



CHINA CLASSIFICATION SOCIETY

RULES FOR MATERIALS AND WELDING

Amendments

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CONTENTS

PART ONE METALLIC MATERIALS.....	2
CHAPTER 1 GENERAL.....	2
Section 2 TESTING AND SURVEY.....	2
CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS.....	2
Section 7 STEELS FOR LOW TEMPERATURE SERVICE.....	2
CHAPTER 4 STEEL PIPES AND TUBES.....	4
Section 1 GENERAL PROVISIONS.....	4
CHAPTER 5 STEEL FORGINGS.....	4
Section 1 GENERAL PROVISIONS.....	4
Section 2 FORGINGS FOR HULL STRUCTURES.....	5
Section 9 AUSTENITIC AND DUPLEX STAINLESS STEEL FORGINGS.....	5
CHAPTER 6 STEEL CASTINGS.....	5
Section 8 AUSTENITIC AND DUPLEX STAINLESS STEEL CASTINGS.....	5
CHAPTER 8 ALUMINIUM ALLOYS.....	5
Section 2 ALUMINIUM ALLOY PLATES AND SECTIONS.....	5
Section 3 ALUMINIUM ALLOY RIVETS.....	5
CHAPTER 9 OTHER NON-FERROUS MATERIALS.....	6
Section 2 CAST COPPER ALLOYS.....	6
CHAPTER 10 EQUIPMENT.....	6
Section 4 STEEL WIRE ROPES.....	6
PART TWO NON-METALLIC MATERIALS.....	6
CHAPTER 7 FIBER ROPES.....	6
Section 1 MARINE FIBER ROPES.....	6
PART THREE WELDING.....	9
CHAPTER 1 GENERAL.....	9
Section 2 TESTING.....	9
CHAPTER 2 WELDING CONSUMABLES.....	10
Section 1 GENERAL PROVISIONS.....	10
Section 2 MECHANICAL PROPERTIES OF WELDING CONSUMABLES.....	10
Section 8 WELDING CONSUMABLES FOR STAINLESS STEEL.....	11
CHAPTER 3 APPROVAL OF WELDING PROCEDURES.....	11
Section 1 GENERAL PROVISIONS.....	11
Section 4 FULL-PENETRATION WELDING PROCEDURE APPROVAL TESTS FOR INCLINED OR T-SHAPED TUBULAR JOINTS.....	11
CHAPTER 4 QUALIFICATION TESTS OF WELDERS.....	12
Section 1 GENERAL PROVISIONS.....	12
Section 2 QUALIFICATION TESTS AND EVALUATION OF WELDERS.....	13
CHAPTER 5 WELDING OF HULL STRUCTURES.....	15
Section 1 GENERAL PROVISIONS.....	15
Section 3 INSPECTION AND REPAIRING OF WELDS.....	16
Section 5 WELDING OF NICKEL ALLOY STEELS.....	17
CHAPTER 8 WELDING OF IMPORTANT MACHINERY COMPONENTS.....	17
Section 4 NON-DESTRUCTIVE INSPECTION AND WELD REPAIRS OF PROPELLERS.....	17
CHAPTER 9 WELDING OF PRESSURE PIPES.....	17
Section 1 GENERAL PROVISIONS.....	17
CHAPTER 11 WELDING AND RIVETING OF NON-FERROUS MATERIALS.....	17
Section 3 WELDING OF TITANIUM AND TITANIUM ALLOYS.....	17
APPENDIX 1 NON-DESTRUCTIVE TESTING OF SHIP HULL STEEL WELDS.....	18

PART ONE METALLIC MATERIALS

CHAPTER 1 GENERAL

Section 2 TESTING AND SURVEY

1.2.5.1 Non-destructive testing personnel are to pass the tests specified in CCS Guidelines for Level Assessment and [Approval Certification](#) of Non-destructive Testing Personnel, and hold a valid “Qualification Certificate of Non-destructive Testing Operator” issued or accepted by CCS.

CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS

Section 7 STEELS FOR LOW TEMPERATURE SERVICE

3.7.1.1 This Section applies to carbon-manganese and nickel alloy steels not over [4050](#) mm in thickness, intended for use in the construction of cargo tanks [and fuel tanks for liquefied gases](#) and the hull structures adjacent to these tanks. Such steels are to comply with the relevant requirements of CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk [and Rules for Application of Natural Gas Fuels on Ships](#) in addition to the requirement of this Section.

3.7.1.2 Carbon-manganese and nickel alloy steels over [4050](#) mm in thickness are to ~~comply with the relevant recognized standards subject to agreement of CCS~~ [be subject to special consideration by CCS.](#)

3.7.3 Heat treatment and mechanical properties

3.7.3.1 The conditions of supply and mechanical properties of carbon and carbon-manganese steels are to comply with the requirements given in Table 3.7.3.1.

3.7.3.2 The conditions of supply and mechanical properties of nickel alloy steel are to comply with the requirements given in Table 3.7.3.2.

Conditions of supply and mechanical properties of carbon-manganese steel^① Table 3.7.3.1

Grade	Condition of supply ^②	Yield strength R_{eH} min. (N/mm ²)	Tensile strength R_m (N/mm ²)	Elongation A_5 min. (%)	Charpy V-notch impact tests			Design Temp. min. (°C)	
					Material thickness t (mm)	Test Temp. T (°C) ^③	Average energy of test specimens, min. (J)		
							Long.		Trans.
CL-I-2	Normalized or quenched and tempered	315	440-570	22	$t \leq 25$	-20	41	27	-15
					$25 < t \leq 30$	-25			
					$30 < t \leq 35$	-30			
					$35 < t \leq 40$	-35			
					$40 < t \leq 45$	-40			
$45 < t \leq 50$	-45								
CL-II-2	Normalized or quenched and tempered	315	440-570	22	$t \leq 25$	-40	41	27	-35
					$25 < t \leq 30$	-45			
					$30 < t \leq 35$	-50			
					$35 < t \leq 40$	-55			
					$40 < t \leq 45$	-60			
$45 < t \leq 50$	-65								
CL-III-2	Normalized or quenched and tempered	315	440-570	22	$t \leq 25$	-60	41	27	-55
					$25 < t \leq 30$	-65			
					$30 < t \leq 35$	-70			
					$35 < t \leq 40$	-75			
					$40 < t \leq 45$	-80			
$45 < t \leq 50$	-85								
CL-I-3	Normalized or quenched and tempered	355	490-630	21	$t \leq 25$	-20	41	27	-15
					$25 < t \leq 30$	-25			
					$30 < t \leq 35$	-30			
					$35 < t \leq 40$	-35			
					$40 < t \leq 45$	-40			
$45 < t \leq 50$	-45								

