magnetic flux indicators(where appropriate), and viewing conditions (as appropriate to the magnetizing technique and media used) (d) Type of product; (e) Product number and unique identification; (f) Grade of steel; (g) Heat treatment; (h) Stage of testing; (i) Position (zone) of testing; (j) Surface condition; (k) Test standards used, including reference to the appropriate tables for acceptance purposes; (l) Testing condition; (m) Results, including documentation regarding the repair and testing history(as appropriate); (n) Statement of acceptance/non acceptance, (o) Details of weld repair including sketch(where applicable);	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
3. Ultrasonic testing (1) **General** (a) Volumetric inspection in this Guidance is to be carried out by ultrasonic testing using the contact method with straight beam and/or angle beam technique. (b) The testing procedures, apparatus and conditions of ultrasonic testing are to comply with ~~the~~ recognized national or international standards. Generally the *DGS*(distance-gain size) procedure is to be applied using straight beam probes and/or angle beam probes with 2 to 4 MHz and inspection should be carried out using a twin crystal 0° probe for near surface scans (25 mm) plus an 0o probe for the remaining volume. Fillet radii should be examined using 45°, 60° or 70° probes. (c) Personnel engaged in ultrasonic testing is to be qualified in accordance with the Society's Rules. The qualification is to be verified by certificates. (d) ~ (e) <New>	**3. Ultrasonic testing** (1) **General** *(2022)* (a) Volumetric inspection in this Guidance should be carried out by ultrasonic testing using the contact method with straight beam and/or angle beam technique. Advanced UT methods (such as PAUT or TOFD) should meet the general requirements of **Annex 2-12**. (b) The testing procedures, apparatus and conditions of ultrasonic testing should comply with recognized national or international standards. Generally, the methods of setting test sensitivity and testing evaluation utilise the DAC(distance amplitude correction) or DGS(distance-gain size) methods. The applied methodology should use 2 to 4 MHz straight beam(or normal) probes and/or angle beam probes. For near surface testing(up to a depth of 25 mm) twin crystal 0° probe should be used, plus a 0° probe (usually single crystal beyond a depth of 25 mm) for the remaining volume. The appropriate acceptance criteria tables should be used, depending on the sensitivity method selected. (c) Fillet radii should be examined using 45°, 60° or 70° probes, primarily to determine the presence of any cracks within the radiused areas, and as an additional scan to confirm any indications that may have been detected with 0° probe(s) within this area. (d) For fabricated forgings and weld repairs, weld testing should be carried out to the appropriate standard, and the acceptance tables contained herein should not be used as a basis for acceptance criteria of welds. (e) Construction of DAC curves for normal probes should be performed using reference blocks containing suitably sized Flat Bottom Holes (FBH) spaced over the inspection thickness. Reference blocks should be manufactured from similar material, with similar surface condition to that being inspected. Where necessary, allowances should be made for attenuation losses by performing a transfer correction and adjusting the DAC curve as required. The applied transfer correction(measured in decibels(dB)) should become the new reference sensitivity, to which indications are evaluated against, according to the appropriate table contained herein.	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
(2) **Products** (A) Volumetric inspections by ultrasonic testing generally apply to the following steel forgings : (a) crankshaft with minimum crankpin diameter not less than 150 mm; (b) propeller shafts, intermediate shafts, thrust shafts and rudder stocks with minimum diameter not less than 200 mm, (c) connecting rods, piston rods and crosshead with minimum diameter not less than 200 mm or equivalent cross section. (B) ~ (D) <New>	(2) **Products** *(2022)* (A) Volumetric inspections by ultrasonic testing generally apply to the following steel forgings : (a) All crankshafts (b) Propeller shafts, intermediate shafts, thrust shafts and rudder stocks with minimum diameter not less than 200 mm, (c) Cylinder heads, connecting rods, piston rods, crosshead, coupling bolts and studs as per the engine type and size requirements in **Pt 5** of the Rules. (B) It is noted that **Pt 2, Ch 1, 601.** of the Rules does not include every forged component type that may be subject to Classification(for example, forged slewing rings). In such cases where the particular component or type is not included, either in **Pt 2, Ch 1, 601.** of the Rules or this Recommendation, appropriate national/international standards, or Rules may be applied, to determine the appropriate testing regime and defect acceptance criteria. (C) Where such standards are used or referenced as a basis for accept and reject criteria, the quality level should provide reasonable equivalence to the allowable criteria stated in the appropriate tables within this Guidance. The quality levels would normally be the highest or most stringent, to provide reasonable equivalence with this Guidance. (D) Ultrasonic acceptance criteria detailed in **Tables 3** to **6** are intended for C, C-Mn, and alloy steel forgings, and do not apply to austenitic stainless steel or ferritic-austenitic(duplex) stainless steel forgings. Examples of standards for acceptance criteria for stainless steel or duplex stainless steel forgings are detailed below, and quality levels should be agreed with the Society. Other national or international standards may be used, as agreed with the Society. (a) ASTM A745/A745M-20 (b) EN 10228-4:2016	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
(3) **Zones for ultrasonic testing** (A) Ultrasonic testing shall be carried out in the zones I to III as indicated in **Figs 5** to **8**. Areas may be upgraded to a higher zone at the discretion of the Surveyors. (4) **Surface Condition** (a) The surfaces of forgings to be examined are to be such that adequate coupling can be established between the probe and the forging and that excessive wear of the probe can be avoided. The surfaces are to be free from scale, dirt, grease or paint. (b) The ultrasonic testing is to be carried out after the steel forgings have been machined to a condition suitable for this type of testing and after the final heat treatment , but prior to the drilling of the oil bores ~~and~~ prior to surface hardening. Black forgings shall be inspected after removal of the oxide scale by either flame descaling or shot blasting methods. (5) **Acceptance Criteria** (a) Acceptance criteria of volumetric inspection by ultrasonic testing are shown in **Table 3** and **4.**	(3) **Zones for ultrasonic testing** (A) Ultrasonic testing should be carried out in the zones I to III as indicated in **Figs 5** to **8**. Areas may be upgraded to a higher zone at the discretion of the Surveyors. (4) **Surface Condition** (a) The surfaces of forgings to be examined should be such that adequate coupling can be established between the probe and the forging and that excessive wear of the probe should be avoided. The surfaces are to be free from scale, dirt, grease or paint. (b) The ultrasonic testing should be carried out after the steel forgings have been machined to a condition suitable for this type of testing and after the final heat treatment , but prior to the drilling of the oil bores, prior to surface hardening and the machining of bolt threads. Black(or 'as forged') forgings should be inspected after removal of the oxide scale by either flame descaling or shot blasting methods. *(2022)* (5) **Acceptance Criteria** (a) Acceptance criteria of volumetric inspection by ultrasonic testing are shown in **Table 3** and **6**.	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present

