CHINA CLASSIFICATION SOCIETY

RULES FOR MATERIALS AND WELDING

AMENDMENTS

2014

Beijing

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CHINA CLASSIFICATION SOCIETY

RULES FOR MATERIALS AND WELDING

AMENDMENTS

(January 2014)

Effective from January 1 2014

Beijing

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CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS

Section 3 HIGHER STRENGTH HULL STRUCTURAL STEELS

New paragraph 3.3.1.2 is added as follows:

"3.3.1.2 Higher strength hull structural steels for large container ships with thicknesses of 50mm to 100mm and the specified minimum yield strength not less than 460 N/mm^2 are to comply with the requirements of CCS Guidelines for Survey of Thick Marine High Tensile Steel Plates."

CHAPTER 10 EQUIPMENT

Section 2 MARINE ANCHOR CHAIN CABLES AND ACCESSORIES

The existing paragraph10.2.9.2 is replaced by:

“10.2.9.2 Chain cables or accessories which meet the requirements are to be certified by CCS at least with the following items:

(1) Name of Manufacturer;

(2) Grade;

(3) Cast number(applicable toaccessories);

(4) Chemical composition (including total aluminum content);

(5) Nominal diameter/weight;

(6) Proof load and breaking load;

(7) Heat treatment;

(8) Marks on chain cables or accessories;

(9) Length(applicable to chain cables);

(10) Mechanical properties(where applicable).”

PART THREE WELDING

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

A new paragraph 1.1.1.4 is added as follows:

"1.1.1.4 The welding ofhigher strength hull structural steels for large container ships with thicknesses of 50mm to 100mm and the specified minimum yield strength not less than 460 N/mm^2 is to comply with the requirements of CCS Guidelines for Survey of Thick Marine High Tensile Steel Plates in additionof the relevant requirements of this PART."

CHINA CLASSIFICATION SOCIETY

RULES FOR MATERIALS AND WELDING

AMENDMENTS

(July 2014)

Effective from July 1 2014

Beijing

PART ONE METALLIC MATERIALS

CHAPTER 1 GENERAL

Section 2 TESTING AND SURVEY

A new paragraph 1.2.2.2 is added as follows:

“1.2.2.2 The chemical composition of each heat is generally to be determined on a sample taken during the pouring of the heat. When multiple heats are tapped into a common ladle, the ladle analysis is to apply. The chemical composition is to be reported in percentage by weight.”

The subsequent paragraph is renumbered accordingly.

A new paragraph 1.2.8.1 is added as follows:

“1.2.8.1 The manufacturer is to adopt a system of identification which will enable the manufacturing processes of the products to be tracedeffectively,and the system is to be applied to products and certificates.”

The subsequent paragraphs are renumbered accordingly.

CHAPTER 2 MATERIAL TESTS

Section 1 GENERAL PROVISIONS

The existing paragraph 2.1.3.1 is replaced by the following:

"2.1.3.1 Test samples from which test specimens are taken are to be cut in the final state of the material. Where separate samples are adopted, the samples are to undergo the same treatment as the material which they representsimultaneously.Test specimens are to be prepared in such a manner that the properties of the original material are not affected as far as possible."

A new paragraph 2.1.4.4 is added as follows:

"2.1.4.4 The calibration of Charpypendulum-type impact testing machines is to be in compliance with the requirements of ISO 148-2 or equivalent standards."

A new paragraph 2.1.5 is added as follows:

"2.1.5 Testing procedures

2.1.5.1 The testing procedures of different tests may follow established practice as laid down in international and national standards except those given in this Chapter."

The subsequent paragraphs are renumbered accordingly.

Section 2 TENSILE TESTS

Notes② and ⑦ to Table 2.2.2.1 is replaced by the following:

"② For test specimen of full thickness of rolled products, the original rolled surfaces are to be kept. When the capacity of the available testing machine is insufficient, this may be reduced to 25 mm by machining one of the rolled surfaces. Alternatively, for materials over about 40 mm thick, round test specimens as specified in Item 2 may be used.