Grade	Condition of supply ^②	Yield strength R_{eH} min. (N/mm ²)	Tensile strength R_m (N/mm ²)	Elongation A_5 min. (%)	Charpy V-notch impact tests				Design Temp. min. (°C)
					Material thickness t (mm)	Test Temp. T (°C) ^④	Average energy of test specimens, min. (J)		
							Long.	Trans.	
CL-II-3		355	490-630	21	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-40 -45 -50 -55 <u>-60</u> <u>-65</u>	41	27	-35
CL-III-3		355	490-630	21	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-60 -65 -70 -75 <u>-80</u> <u>-85</u>	41	27	-55
CL-I-4		390	510-660	20	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-20 -25 -30 -35 <u>-40</u> <u>-45</u>	41	27	-15
CL-II-4		390	510-660	20	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-40 -45 -50 -55 <u>-60</u> <u>-65</u>	41	27	-35
CL-III-4		390	510-660	20	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-60 -65 -70 -75 <u>-80</u> <u>-85</u>	41	27	-55

- ① The requirement is applicable to materials not over 4050 mm in thickness. For materials over 4050 mm in thickness, the energy value of Charpy V-notch impact test is subject to agreement of CCS-;
- ② Controlled rolling process or TMCP may replace normalized or quenched and tempered-;
- ③ In the table, the transverse values of impact tests apply to plates and the longitudinal values to sections.
- ④ With regard to materials for type C independent cargo tanks/fuel tanks which are completely thermally stress relieved after welding, Charpy V-notch impact test temperature may be 5°C below design temperature or -20°C, whichever is lower. Exemption to post-weld stress relief heat treatment based on alternative approach (e.g. Engineering Critical Assessment) shall be approved by CCS or shall be to recognized standards.

Conditions of supply and mechanical properties of nickel alloy steel

Table 3.7.3.2

Grade	Condition of supply	Proof strength $R_{p0.2}$ min. (N/mm ²)	Tensile strength R_m (N/mm ²)	Elongation A_5 min. (%)	Charpy V-notch impact tests				Design Temp. min. (°C)
					Material thickness t (mm)	Test Temp. T (°C)	Average energy of test specimens, min. (J)		
							Long.	Trans.	
1.5Ni	Normalized or normalized and tempered or quenched and tempered or TMCP ^①	275	470~640	22	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-65 -70 -75 -80 <u>-85</u> <u>-90</u>	41	27	-60
2.25Ni	Normalized or normalized and tempered or quenched and tempered or TMCP ^①	295	420~570	19	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ <u>40 < $t \leq 45$</u> <u>45 < $t \leq 50$</u>	-70 -75 -80 -85 <u>-90</u> <u>-95</u>			

Grade	Condition of supply	Proof strength $R_{p0.2}$ min. (N/mm ²)	Tensile strength R_m (N/mm ²)	Elongation A_5 min. (%)	Charpy V-notch impact tests			Design Temp. min. (°C)	
					Material thickness t (mm)	Test Temp. T (°C)	Average energy of test specimens, min. (J)		
							Long.		Trans.
3.5 Ni	Normalized or normalized and tempered or quenched and tempered	345	440~690	21	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ 40 < $t \leq 45$ 45 < $t \leq 50$	-95 -100 -105 -110 -115 -120			-90
5Ni	Normalized or normalized and tempered or quenched and tempered ^①	390	520~710	21	$t \leq 25$ 25 < $t \leq 30$ 30 < $t \leq 35$ 35 < $t \leq 40$ 40 < $t \leq 45$ 45 < $t \leq 50$	-110 -115 -120 -125 -130 -135			-105
9Ni	Double normalized and tempered or quenched and tempered	490	640~830	19	$t \leq$ 4050	-196			-165

① Nickel steel supplied in TMCP is subject to agreement of CCS;
② Nickel steel with 5% Ni content after being subject to special heat treatment, such as three stage heat treatment (double quenched and tempered), may be used in locations where the minimum temperature is -165°C. However, impact tests are to be carried out at temperature below -196°C;
③ The requirement is applicable to materials not over [4050](#) mm in thickness. For materials over [4050](#) mm in thickness, the energy value of Charpy V-notch impact test is subject to agreement of CCS;
④ The transverse values of impact tests apply to plates and the longitudinal values to sections.

3.7.3.3 Preparation of the specimens for mechanical tests

- (1) For plates: one tensile test specimen and a set of three impact test specimens are to be taken from one end of each rolled piece.
- (2) For sections and other steels: one tensile test specimen and a set of three impact test specimens are to be taken from one piece in each batch with similar dimensions, originating from the same heat treatment charge and the same heat of steel by the same rolling procedure. The mass of each batch is not to exceed 10t.
- (3) The direction of cut, shape and dimensions of the tensile and impact test specimens are to comply with the relevant requirements of Chapter 2 of this PART and Section 1 of this Chapter. For plates intended for the applications as detailed in 3.7.1.1 above, transverse specimens are to be taken for impact tests. The locations where the specimens are taken and the test values are to be in accordance with the relevant requirements of 6.3.1, 6.3.2 and 6.4.1, Chapter 6 of CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. [A further set of impact test at mid thickness for products with \$t > 40\$ mm is required except steels specified in Sections 3 and 4 of this Chapter.](#)

CHAPTER 4 STEEL PIPES AND TUBES

Section 1 GENERAL PROVISIONS

4.1.8 Hydraulic test

4.1.8.1 Each pipe or tube is to be subjected to a hydraulic test at the manufacturer's works. Subject to agreement of CCS, either an ultrasonic, ~~or~~ eddy current test [or magnetic flux leakage test](#) can be accepted in lieu of the hydraulic test, and technical documents which can demonstrate the efficiency of the method [or relevant recognized standards](#) are to be submitted by the manufacturer.

CHAPTER 5 STEEL FORGINGS

Section 1 GENERAL PROVISIONS

5.1.6.4 Non-destructive testing is to be carried out after the forgings have been machined to a condition suitable for this type of examination and after the final heat treatment, and the following requirements are to be complied with:

- (1) the test methods and extent are to comply with the requirements of Appendix 7A, Chapter 7 of CCS Guidelines for Inspection of Hull Welds;
- (2) where current flow methods are used for magnetization, particular care is to be taken to avoid damaging machined surfaces by contact burns from the prods;
- (3) radial and axial scanning is generally to be carried out when carrying out ultrasonic examination. When the dimensions and shape are limited, radial or axial scanning may be carried out;
- (4) unless specified by the plan or otherwise agreed, the results of non-destructive testing are to comply with the requirements of Appendix 7A, Chapter 7 of CCS Guidelines for Inspection of Hull Welds [or relevant recognized standards](#).

5.1.7.2 Repair welding of forgings except [the transmission shaft and crankshaft forgings subject to torsional fatigue crankshaft forgings](#) may be permitted subject to prior approval of CCS. In such cases, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted to CCS for approval.