Table 3 Acceptance Criteria for Crankshafts

Type of Forging	Zone	Allowable disc shape according to *DGS*(1)	Allowable length of indication(2)	Allowable distance between two indications(3)
Crank sha ft	I	d ≤ 0.5 mm	-	-
	II	d ≤ 2.0 mm	≤ 10 mm	≥ 20 mm
	III	d ≤ 4.0 mm	≤ 15 mm	≥ 20 mm

Notes :

(1) *DGS* : Distance Gain Size evaluation system

(2) The transference distance of the probe in the range where the echo height exceeds 50% of DGS line is taken as the length of indication.

(3) In case of accumulations of two or more isolated indications which are subjected to registration the minimum distance between two neighboring indications must be at least the length of the bigger indication. This applies ~~as well~~ to the distance in axial direction as to the distance in depth. Isolated indications with less distances are to be determined as one single indication.

(4) ~ (5) <New>

Amendment

Table 3 Ultrasonic Acceptance Criteria for Crankshafts: DGS Method-Normal Probes *(2022)*

Type of Forging	Zone	Allowable disc shape according to *DGS*(1)	Allowable length of indication(2)	Allowable distance between two indications(3)
Crank sha ft	I	d ≤ 1.0 mm(4)	Not applicable(5)	Not applicable
	II	d ≤ 2.0 mm	≤ 10 mm	≥ 20 mm
	III	d ≤ 4.0 mm	≤ 15 mm	≥ 20 mm

Notes :

(1) *DGS* : Distance Gain Size evaluation system

(2) The transference distance of the probe in the range where the echo height exceeds 50% of DGS line is taken as the length of indication.

(3) In case of accumulations of two or more isolated indications which are subjected to registration the minimum distance between two neighbouring indications should be at least the length of the larger indication. This also applies to the distance in axial direction as well as to the distance in depth. Isolated indications with less distances should be determined as one single indication.

(4) For zone 1 testing, probe selection should take into account the limits of probe beam-path length and depth of beam penetration and should normally be carried out with a minimum probe frequency of 4 MHz.