⑦ The test specimen is to be cut longitudinally. The parallel test length is not to be flattened, but the enlarged ends may be flattened for gripping in the testing machine. When the wall thickness is sufficient, round test specimens as specified in Item 2 may be used, with their axes located at the mid-wall thickness."

Section 3 IMPACT TESTS

The existing paragraph 2.3.1.3 is replaced by the following:

"2.3.1.3 In all cases, specimens with maximum thickness are to be taken as far as possible. The width of the standard subsidiary test specimen and the conversion with the impact energy of the standard specimen is given in Table 2.3.1.3. For specimens smaller than 5 mm in size, the impact test is generally not required."

Section 6 DUCTILITY TESTS FOR PIPES AND TUBES

A new paragraph 2.6.1 is added as follows:

"2.6.1 General requirements

2.6.1.1 Ductility tests for pipes and tubes are generally used for inspecting the ductility and metallurgical defects of metal pipes and tubes.

2.6.1.2 In addition to ductility tests specified in this Section, where ring expanding tests or ring tensile tests are required, such tests are to be carried out in accordance with ISO 8495 or ISO 8496 respectively."

The subsequent paragraphs are renumbered accordingly.

Section 10 METAL DROP-WEIGHT TEST

The existing paragraph 2.10.2.2 is replaced by the following:

"2.10.2.2 Dimensions of specimens are shown in Table 2.10.2.2. During sampling,specimens with maximum thickness are to be taken as far as possible. The preparation of specimens (includingdimensional deviation, crack-starter weld deposited and notch preparation) is to comply with the requirementsof recognized standards (such as GB/T6803) in addition to the following requirements:

(1) the specimen sides are to be saw-cut or machined (minimum 25 mm to flame-cut surface);

(2) where the thickness of the material is greater than the prescribed specimen thickness, the machining of the plate to prescribed specimen thickness is to be on one side only."

CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS

Section 1 GENERAL PROVISIONS

The existing paragraph 3.1.7.3 is replaced by the following:

"3.1.7.3 The certificate of conformity for steels is to include the following particulars:

(1) purchaser's name and order number, and if known, the shipplude the following particulars:ace)ce)ly material is intended;

(2) address to which material is dispatched;

(3) description and dimensions of the material;

(4) number and weight of the cargo;

(5) specification or grade of the steel;

(6) cast number and chemical composition of ladle samples;

(7) mechanical test results;

(8) condition of supply when other than as rolled."

Section 12 ROLLED STEEL BARS FOR ANCHOR CHAIN CABLES AND ACCESSORIES

The existing paragraph 3.12.8.2 is replaced by the following:

"3.12.8.2 Each batch of bars is to be furnished with a certificate of conformity signed by CCS Surveyor. The certificate is to contain particulars required by 3.1.7.3 of this Chapter and, when the heat treatment required for the finished chain cables is carried out according to 3.12.5.1 of this Section, details of heat treatment of specimens, number of specimens and the corresponding mechanical test results. Additionally for Grades OM4S and OM5 bars intended for mooring chains,the certificate is to contain the results of hydrogen embrittlement test,non-destructive examination, etc. and the information of austenitic grain size, non-metallic inclusions and hardenability."

CHAPTER 5 STEEL FORGINGS

Section 1 GENERAL PROVISIONS

The existing paragraph 5.1.2.1 is replaced by the following:

"5.1.2.1 The chemical composition of each heat is generallyto be determined on a sample taken during the pouring of the heat. When multiple heats are tapped into a common ladle, the ladle analysis is to apply.The chemical composition of ladle samples is to comply with the requirements detailed in subsequent sections of this Chapter. The chemical composition selected isto be appropriate for the type of steel, dimensions and required mechanical properties of the forgings being manufactured."