Section 2 FORGINGS FOR HULL STRUCTURES

5.2.4.3 For ships navigating in ice with an Ice Class Notation B1* or B1, the forgings for the rudder stock, axle or pintle are, in addition to the tests required by 5.2.4.1 of this Section, to be subjected to Charpy V-notch impact tests at -10°C. A set of three impact test specimens is to be provided, and the average [longitudinal](#) impact energy is not to be lower than 27 J.

Section 9 AUSTENITIC AND DUPLEX STAINLESS STEEL FORGINGS

5.9.4.1 Stainless steel forgings are to be sampled according to the following requirements:

- (1) Sampling of shaft forgings is to meet the requirements of ~~5.3.4.1 and 5.3.4.2~~ of Section 3 of this Chapter;

CHAPTER 6 STEEL CASTINGS

Section 8 AUSTENITIC [AND DUPLEX](#) STAINLESS STEEL CASTINGS

6.8.1 Application

[6.8.1.2 The chemical composition, mechanical properties, pitting corrosion properties and heat treatment procedures of duplex stainless steel castings may be accepted according to relevant recognized standards.](#)

CHAPTER 8 ALUMINIUM ALLOYS

Section 2 ALUMINIUM ALLOY PLATES AND SECTIONS

8.2.4.1 Aluminum alloy plates, bars, sections and pipes may be formed by rolling, [drawing](#) or extrusion.

Section 3 ALUMINIUM ALLOY RIVETS

8.3.3.1 Bars used for the manufacture of rivets or finished rivets are to be supplied for inspection in one of the

following conditions:

- (1) annealed;
- (2) solution heat treated and naturally aging treated.

CHAPTER 9 OTHER NON-FERROUS MATERIALS

Section 2 CAST COPPER ALLOYS

9.2.4.2 The chemical analysis by the ingot maker is to comply with the requirements of relevant recognized standards 9.1.3.1 of this Chapter.

CHAPTER 10 EQUIPMENT

Section 4 STEEL WIRE ROPES

10.4.4.5 Wrapping test: The adhesion of the coating is to be tested by wrapping the wire round a cylindrical mandrel for 10 complete turns. After wrapping on the appropriate mandrel, the zinc coating is to have neither flaked nor cracked. At least 56 wires of each size are to be tested. The ratio between the diameter of the mandrel and that of the wire is to comply with the requirements given in Table 10.4.4.5.

Coating	Diameter of coated wire (mm)	Ratio of mandrel to wire diameter
Grade 1 or 2	< 1.5	1 : 4
	≥ 1.5	1 : 6
Grade 3	< 1.5	1 : 2
	≥ 1.5	1 : 3

PART TWO NON-METALLIC MATERIALS

CHAPTER 7 FIBER ROPES

Section 1 MARINE FIBER ROPES

7.1.1 General requirements

7.1.1.1 The requirements of this Section apply to fiber ropes used as towlines and mooring lines made from natural or synthetic fibers.

7.1.1.2 The materials, constructions, linear density and rated minimum breaking load strength of marine fiber ropes are to comply with the relevant recognized standards.

7.1.1.3 Definitions and terms

(1) Linear density means the mass per length of a fiber rope under preload.

(2) Preload means the load applied to determine nominal diameter and linear density of a fiber rope ~~in accordance with recognized standards, to be obtained from the following formula:~~

$$F = \frac{n^2}{8} \times 0.01 \quad kN$$

Where: F—preload, in kN;

n—nominal diameter, in mm.

(3) Rated Minimum breaking load means the acceptable load index nominal value which is to be reached ~~or~~

~~exceeded~~ in breaking test as provided by recognized standards for fiber ropes ~~and is also used to check the nominal diameter of a fiber rope.~~

(4) Actual breaking load means the measured value of breaking load of a fiber rope in tensile breaking test under specified test conditions ~~breaking test.~~

(5) Nominal diameter means the nominal value of a given fibre rope diameter in recognized standards.

7.1.2 Materials

7.1.2.1 Fiber ropes may be made of natural fibers (coir, hemp, manila or sisal) or may be composed of synthetic fibers (polyamide, polyester, polypropylene-polyolefin, ultra-high molecular weight polythene or the mixture of above materials). If it is intended to use other materials, sufficient data are to be available to show compliance of their properties with service requirements.

7.1.2.2 The material used for the manufacture of fiber ropes is to be of good and consistent quality and resistant to corrosion and aging.

7.1.2.3 The fiber used for the manufacture of fiber ropes is to be subjected at least to the testing of:

- (1) breaking load;
- (2) elongation to break;
- (3) linear density .

7.1.3 Manufacture

7.1.3.1 Fiber ropes are to be manufactured at works approved by CCS.

7.1.3.2 Any lubricant in the natural fiber ropes is to be kept to a minimum, and any rot-proofing or water repellency treatment is not to be deleterious to the fiber.

7.1.3.3 Fiber ropes may be of a three-strand, four-strand, six-strand, eight-strand, ~~or~~ twelve-strand or double-braid construction appropriate to their respective materials and types, other construction forms will be specially considered.

7.1.4 Tests

7.1.4.1 Completed fiber ropes are usually to be subjected to tensile breaking tests and line density measurements.

7.1.4.2 Samples are to be selected from a batch of fiber ropes manufactured from the same batch of raw material, with the same structure, the same size and the same technology. Unless otherwise agreed, samples are to be selected randomly from such fiber ropes for test. The number S of samples is to be obtained from the following formula:

$$S = 0.4 \times \sqrt{N}$$

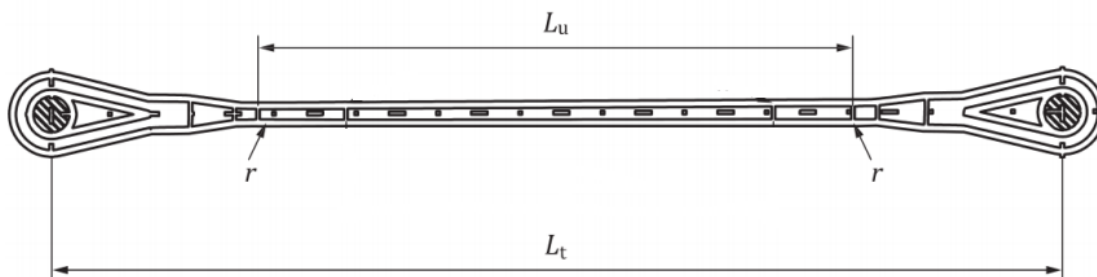
where: S – number of samples;

N – ~~number of fiber rope coils in one batch.~~ the batch size, expressed as the number of continuous coils of 220m (less than 220m is regarded as one coil).