(5) For zone 1, indications with an echo height greater than a 1.0 mm disc shaped reflector are not acceptable. Indications with an echo height of less than or equal to 1.0 mm are acceptable if they are deemed as point reflectors and have no measurable length.

reason

- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
Table 4 <New>	**Table 4 Ultrasonic Acceptance Criteria for Crankshafts: DAC Method-Normal Probes *(2022)***	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Type of Forging	Zone	DAC reference level, based on 3.0 mm FBH(1)(2)(3)	Allowable length of indication	Allowable distance between two indications(5)
Crank shaft	I	3.0 mm DAC − 19 dB	Not applicable(4)	Not applicable
	II	3.0 mm DAC − 7 dB	≤ 10.0 mm	≥ 20 mm
	III	3.0 mm DAC + 5 dB	≤ 15.0 mm	≥ 20 mm

Notes :

(1) The requirement of a 3mm FBH is to standardise the DAC reference blocks for clarity and consistency. The dB value for the FBH/DAC setting is equivalent to the disc shaped reflector stated in **Table 3**, corresponding to the applicable zone.

(2) Other size FBH's may be used for the DAC method (and the dB value adjusted accordingly to provide equivalence with the stated FBH/disc shaped reflector). Where other size FBH's are used, the ultrasonic procedure should state the equivalence using an appropriate calculation formula.

(3) For zone 1 testing, probe selection should take into account the limits of probe beam-path length and depth of beam penetration and should normally be carried out with a minimum probe frequency of 4 MHz.

(4) For zone 1, indications with an echo height greater than the DAC reference level are not acceptable. Indications with an echo height of less than the DAC reference level are acceptable if they are deemed as point reflectors and have no measurable length.

(5) In case of accumulations of two or more isolated indications which are subject to registration the minimum distance between two neighbouring indications be at least the length of the larger indication. This also applies to the distance in axial directions as well as to the distance in depth. Isolated indications with less distances should be determined as one single indication.

Present

Table 4 Acceptance Criteria for Shafts and Machinery Components

Type of Forging	Zone	Allowable disc shape according to *DGS*(1)(2)	Allowable length of indication(3)	Allowable distance between two indications(4)
Propeller shaft, intermediate shaft Thrust shaft, Rudder stock	II	outer: d≤2 mm inner: d≤4 mm	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
	III	outer: d≤3 mm inner: d≤6 mm	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
Connecting rod, Piston rod, Crosshead	II	d≤2.0 mm	≤ 10 mm	≥ 20 mm
	III	d≤4.0 mm	≤ 10 mm	≥ 20 mm

Notes :
(1) *DGS* : Distance Gain Size evaluation system
(2) Outer part means the part beyond one third of the shaft radius from the center, the inner part means the remaining core area.
(3) The transference distance of the probe in the range where the echo height exceeds 50% of DGS line is taken as the length of indication.
(4) In case of accumulations of two or more isolated indications which are subjected to registration the minimum distance between two neighboring indications must be at least the length of the bigger indication.

Amendment

Table 5 Ultrasonic Acceptance Criteria for Shafts and Machinery Components: DGS Method-Normal Probes *(2022)*

Type of Forging	Zone	Allowable disc shape according to *DGS*(1)(2)	Allowable length of indication(3)	Allowable distance between two indications(4)
Propeller shaft, intermediate shaft, Thrust shaft, Rudder stock	II	outer: d≤2 mm inner: d≤4 mm	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
	III	outer: d≤3 mm inner: d≤6 mm	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
Connecting rod, Piston rod, Crosshead	II	d≤2.0 mm	≤ 10 mm	≥ 20 mm
	III	d≤4.0 mm	≤ 10 mm	≥ 20 mm

Notes :
(1) *DGS* : Distance Gain Size evaluation system
(2) Outer part means the part beyond one third of the shaft radius from the centre, the inner part means the remaining core area.
(3) The transference distance of the probe in the range where the echo height exceeds 50% of DGS line is taken as the length of indication.
(4) In case of accumulations of two or more isolated indications which are subjected to registration the minimum distance between two neighbouring indications must be at least the length of the larger indication. Isolated indications with less distances should be determined as one single indication.

reason

- To reflect IACS Rec 68(Rev.1 Apr 2021)

Present	Amendment	reason
Table 6 <New>	**Table 6 Ultrasonic Acceptance Criteria for Shafts and Machinery Components: DAC Method-Normal Probes *(2022)***	- To reflect IACS Rec 68(Rev.1 Apr 2021)

Type of Forging	Zone	*DAC* reference level, based on 3.0 mm FBH[(1)(2)]	Allowable length of indication	Allowable distance between two indications[(3)]
Propeller shaft, intermediate shaft, Thrust shaft, Rudder stock	II	Outer : DAC − 7 dB Inner : DAC + 5 dB	≤ 10.0 mm ≤ 15.0 mm	≥20 mm ≥20 mm
	III	Outer : +0 DAC Inner : DAC + 12 dB	≤ 10.0 mm ≤ 15.0 mm	≥20 mm ≥20 mm
Connecting rod, Piston rod, Crosshead	II	DAC − 7 dB	≤ 10.0 mm	≥20 mm
	III	DAC + 5 dB	≤ 10.0 mm	≥20 mm

Notes :

(1) The requirement of a 3 mm FBH is to standardise the DAC reference blocks for clarity and consistency. The dB value for the FBH/DAC setting is equivalent to the disc shaped reflector stated in **Table 3**, corresponding to the applicable zone.