The existing paragraph 5.1.5.1 is replaced by the following:

"5.1.5.1 Test material, sufficient for the required tests and for possible retest purposes, is to be provided with a cross-sectional area of not less than that part of the forging which it represents. The test material is to be integral with each forging except as provided in 5.1.5.2 and 5.1.5.3. Separately forged test material is to have a reduction ratio similar to that used for the forgings represented."

A new paragraph 5.1.5.2 is added as follows:

"5.1.5.2 When a forging is subsequently divided into a number of components, all of which are heat treated together in the same furnace charge, for test purposes this may be regarded as one forging and the number of tests required is to be related to the total length and mass of the original multiple forging."

The subsequent paragraphs are renumbered accordingly.

In the existing paragraph 5.1.5.6, the last sentence "Unless otherwise specified, either Charpy V-notch orCharpy U-notch test specimens may be used at the option of the manufacturer."is replaced by "Charpy V-notchtest specimens are to be used forthe impact specimens."

The existing paragraph 5.1.5.7 is replaced by the following:

"5.1.5.7 The procedures used for tensile and impact tests are to be in accordance with the requirements of Chapter 2 of this PART. Hardness tests are to be carried out whenever specified in subsequent sections of this Chapter. Unless otherwise agreed upon, all tests are to be carried out in the presence of the Surveyor."

A new paragraph 5.1.6.4 is added as follows:

"5.1.6.4When required by the construction Rules, or by the approved procedure for weldedcomposite components in accordance with5.1.3.8 of this Chapter, appropriate non-destructive testing is to be carried out beforeacceptance and the results are to be reported by the manufacturer."

The subsequent paragraphs are renumbered accordingly.

The renumbered paragraph 5.1.6.6 is replaced by:

"5.1.6.6 Ultrasonic examination 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. Radial and axial scanning is generally to be carried out. When the dimensions and shape are limited, radial or axial scanning may be carried out. The examination is to be made in accordance with recognized methods, and to comply with the requirements of Appendix 7A, Chapter 7 of CCS Guidelines for Inspection of Hull Welds or recognizedacceptancecriteria."

Theexisting paragraph 5.1.7.2 is replaced by the following:

"5.1.7.2 Repair welding of forgings except 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."

The existing paragraph 5.1.8.2 is replaced by the following:

"5.1.8.2 All forgings which have been satisfactorily inspected by CCS are to be clearly marked by themanufacturer in at least one place with the following:

(1) CCS logo;

(2) cast number or other marking which will enable the full history of the forging to be traced;

(3) test pressure (if any);

(4) brand or grade of forging material;

(5) abbreviated name of the survey unit and personal stamp of Surveyor responsible for inspection;

(6) certificate number.

When the area is not enough for all marks, at least the items (1) to (3) are to be marked.

Any mark is to be encircled with paint for easy recognition."

The existing paragraph 5.1.9.1 is replaced by the following:

"5.1.9.1 The manufacturer is to provide the required type of inspection certificate giving the following particulars for each forging or batch of forgings which has been accepted:

(1) purchaser's name and order number;

(2) description of forgings (name) and steel quality (grade), and marking which will enable the full history of the forging to be traced;

(3) steelmaking process, cast number and chemical analysis of ladle sample;

(4) details of heat treatment, including temperature and holding times;

(5) results of mechanical tests;

(6) results of macrostructure examination (if any);

(7) forging reduction ratio;

(8) test pressure (if any);

(9) method and results of non-destructive examination(where applicable)."

Section 3 FORGINGS FOR SHAFTING AND MACHINERY

The existing paragraph 5.3.5.3 is replaced by the following:

"5.3.5.3 For ships navigating in ice with an Ice Class Notation B1* or B1, the forgings for the screwshaftof all steel types listed in Table 5.3.5.1 are to be subject to Charpy V-notch impact tests at -10℃. A set of three impact test specimens is to be provided (from the propeller end of each shaft), and the average impact energy is not to be lower than 27 J."