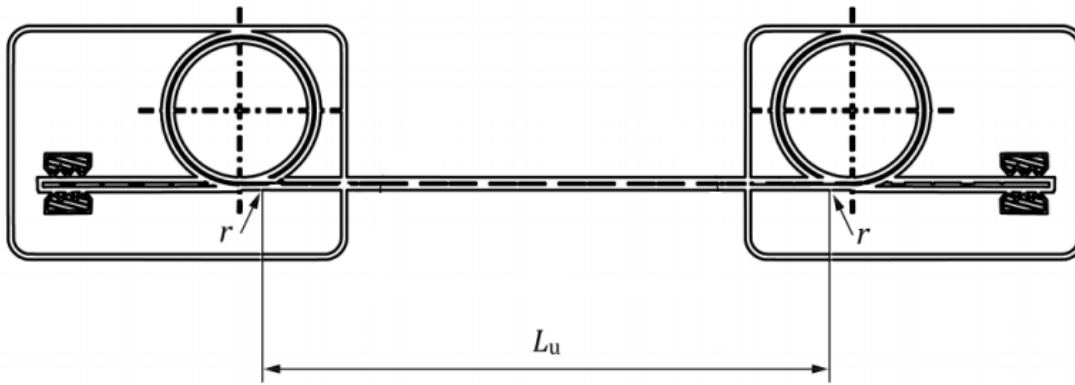
If the calculated S value is not an integer, it is to be rounded to the closest integer. When S is less than 1, one sample only is to be taken.

7.1.4.3 The breaking test is to be carried out according to the following requirements:

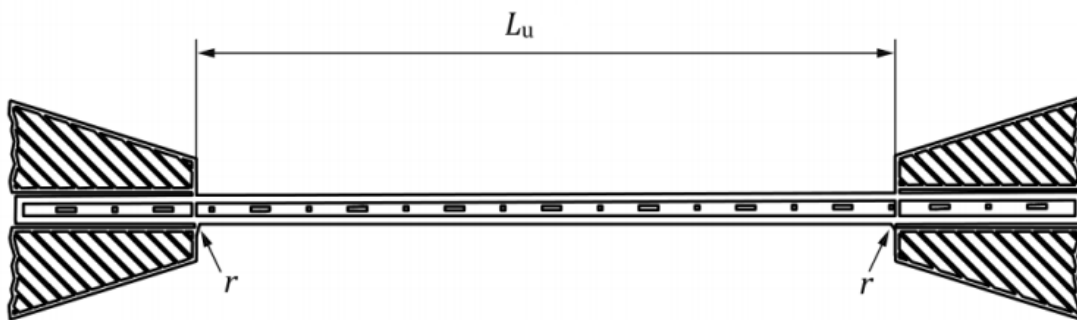
(1) ~~The sampling length and preload of breaking test specimens are to comply with the requirements of Table 7.1.4.3(1).~~ The test piece of breaking test is to be of adequate length to give a minimum free length, L_u , between terminations which is at least equal to 5 pitches or lays or 400 mm, whichever is greater. The distance from each mark "r" to the end of the splice (or to the tangent point in the case of a bollard) is to be a minimum of twice the diameter and a maximum of three times the diameter of the rope. See Figure 7.1.4.3(1).



(a) Diagram of a fiber rope with nominal diameter not less than 20mm tested using eye splices



(b) Diagram of a fiber rope with nominal diameter less than 20mm tested using bollard grips



(c) Diagram of a fiber rope with nominal diameter less than 20mm tested using wedge grips
Figure 7.1.4.3(1) Diagram of a fiber rope mounted between grips

Specifications for Breaking Test

Table 7.1.4.3(1)

Material	Test length min. (mm)	Load ratio* (%)	Test speed (mm/min)
Natural fiber	1800	2	150 ±50
Synthetic fiber	900	1	75 ±25

Note: Load ratio is the ratio of preload to rated breaking load.

(2) After application of preload, the diameter and even lay-up of the sample are to be checked. The sample is then to be uniformly strained at the test speed given in Table 7.1.4.3(1) until it breaks. The sample is then subject to load at the test speed given in Table 7.1.4.3(2) from preload to 50% of the minimum breaking force for 3 or 10 consecutive cycles (the number of cycles are to be recorded in the test report), followed by load at the same speed until it breaks.

Loading speed of breaking test

Figure 7.1.4.3(2)

Type of grips	Test speed (mm/min)
Eye splices	$(2-12\%) \times L_t^{(1)}$
Bollard grips, wedge grips	250 ±50

Figure ①: L_t is given in Figure 7.1.4.3(1)(a).

(3) Test results are to comply with the following requirements:

- ① The actual breaking load of the test sample is not to be less than the rated breaking load given in relevant recognized standards;
- ②① During testing, if the sample is held by grips and the break occurs within the “r” marks and the breaking load is not less than the minimum breaking load specified in the recognized standard, the test may be accepted; 150 mm of the grips, the test may be repeated;
- ③② If the break occurs outside the “r” marks at the gripped or twisted portion while the breaking load has attained to or is higher than more than 90% of the rated minimum breaking load, the test may be accepted. However, it should not be assumed that the true breaking load of the specimen would be represented by multiplying the result by 10/9.

7.1.4.4 Linear density measurements are to comply with the following requirements:

(1) The linear density is to be calculated by dividing the gross mass of the sample by its length under pretension

~~after adjusting its temperature and moisture using the following formula:~~ tested as follows: after adjusting the temperature and moisture of the sample according to recognized standards, apply preload (the error is to be controlled within $\pm 5\%$) on the rope and maintain for 1 min. Place two marks on the rope 2 m apart, then remove the load and detach the sample from the parent length by cutting cleanly at the two marks. Weigh the mass of the sample and calculate linear density using the following formula:

$$\rho_x = m_0/L \quad \text{ktex}$$

where: ρ_x – linear density, in ktex;

m_0 – mass of sample detached, in g;

L – length of sample under preload, in m; $L = D_p \times L_0/D_0$.

where: L_0 – initial length of straightened sample prior to being installed on testing machine, in m;

————— D_0 – initial distance between two gauge lengths when the sample is flattened, in m (at least 0.5 m);

————— D_p – distance between two gauge lengths measured under preload, in m.

(2) The measured value of linear density is to be recorded.

7.1.5 Marking and certificate

7.1.5.1 Each coil of rope which has been accepted is to be marked at a clearly visible position with an attached label detailing the rope name, model, no., material, construction, diameter and length, and the maker's name, and additionally identified with CCS stamp.

7.1.5.2 The maker is to provide qualified fiber ropes with a qualification certificate detailing at least:

- (1) product name, type and no.;
- (2) material of fiber ropes;
- (3) linear density of fiber ropes;
- (4) length and diameter of a whole fiber rope coil;
- (5) construction of fiber ropes;
- (6) ~~rated~~ minimum breaking load of fiber ropes (actual breaking load to be added when necessary).