(2) Other size FBH's may be used for the DAC method (and the dB value adjusted accordingly to provide equivalence with the stated FBH/disc shaped reflector). Where other size FBH's are used, the ultrasonic procedure should state the equivalence using an appropriate calculation formula.

(3) In case of accumulations of two or more isolated indications which are subject to registration the minimum distance between two neighbouring indications must be at least the length of the larger indication. This also applies to the distance in axial directions as well as to the distance in depth. Isolated indications with less distances should be determined as one single indication.

Present	Amendment	reason
(6) **Record** Test results of volumetric inspection are to be recorded at least with the following items: (a) Date of testing; (b) Names and qualification level of inspection personnel; (c) Kind of testing method; (d) Kind of product; (e) Product number for identification; (f) Grade of steel; (g) Heat treatment; (h) Stage of testing; (i) Position (zone) of testing; (j) Surface condition; (k) Test standards used; (l) Testing condition; (m) Results, (n) Statement of acceptance/non acceptance; (o) <New> ⚓	(6) **Reporting** *(2022)* Test results of volumetric inspection should be recorded at least with the following items: (a) Date of testing; (b) Name(s), signature(s) and qualification level of inspection personnel; (c) Testing method including procedure number, and details of the following items; - Equipment used(instrument, probes [and any adaptions to probes for curved surfaces], calibration and refence blocks) - Technique(s) used to set test sensitivity(including sensitivity method, specific reference blocks, reflector size, transfer correction) - Maximum scanning rate(mm/s) - Details of any testing restrictions (d) Type of product; (e) Product number and unique identification; (f) Grade of steel; (g) Heat treatment; (h) Stage of testing; (i) Position (zone) of testing; (j) Surface condition; (k) Test standards used including reference to the appropriate tables for acceptance purposes; (l) Testing condition; (m) Results including documentation regarding the repair and testing history(as appropriate); (n) Statement of acceptance/non acceptance; (o) Details of weld repair including sketch(where applicable). ⚓	- To reflect IACS Rec 68(Rev.1 Apr 2021)

GUIDANCE RELATING TO THE RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Guidance Part 2 Materials and Welding)

- For external opinion inquiry -

2022. 1.

Machinery Rule Development Team

- Main Amendments -

(1) Enter into force on 1 July 2022 (the date of application for certification of material & welding or the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules

Present	Amendment	reason
CHAPTER 1 <Omitted> **CHAPTER 2 WELDING** **Section 1 ~ Section 3 <Omitted>** **Section 4 Welding Procedure Qualification Tests** **403. Welding procedure qualification tests(WPQT)** **1. Welding procedure qualification tests for duplex stainless steels** In application to **403. 5** of the Rules, the welding procedure qualification tests for duplex stainless steels are to comply with the followings: **【See Rule】** (1) ~ (3) <Omitted> (4) **Micro structure test** (a) <Omitted> (b) The micro structure shall be suitably etched and examined at 400 X magnification in total 6 points, each 2 points for weld metal root, last bead of the weld cap and HAZ. The micro structure shall have grain boundary with no continuous precipitations and the inter-metallic phases, nitrides and carbides shall not in total exceed 0.5%. *(2017)* <hereafter, omitted>	**CHAPTER 1 <Same as the present Guidance>** **CHAPTER 2 WELDING** **Section 1 ~ Section 3 <Same as the present Guidance>** **Section 4 Welding Procedure Qualification Tests** **403. Welding procedure qualification tests(WPQT)** **1. Welding procedure qualification tests for duplex stainless steels** In application to **403. 5** of the Rules, the welding procedure qualification tests for duplex stainless steels are to comply with the followings: **【See Rule】** (1) ~ (3) <Same as the present Guidance> (4) **Micro structure test** (a) <Same as the present Guidance> (b) The micro structure shall be suitably etched and examined at 400~500 X magnification in total 6 points, each 2 points for weld metal root, last bead of the weld cap and HAZ. The micro structure shall have grain boundary with no continuous precipitations and the inter-metallic phases, nitrides and carbides shall not in total exceed 0.5%. *(2017)* *(2022)* <hereafter, same as the present Guidance>	* Request for Establishment/Revision of Classification Technical Rules - Increase the magnification range in consideration of the testing facility of the testing institute - Refer to ASTM A923