CHAPTER 6 STEEL CASTINGS

Section 1 GENERAL PROVISIONS

A new paragraph 6.1.1.2 is added as follows:

"6.1.1.2 Unless provided otherwise in Section 6 to Section 8, the provisions of this Chapter are applicable only to steel castings where the design and acceptance tests are related to mechanical properties at ambient temperature. Where required by designs and applications, necessary additional tests may be required, especially when the castings are intended for service at low or elevated temperatures."

The subsequent paragraphs are renumbered accordingly.

In the existing paragraph 6.1.8.4, the last sentence "After ultrasonic examination, a test report is to be submitted by the manufacturer and the test results are tocomply with the approved plan or relevant recognized standards."is deleted.

A newparagraph 6.1.8.5 is added as follows:

"6.1.8.5 Non-destructive testing of steel castings is generally to be carried out in accordance with recognized methods of examination, and to comply with the requirements of Appendix 7B, Chapter 7 of CCS Guidelines for Inspection of Hull Welds or recognizedacceptancecriteria."

The existing paragraph 6.1.8.5 is renumberedas 6.1.8.6andis replaced by:

"6.1.8.6 Whereradiographic examination is carried out in areas as indicated for ultrasonic examination in 6.1.8.4 of this Section, the details of radiographic technique are to be submitted to CCS for approval.The results are to comply with the relevant recognized standards."

The existing paragraph 6.1.10 is replaced by the following:

"6.1.10 Rectification of defective castings

6.1.10.1 The defects of castings may be classified based on the extent of weld repairs:

(1) Major repairs are thosewhere the depth is greater than 25% of the wall thickness or 25mm, whicheveris less, or where the total weld area on a casting exceeds 2% of the casting surface notingthat where a distance between two welds is less than their average width,they are to be considered as one weld.

(2) Minor repairs are thosewhere the total weld area (length × width) exceeds 500mm^2.

(3) Cosmetic repairs areall other welds not included in (1) and (2) above.

(4) Castings subject to the removal of defects may be supplied without weldingon un-machined surfaces where the depth of defect removal is not over 15mmor 10% of wall thickness, whichever is less, and the length of the removed partis not over 100mm.

6.1.10.2 Defects found in castings are to be removed by one of thefollowing methods:

(1) grinding, machining;

(2) chipping and grinding;

(3) flame-cutting or arc-air gouging and grinding.

Thermal methods of metal removal are only to be allowed before the final heat treatment.

6.1.10.3 Complete elimination of the defective material is to be verified by non-destructive testing.Where the defective areais not required to be repaired by welding, the shallow grooves or excavationsresulting from the removal of defects are tobe blended by grinding and to besmoothly blended to the surface area with a finish equal to that of the adjacentsurface, subject to the inspection andacceptance by the Surveyor.Where the defective area is required to be repaired by welding, the excavations are tobe suitably shaped to allow good access for welding.All grooves are tohave abottom radius of approximately three times the groove depth.

6.1.10.4 Where defects are removed by flame cutting or arc-air gouging, the castings may be required tobe preheated depending on their chemical composition, the dimensions and nature of defects.

6.1.10.5 Where it is proposed to repair defective castings by welding,the welding procedure specification is to be submitted to CCS for approval. Major repairs require the approval of theSurveyor before the repairis carried out.

6.1.10.6 Welding repairs are to be carried out in accordance with the approved procedure specification byqualified welders in the downhand position or a position in which a good welding quality is assured.Welding is to be done in positions free from adverse weather conditions.

6.1.10.7 The welding consumables used are to be of an approved low hydrogen type, giving a welddeposit with mechanical properties similar and in no way inferior to those of the parent castings.

6.1.10.8 All castings in alloy steels and crankshaft castings are to be suitably preheated prior to welding.Castings in carbon and carbon-manganese steels may also be required to be preheated, depending on theirchemical composition, the dimensions and positions of the defects. Where the repair of major defects isrequired, a grain refining heat treatment is to be given prior to carrying out weld repairs.