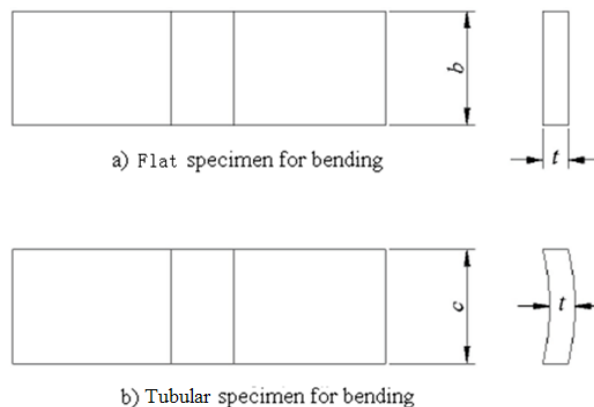
PART THREE WELDING

CHAPTER 1 GENERAL

Section 2 TESTING

1.2.3 Shapes and dimensions of specimens

1.2.3.3 Butt weld face and root bend test specimens are to be machined to the dimensions as shown in Figure 1.2.3.3. The upper and lower surfaces of the weld are to be filed, ground or machined flush with the surface of the plate. The edges on the tension side may be rounded to a radius of 1 mm to 2 mm. For tubular specimens, the compression side may be machined to a plane.

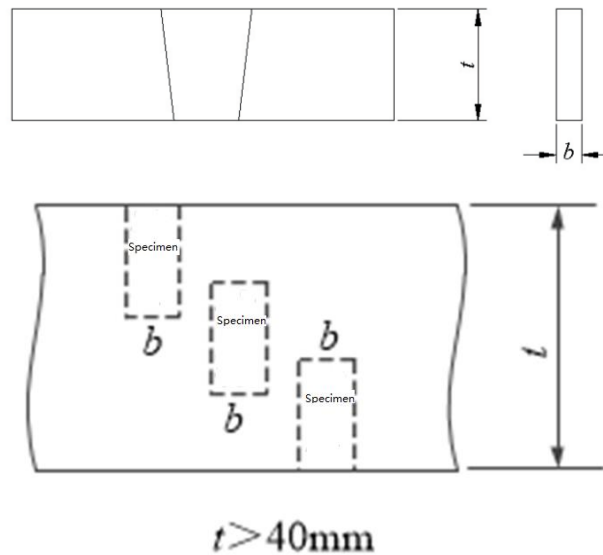


t – Thickness of specimen, to be taken as the thickness of parent plate. Where the thickness exceeds 25 mm, the specimens may be

machined on the compression side to reduce the thickness to 25 mm. For aluminum alloys, thickness reduction is not to be applied; b – Breadth of flat specimen, to be taken as 30 mm; c – Breadth of tubular specimen, taken as $t + 0.1d$, but neither less than 10 mm, nor more than 30 mm, where d is the outside diameter of tubular specimen, in mm. When the diameter of a tubular specimen is less than or equal to 25mm, the specimen may be taken in four equal parts along the circumferential direction.

Figure 1.2.3.3

1.2.3.4 Butt weld side bend test specimens are to be machined to the dimensions as shown in Figure 1.2.3.4. The upper and lower surfaces of the weld are to be machined flush with the surface of the plate. The edges on the tension side may be rounded to a radius of 1 to 2 mm.



t – Thickness of the test plate, in mm. When t is greater than 40 mm, the specimen may be divided into several portions with t equal to 20 mm ~ 40 mm; b – Thickness of specimen, to be taken as 10 mm.

Figure 1.2.3.4

1.2.3.7 Macro specimens are to be taken by fracturing the test plate at the weld joint in a direction perpendicular to the weld, having a length including at least 10 mm unaffected base metal. The complete cross section of the fractured surface in way is to be ground, polished and ~~acid~~-etched for examination.

CHAPTER 2 WELDING CONSUMABLES

Section 1 GENERAL PROVISIONS

2.1.4 Maintenance of approval

2.1.4.3 In the following cases, CCS will inform the manufacturer that the approval of the welding consumables is revoked:

- (1) where the consumables fail to meet the requirements at the annual inspection and testing; or
- (2) where the manufacturer fails to receive annual inspection and testing without acceptable reasons; or
- (3) where the results of any random check indicate that the quality of the welding consumables is remarkably worse than that at the approval test.

Section 2 MECHANICAL PROPERTIES OF WELDING CONSUMABLES

2.2.2 Consumables for welding structural steels

~~2.2.2.4 Welding consumables with grade Y89 are considered suitable for welding steels in the same strength level only. Welding consumables with grade Y96 are also considered suitable for welding steels in the one~~

strength level below that for which they have been approved. For grade Y89 and Y96 in Table 2.2.2.3 of this PART, where the design requirements permit undermatching weld joint, then welding consumables within the scope of this chapter can be considered subject to Manufacturer's recommendations and be agreed with CCS.

2.2.2.54 Where the bend test results of welding consumables with the yield stress of 420 N/mm² or above do not comply with Table 2.2.2.3, except that the elongation within the gauge length L_0 of bend specimens complies with that required for the deposited metal test, the test may be considered satisfactory. The gauge length L_0 of the bend specimen is shown in Figure 2.2.2.54.

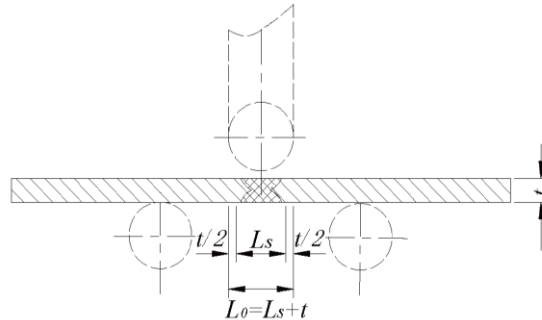


Figure 2.2.2.54

Section 8 WELDING CONSUMABLES FOR STAINLESS STEEL

2.8.5 Annual inspections

2.8.5.2 All test results are to comply with the relevant requirements of 2.8.3 and 2.8.4.

CHAPTER 3 APPROVAL OF WELDING PROCEDURES

Section 1 GENERAL PROVISIONS

3.1.4 Application of approved welding procedures

3.1.4.4 The application of a welding procedure specification to aluminum alloys is to comply with the following requirements:

(1) Welding procedures to be approved for aluminum alloys may be grouped as follows according to the chemical composition of their parent metal:

Group **A I**: aluminum-magnesium alloys with Mg content < 4% (alloys 5754, 5454)

Group **B II**: aluminum-magnesium alloys with 4% ≤ Mg ≤ 7% (alloys 5086, 5083, 5383, 5456, 5A01, 5059)

Group **C III**: aluminum-magnesium-silicon alloys (alloys 6005A, 6061 and 6082).

(2) The welding procedure qualified for one alloy is applicable to the other alloys with an equal or lower strength level in the same Group. The welding procedures qualified for Group **B II** alloys are applicable to Group **A I** alloys.

Section 4 FULL-PENETRATION WELDING PROCEDURE APPROVAL TESTS FOR INCLINED OR T-SHAPED TUBULAR JOINTS

3.4.1 General requirements

3.4.1.1 The full-penetration welding procedure approval tests for inclined or T-shaped tubular joints ~~of steel offshore structures~~ are to be carried out for different welding processes and positions respectively.

3.4.2 Test assemblies

3.4.2.1 Unless otherwise specified, test assemblies for inclined or T-shaped tubular joints are to be prepared

as shown in Figure 3.4.2.1.

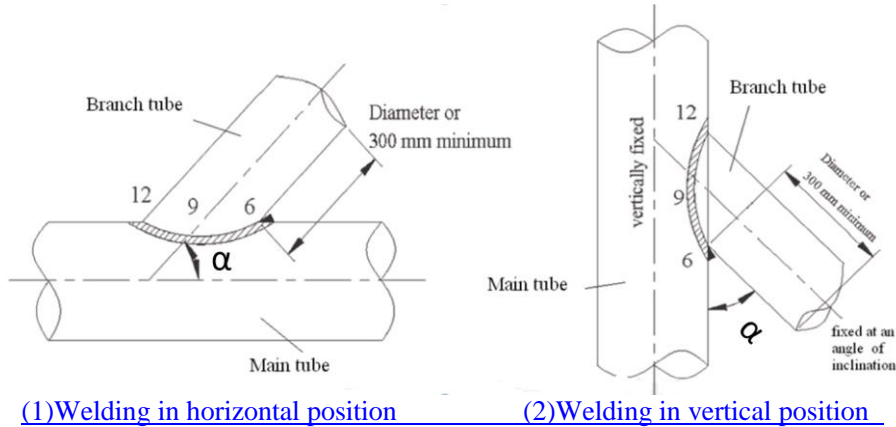


Figure 3.4.2.1

3.4.2.2 ~~The parameters concerning diameter, wall thickness, inclined angle, etc. of main and branch tubes are to be determined according to their structures as appropriate. The inclined angle is usually 30° to 45°, or the minimum possible inclined angle in the actual structures.~~ The minimum length of the branch tube is to be taken as its diameter, but does not need to be more than 300 mm. Shape of grooves, edge preparation, assembly and welding procedures are to be as required by the actual structures.

3.4.2.4 The welding of tubular joints may be divided into two kinds: welding in horizontal position shop (rotating) and in vertical position on-site (fixed), with a test assembly being prepared for each kind. The length of the test weld is to be the full weld length of the joint and where this length is 800 mm or greater, half of it may be taken as the test weld.

3.4.3 Test items

3.4.3.2 Impact tests: 43 sets (3 specimens for each set) (when the wall thickness of the main tube allows). The specimens are to be taken from the positions near “9 o’clock” point as shown in Figure 3.4.2.1. The notches are to be positioned in the center of the weld, on fusion line and 2 mm and 5 mm from fusion line within the HAZ respectively. For offshore installations, a HAZ at 5mm away from the fusion line is added. V-notches are to be perpendicular to the wall of the branch tube.

3.4.5 Application of approved welding procedures

3.4.5.1 In addition to the application scope specified in Section 1 of this Chapter, the inclined angle α of the inclined or T-shaped tubular joints is applicable to the test angle up to 90°.

CHAPTER 4 QUALIFICATION TESTS OF WELDERS

Section 1 GENERAL PROVISIONS

4.1.1 Application

4.1.1.1 The requirements of this Chapter apply to the qualification tests of welders intended to be engaged in the fusion welding (including shielded metal arc welding, semi-automatic welding and TIG welding) of ship and offshore structures, machinery, boilers and pressure vessels as well as piping with carbon steels, carbon-manganese steels, alloy steels or aluminum alloys as the base metal. ^{Notes}

- Notes: ① ~~The requirements of this Chapter apply to applications for welder or welding operator qualification (initial or renewal) dated on or after 1 January 2018.~~
- ② ~~The requirements of this Chapter do not invalidate welder’s qualifications issued and accepted by CCS before 1 January 2018. These qualifications are to be renewed in accordance with the requirements of this Chapter latest by 31 December 2020.~~
- ③ ~~Certificates that expire on or after 1 January 2022 are to be renewed in accordance with the requirements of this Chapter.~~
- ④ ~~The welder’s or welding operator’s qualifications which have not been required before 1 January 2018, are to be initially issued in accordance with the requirements of this Chapter by the 31 December 2020 at the latest.~~

4.1.7.4 Except that the Qualification Certificate of Welder for tack welding is valid for an unlimited period, to extend the validity of certificates of welders, revalidation is to be carried out by CCS for the Qualification Certificate of all welders provided that the requirements of 4.1.7.2 are complied with. The skill of the welder is to be periodically verified by one of the following:

(1) The welder is to be re-tested every 3 years.

(2) 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 are to be recorded. The welds tested are to reproduce the initial test conditions except for the thickness. These tests revalidate the welder's qualifications for an additional 2 years.

(3) A welder's qualification for any certificate is to be valid ~~as long as it is signed according to 4.1.7.2~~ subject that all the following conditions are fulfilled. In this option, the fulfillment of all the conditions is to be verified by CCS. The frequency of verification by CCS is to be no longer than 3 years and is to be agreed between CCS and the shipyards/manufacturers ~~(This paragraph and its subparagraphs will take effect from 1 January 2022)~~.

① The welder is working for the same shipyard/manufacturer which is responsible for production weld quality as indicated on his or her qualification certificate.