6.1.10.9 After welding is completed, the castings are to be given a stress relieving heat treatment at atemperature of not less than 550℃according to the existing requirements for heat treatment. Post-weldlocal stress relieving heat treatmentmay be used for cosmetic repairs.

6.1.10.10 On completion of post-weld heat treatment, the weld repairs and adjacent material are to beground smooth and further examined by the existing non-destructive method dependent on thedimensions, number and position of the defects as shown on a sketch, so as to ensure that the quality of the repaired area is satisfactory.

6.1.10.11 Weld repair of defective steel castings for crankshafts is to comply with the requirements ofSection 4 of this Chapter.

6.1.10.12 The manufacturer is to maintain full records detailing the extent and location of repairs made toeach casting and details of weld procedures and heat treatments applied for repairs. These records are to beavailable to the Surveyor and copies provided on request."

Section 3 CASTINGS FOR MACHINERY CONSTRUCTION

The existing paragraph 6.3.3.1 is replaced by the following:

"6.3.3.1 Castings are to be heat treated as follows:

(1) fully annealed; or

(2) normalized; or

(3) normalized and tempered at a temperature of not less than 550℃;or

(4) quenched and tempered."

CHAPTER 7 IRON CASTINGS

Section 2 GREY IRON CASTINGS

The existing paragraph 7.2.2.3 is replaced by the following:

"7.2.2.3 Unless provided otherwise in 7.2.2.4, iron castingsmay be tested in batch in accordance with the following principles. At least one test sample is to be cast with each batch.

(1) A batch testing procedure may be adopted for castings in a batch of similar type and dimensions, the total mass of which does not exceed 2 tonnes, and cast from the same ladle of metal.

(2) A single casting will constitute a batch if its mass is 2 tonnes or more.

(3) For continuous melting and casting of the same grade of cast iron in large tonnages the mass of a batch may be increased to the output of 2 h of pouring."

The existing paragraph 7.2.2.4 is deleted and subsequent paragraphs are renumbered accordingly.

In the existing Table 7.2.4.1, note ① "For all grades of castings in the Table, the tensile strength range is 100 N/mm^2."is deleted.

CHAPTER 8 ALUMINIUM ALLOYS

Section 1 GENERAL PROVISIONS

In the existing paragraph 8.1.4.1, the words “of similar dimensions” are replaced by “of similar dimensions (the same thickness for plates)”.

Section 2 ALUMINIUM ALLOY PLATES AND SECTIONS

The existing Table 8.2.5.3 is replaced by the following:

“Underthickness Tolerances for Rolled Products Table 8.2.5.3

Nominal width B(mm) / Nominal thickness t(mm)	$B \leq 1500$	$1500 < B \leq 2000$	$2000 < B \leq 3500$
$3 \leq t < 4$	0.10	0.15	0.15
$4 \leq t < 8$	0.20	0.20	0.25
$8 \leq t < 12$	0.25	0.25	0.25
$12 \leq t < 20$	0.35	0.40	0.50
$20 \leq t < 50$	0.45	0.50	0.65

”

The existing paragraph 8.2.5.5 “The weight of each batch of rolled products is not to exceed 2,000 kg and one sample is to betaken therefrom. Where the weight of a single piece is greater than 2,000 kg, only one sample is required.”is replaced by:

“8.2.5.5 Onetensile specimen is to be taken from each batch of rolled products. If the weight of each batch exceeds 2,000 kg, one extra tensile specimen is to be taken from every 2,000 kg of the product or fraction thereof, in each batch. Where the weight of a single piece (plate or coil) is greater than 2,000 kg, only one tensile specimen is required.”