② CCS is to verify that the welder quality management system of the shipyard/manufacturer includes as minimum:

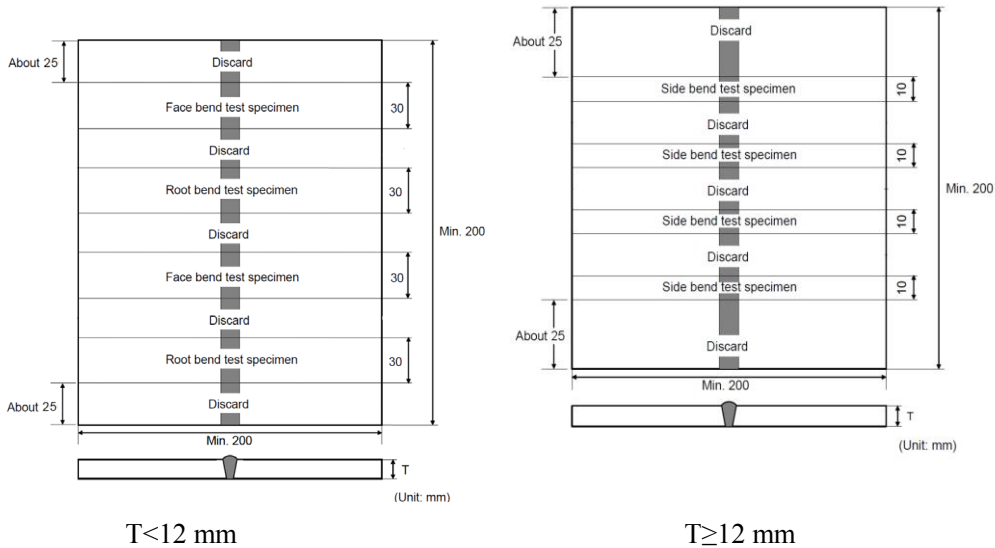
- A designated person responsible for the coordination of the welder quality management system;
- List of welders and welding supervisors in shipyard/manufacturer;
- If applicable, list of subcontracted welders;
- Qualification certificate of welders and description of the associated management system;
- Training requirements for welder qualification programme;
- Identification system for welders and WPS used on welds;
- ~~Procedure describing the system in place to monitor each welder performance (Results of welds examination records).~~ 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 minimum standards permitting the maintenance of the welder qualification without retesting as described in above (1) and (2).

③ ~~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 CCS' requirements, which should be in agreement between CCS and the shipyards/manufacturers.~~ The shipyards/manufacturers have to document at least once a year that the welder has produced acceptable welds by evaluating welder's work quality (welding quality, repair rate, etc.) in accordance with construction quality standards and CCS rules' requirements .

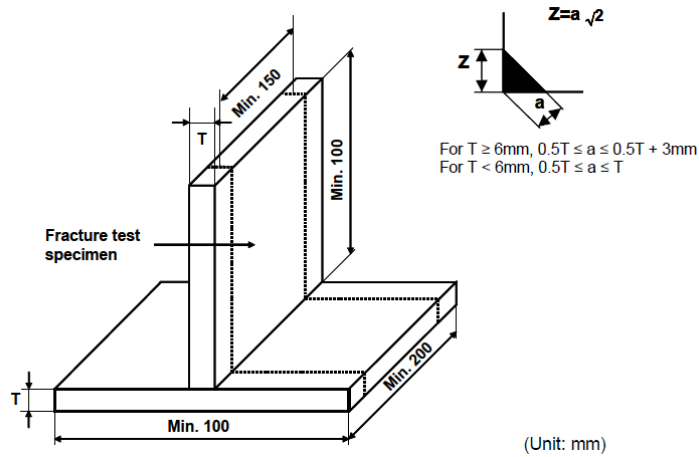
Section 2 QUALIFICATION TESTS AND EVALUATION OF WELDERS

4.2.2 Type and dimensions of test assemblies

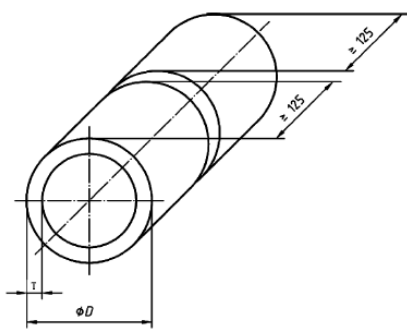
4.2.2.1 Dimensions for butt and fillet welds in plates, butt welds in pipes and pipe-to-plate fillet welds are shown in Figures 4.2.2.1(a), (b), (c) and (d) respectively.



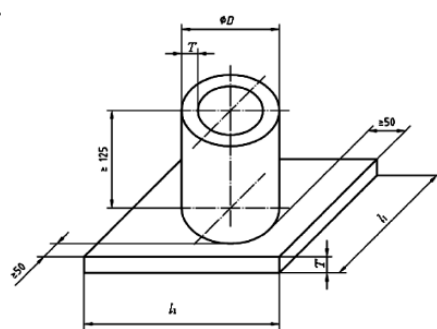
(a) Butt welds



(b) Fillet welds



(c) Butt welds in pipes



(d) Pipe-to-plate fillet welds (insertion)

(in mm)

Figure 4.2.2.1 Dimensions of Test Assemblies

4.2.4 Test or inspection

4.2.4.7 When macro examination is used for fillet welds, two test specimens are to be prepared from different cutting positions; at least one macro examination specimen is to be cut at the position of one stop and restart in either root run or cap run. Prepare the specimens according to 1.2.3.7, Chapter 1 of this PART. These specimens are to be etched on one side to clearly reveal the weld metal, fusion line, root penetration and the heat affected zone. Macro sections are to include at least 10mm of unaffected base metal. The examination is to reveal a

regular weld profile, through fusion between adjacent layers of weld and base metal, sufficient root penetration and the absence of defects such as cracks, lack of fusion etc.

4.2.4.8 For pipe-to-plate fillet welds, the test assembly is to be cut by mechanical means into four equal parts as shown in Figure 4.2.4.8, from which two parts are to be selected for macro-examination of sections A and B (B being the stop/start location). The specimens are to be prepared and etched as per 4.2.4.7. The examination of macro sections is to reveal a regular weld profile, full root penetration and the absence of defects such as cracks, lack of fusion etc.

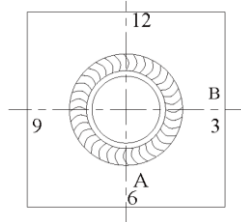


Figure 4.2.4.8 Cutting Position of Macro Sections of Pipe-to-Plate Assembly

CHAPTER 5 WELDING OF HULL STRUCTURES

Section 1 GENERAL PROVISIONS

5.1.4 Selection of welding consumables

5.1.4.1 Welding consumables used for hull structures are to comply with the requirements of Chapter 2 of this PART. The grade of welding consumables selected is to be suitable for the grade of hull structural steel, and is preferably to be selected according to ~~comply with~~ the requirements of Table 5.1.4.1(1), unless otherwise specified. For welding high strength structural steel, grades of applicable welding consumables are preferably to be selected according to the requirements of Table 5.1.4.1(2), unless otherwise specified.

Selection of Welding Consumables Table 5.1.4.1

Hull structural steel grade Grade of welding consumables	A	B	D	E	AH27 AH32 AH36	DH27 DH32 DH36	EH27 EH32 EH36	FH27 FH32 FH36	AH40	DH40	EH40	FH40
	1	X										
2	X	X	X									
3	X	X	X	X								
1Y	X				X							
2Y	X	X	X		X	X						
3Y	X	X	X	X	X	X	X					
4Y	X	X	X	X	X	X	X	X				
2Y40	X	X	X		X	X			X	X		
3Y40	X	X	X	X	X	X	X		X	X	X	
4Y40	X	X	X	X	X	X	X	X	X	X	X	X
5 Y40	X	X	X	X	X	X	X	X	X	X	X	X

Notes: "X" means applicable.