The existing paragraph 8.2.5.7 is replaced by the following:

“8.2.5.7 The manufacturer has to demonstrate by macrosection tests or drift expansion tests of closed profiles performed on each batch of closed profiles that there is no lack of fusion at the press welds. Drift expansion tests may be carried out in accordance with the following requirements:

(1) Every fifth profile is to be sampled after final heat treatment. Batches of five profiles or less are to be sampled one profile. Profiles with lengths exceeding 6 m are to be sampled every profile in the start of the production. The number of tests may be reduced to every fifth profile if the results from the first 3-5 profiles are found acceptable.

(2) Each profile sampled is to have two samples cut from the front and back end of the production profile.

(3) The test specimens are to be cut with the ends perpendicular to the axis of theprofile. The edges of the end may be rounded by filing.

(4) The length of the specimen is to be in accordance with 2.6.2, Chapter 2 of this PART.

(5) Testing is to be carried out at ambient temperature and is to consist of expanding the end of the profile by means of a hardened conical steel mandrel having an included angle of at least 60°.

(6) The sample is considered to be unacceptable if the sample fails with a clean split along the weld line which confirms lack of fusion."

In the first line of paragraph 8.2.5.11, the words "the manufacturers are to establish the relationship between…" are replaced by "the manufacturers are in general to establish the relationship between…".

Section 4 ALUMINIUM ALLOY PISTONS

The existing Tables 8.4.3.1(1) and (2) are replaced by the following:

"Chemical Composition of Aluminum Alloy Piston Table 8.4.3.1(1)

Designation	Alloy code	Chemical composition (%)					
		Si	Cu	Mn	Mg	Ni	Al
ZAlSi12Cu2Mgl	ZL108	11~13	1~2	0.3~0.9	0.4~1.0	-	Residual
ZAlSi12CulMglNil	ZL109	11~13	0.5~1.5	-	0.8~1.3	0.8~1.5	Residual
ZAlSi5Cu6Mg	ZL110	4~6	5~8	-	0.2~0.5	-	Residual

Mechanical Properties of Aluminum Alloy Pistons Table 8.4.3.1(2)

Designation	Alloy code	Tensile Strength R_m min. (N/mm^2)	Hardness HBW min.	Delivery condition
ZAlSil2Cu2Mgl	ZL108	200	85	Artificial ageing (T5)
	ZL108	260	90	Solution treated & complete artificial ageing (T6)
ZAlSil2Cu1MglNil	ZL109	195	90	Artificial ageing (T5)
	ZL109	245	100	Solution treated & complete artificial ageing (T6)
ZAlSi5Cu6Mg	ZL110	170	90	Artificial ageing (T5)

"

CHAPTER 9 OTHER NON-FERROUS MATERIALS

Section 1 COPPER ALLOY PROPELLERS

The existing paragraph 9.1.3.3 is replaced by the following:

"9.1.3.3 In order to ensure the proportions of α phase in microstructure of Cu1 and Cu2, zinc equivalent of copper alloy is not to exceed 45%. Zinc equivalent is to be defined by the following formula:

$$\text{Zinc equivalent} = 100 - \frac{100 \times Cu\%}{100 + A} \qquad (\%)$$

where: A = 1 × Sn% + 5 × Al% — 0.5 × Mn%0.1 × Fe% — 2.3 × Ni%.

Where the proportion of α phase is or above 25%, the zinc equivalent may not be required."

The existing paragraph 9.1.6.3 is replaced by the following:

"9.1.6.3 The tensile strength, 0.2% proof strength and elongation are to be determined by mechanical tests. Test results oftest specimens taken from separately cast samples are to comply with the values given in Table 9.1.6.3. For integrally cast test specimens the mechanical characteristics are specially to be agreed with CCS."

In the existing paragraph 9.1.6.8, the sentence "Dynamic balancing is generally necessary for propellers running above 500 rpm." is replaced by "Dynamic balancing is to be carried out for propellers running above 500 rpm."