① When joining structural steels of normal strength, it is not recommended to use a much higher grade of welding consumable.

② When using Grade 1Y welding consumables, the material thickness is not to exceed 25 mm.

Selection of Welding Consumables Table 5.1.4.1(1)

Grade of welding consumables	Normal strength and high strength hull structural steel ^①															
	A	B	D	E	AH27 AH32	DH27 DH32	EH27 EH32	FH27 FH32	AH36	DH36	EH36	FH36	AH40	DH40	EH40	FH40
1	X															
2	X	X	X													

Grade of welding consumables	Normal strength and high strength hull structural steel ^①															
	A	B	D	E	AH27 AH32	DH27 DH32	EH27 EH32	FH27 FH32	AH36	DH36	EH36	FH36	AH40	DH40	EH40	FH40
3	x	x	x	x												
1Y	x				x ^②				x ^②							
2Y	x	x	x		x	x			x	x						
3Y	x	x	x	x	x	x	x		x	x	x					
4Y	x	x	x	x	x	x	x	x	x	x	x	x				
2Y40					x	x			x	x			x	x		
3Y40					x	x	x		x	x	x		x	x	x	
4Y40					x	x	x	x	x	x	x	x	x	x	x	x
5Y40					x	x	x	x	x	x	x	x	x	x	x	x
3Y42									x	x	x		x	x	x	
4Y42									x	x	x	x	x	x	x	x
5Y42									x	x	x	x	x	x	x	x
3Y46													x	x	x	
4Y46													x	x	x	x
5Y46													x	x	x	x

Notes: ① “x” means applicable, blank space means not applicable.

② When using Grade 1Y welding consumables, the base material thickness is not to exceed 25 mm.

Selection of Welding Consumables

Table 5.1.4.1(2)

Grade of welding consumables	High strength hull structural steel ^①																								
	AH420 DH420	EH420	FH420	AH460 DH460	EH460	FH460	AH500 DH500	EH500	FH500	AH550 DH550	EH550	FH550	AH620 DH620	EH620	FH620	AH690 DH690	EH690	FH690	AH890 DH890	EH890	FH890	AH960 DH960	EH960	FH960	
3Y42	x																								
4Y42	x	x																							
5Y42	x	x	x																						
3Y46	x			x																					
4Y46	x	x		x	x																				
5Y46	x	x	x	x	x	x																			
3Y50	x			x			x																		
4Y50	x	x		x	x		x	x																	
5Y50	x	x	x	x	x	x	x	x																	
3Y55							x			x															
4Y55							x	x		x	x														
5Y55							x	x	x	x	x	x													
3Y62										x			x												
4Y62										x			x	x											
5Y62										x	x	x	x	x	x										
3Y69													x			x									
4Y69													x	x		x	x								
5Y69													x	x	x	x	x	x							
3Y89																				x					
4Y89																				x	x				
5Y89																				x	x	x			
3Y96																				x			x		
4Y96																				x	x		x	x	
5Y96																				x	x	x	x	x	x

Note: ① “x” means applicable, blank space means not applicable.

5.1.4.4 When grades Y89 and Y96 welding consumables are designed for use in low grade matching welded joints, the manufacturer’s recommendations are to be satisfied subject to agreement by CCS.

Section 3 INSPECTION AND REPAIRING OF WELDS

5.3.2 Inspection

5.3.2.2 The internal quality of welds may be examined by non-destructive testing such as radiographic examination, ultrasonic inspection or other suitable methods. ~~Some welds are to be subject to a~~ suitable number of additional magnetic particle or dye penetrant examinations ~~are to be carried out~~ where necessary. Non-destructive testing is generally to meet the requirements of [Appendixes 1 and 2 of this PART](#) and Chapter 7 of CCS Guidelines for Inspection of Hull Welds or recognized methods of examination and acceptance criteria.

Section 5 WELDING OF NICKEL ALLOY STEELS

5.5.4 Welding

5.5.4.2 ~~Measures are to be taken to~~ avoid magnetic arc blow during welding, ~~alternating current (AC) as well as electrodes or wire flux combinations suitable for AC are preferable.~~

CHAPTER 8 WELDING OF IMPORTANT MACHINERY COMPONENTS

Section 4 NON-DESTRUCTIVE INSPECTION AND WELD REPAIRS OF PROPELLERS

8.4.4 General requirements for repairs

8.4.4.2 Indications exceeding the acceptance criteria of Table 8.4.3.57 (e.g. cracks, shrinkage cavities, sand, slag and other non-metallic inclusions, blowholes and other defects which may impair the safe service of the propeller) are to be rectified or repaired by welding as necessary.

CHAPTER 9 WELDING OF PRESSURE PIPES

Section 1 GENERAL PROVISIONS

9.1.3 Approval of welding procedures

9.1.3.1 Where any of the following joints is to be welded for the first time or when a new welding procedure is proposed to the following joints, details of the welding procedure specification are to be submitted to CCS for approval, in accordance with the relevant requirements in Chapter 3 of this PART:

- (1) attachment of flanges to pipes;
- (2) attachment of valve chests to pipes;
- (3) attachment of fittings to pipes;
- (4) butt joints of pipes to pipes;
- (5) fabrication of branch pieces.

CHAPTER 11 WELDING AND RIVETING OF NON-FERROUS MATERIALS

Section 3 WELDING OF TITANIUM AND TITANIUM ALLOYS

11.3.6 Inspection and repairing of welds

11.3.6.3 The internal quality of welds is to be examined by non-destructive testing (radiographic examination or ultrasonic testing). The extent and number of non-destructive testing and the procedures and standards used are to be in compliance with the standards acceptable to CCS (such as [JB/T4730-NB/T 47013](#)).

APPENDIX 1 NON-DESTRUCTIVE TESTING OF SHIP HULL STEEL WELDS

5 General plan of testing: NDT method selection

5.8 In general start/stop points in welds made using automatic [or fully](#) ~~(mechanized)~~ welding processes are to be examined using RT or UT, except for internal members where the extent of testing is to be agreed with the attending surveyor.

6 Testing

6.5.2.2 Consideration may be given for reduction of inspection frequency for automated [or fully mechanized](#) welds where quality assurance techniques indicate consistent satisfactory quality. The number of checkpoints is to be increased if the proportion of non-conforming indications is abnormally high.

9 Unacceptable indications and repairs

9.2 When unacceptable indications are found, additional areas of the same weld length are to be examined unless it is agreed with the surveyor and fabricator that the indication is isolated without any doubt. In case of automatic [or fully mechanized](#) welded joints, additional NDT is to be extended to all areas of the same weld length.