The existing paragraph 9.1.7.1 is replaced by the following:

"9.1.7.1 Each propeller casting is to be marked by the manufacturer at least with the following:

a) grade of cast material or corresponding abbreviated designation;

b) manufacturer's mark;

c) heat number or other marking which will enable the full history of the casting to be traced;

d) specimen number;

e) number of CCS certificate;

f) ice class notation, where applicable;

g) skew angle for high skew propellers;

h) date of final inspection;

i) CCS stamp, where the casting is found satisfactory."

The existing paragraph 9.1.7.2 is replaced by the following:

"9.1.7.2 Each satisfactorily inspected propeller casting is to be provided with a certificate containing the following details:

a) purchaser's name and order number;

b) ship'sname, if known;

c) description of the casting with drawing number;

d) diameter, number of blades, pitch, direction of turning;

e) skew angle for high skew propellers;

f) final weight;

g) alloy type, heat number and chemical composition;

h) heat or casting number;

i) casting identification number;

j) method and results of non-destructive examination;

k) results of mechanical tests;

l) proportion of αphase in metallographic examination (for Cu1 and Cu2 alloys only)."

Section 2 CAST COPPER ALLOYS

The existing paragraph 9.2.6.1 is replaced by the following:

"9.2.6.1 Small castings of cast copper alloy less than 250 kg in mass may be sampled for test with similar dimensions and same cast number in batches not greater than 1tonne. Test samples for mechanical properties may be separately cast as keel block type ones in accordance with Figure 9.1.5.1 of this Chapter or may be sampled directly from the product."

CHAPTER 10 EQUIPMENT

Section 2 MARINE ANCHOR CHAIN CABLES AND ACCESSORIES

The existing paragraph 10.2.7.1 is replaced by the following:

"10.2.7.1 Finished chain cables are to be subjected to the proof load test and the breaking load test inaccordance with recognized standards in the presence of the Surveyor, and are not to fracture or exhibit cracking. Special attention is to be given to the visual inspection of the flash-butt weld, if present. For this purpose, the chain cables must be free from paint and anti-corrosion media. Where the manufacturer has a procedure to record proof loads and the adequacy of the recording system to the satisfaction of the Surveyor, the Surveyormay not witness all proof load tests,provided that he is satisfied that the testing machines are calibrated and maintained in a satisfactory condition."

The existing Table 10.2.7.5 is replaced by the following:

"Number of Mechanical Specimens for Finished Chain Cables and Accessories Table 10.2.7.5

Grade	Manufacturing method	Condition of supply	Number of specimens		
			Tensile test for base metal	Charpy V-notch impact test	
				Base metal	Weldment
1	Flash-butt welded	As welded, normalized	Not required	Not required	Not required
2	Flash-butt welded	As welded	1	3	3
		Normalized	Not required	Not required	Not required
	Forged or Cast	Normalized	1	3①	Not applicable
3	Flash-butt welded	Normalized, normalized and tempered, quenched and tempered	1	3	3
	Forged or Cast	Normalized, normalized and tempered, quenched and tempered	1	3	Not applicable

Note: ① This only applies to accessories."

The existing paragraph 10.2.8.4 is replaced by the following:

"10.2.8.4 For test sampling, forged or cast accessories of similar dimensions originating from the same heat of steel and the same heat treatment charge are to be combined into one test unit. From each test unit, at least one specimen is to be taken for mechanical test after heat treatment in accordance with the requirements of 10.2.7.5 in this Section. Test results and retest requirements are to comply with Table 10.2.8.4."

Section 3 OFFSHORE MOORING CHAINS AND ACCESSORIES

The existing paragraph 10.3.5.1 is replaced by the following:

"10.3.5.1 Chain manufacturers are to be approved by CCS and to purchase steel bars for mooring chains from the works approved by CCS.

The existing subparagraph 10.3.8.5(1) is replaced by the following:

"(1) The entire length of chain is to withstand the proof load specified in Table 10.3.8.5(1) withoutfracture and is not to crack in the flash weldand without obvious stud loosening. The load applied is not to exceed the proof load by more than 10% when stretching the chain. Where plastic straining is used to set studs, theapplied load is not to be greater than that qualified in approval testsand is to be recorded in the test report."

A new paragraph 10.3.11.9 is added as follows:

“10.3.11.9 The locations of mechanical tests of cast shackles and cast Kenter shackles can be taken from the straight part of the accessory. The tensile properties and impact values are to meet the requirements of Table 10.3.8.8(3) in the locations specified in Figure 10.3.8.8(1).”

The subsequent paragraphs are renumbered accordingly.

PART TWO NON-METALLIC MATERIALS

CHAPTER 1 GENERAL

Section 2 TEST AND INSPECTION

In the existing paragraph 1.2.2.1, the words “in accordance with the relevant recognized standards”are replaced by “in accordance with the standards given by CCS or other equivalent standards”.

CHAPTER 2 PLASTICS MATERIALS

Section 2 RAW MATERIALS

The existing Table 2.2.7.7 is replaced by the following:

"Requirements for Properties of Resin Chock Castings Table 2.2.7.7

Compressive strength N/mm^2	Compressive modulus N/mm^2	Barcol hardness	Heat deflection temperature ℃	Flammability	Waterabsorption①%	Oil absorption①%
ASTM D695-2010	ASTM D695-2010	ASTM D2583-2013	ISO 75-2-2013	ASTM D635-2010	ISO 62-2008	ISO 62-2008
≥ 120	≥ 5000	≥ 35	≥ 80	Self-extinguishing	≤ 0.9	≤ 0.9

Note: ① The size of test sample for water and oil absorption is 50 mm*50 mm*4 mm."

The existing Table 2.2.8.5 is replaced by the following:

"Requirements for Physical Properties of Synthetic Bearing Materials Table 2.2.8.5

Compressive stress① MPa	Compressive modulus① MPa	Friction coefficient	Temperature and water resistance	Volumetric swelling in lubricating medium④%	Tensile strength MPa
ISO 604-2002	ISO 604-2002	-	-	ISO 175-2010	ISO 527-2-2012
≥ 120② ≥ 85③	≥ 1500②	≤ 0.25	Not less than 80% of test value in 2.2.8.4(1)	≤ 3	≥ 70

Notes:① Under the condition of 25% compressive straining.
② Vertical to the compression side of bearing.
③ Parallel to the compression side of bearing, only for bearings of strip shape.
④ For test of volumetric swelling in lubricating medium, the size of test sample is 50 mm×50 mm×*t*, *t* is generally 4 mm, and minimum product thickness may also be adopted."

CHAPTER 3 FIBER-REINFORCED PLASTIC HULL MATERIALS

Section 1 GENRAL PROVISIONS

The existing subparagraph 3.1.3.3(5) is replaced by "The results of the above-mentioned tests are not to be lower than the requirements given in Table 3.1.3.3(5) and are to be submitted to the Surveyor for confirmation."

The existing Table 3.1.3.3(5) is replaced by the following:

"

Items	Standard	CSM&BLAXIAL/BLAXIAL type complex mat / CSM&BLAXIAL type complex mat
Tensile strength (N/mm^2)	ISO 527-4-1997	$800\ G^2 - 80\ G + 37$
Tensile modulus (N/mm^2)	ISO 527-4-1997	$38000\ G - 5000$
Bending strength (N/mm^2)	ISO 14125-1998	$502\ G^2 + 107$
Flexural modulus (N/mm^2)	ISO 14125-1998	38000G-6500
Compressive strength (N/mm^2)	ISO 604-2002	$150\ G + 72$
Compressive modulus (N/mm^2)	ISO 604-2002	$38\ 000\ G - 5\ 000$
Interlaminar shear strength (N/mm^2)	ISO 14130-1997	$23.2 - 17.5\ G$
Glass fiber content (%, weight)	ISO 1172-1999	G
Barcol hardness	ASTM D2583-2013	40

Notes:① Tensile and compressive properties in the Table mean in-plane properties, and out-plane compression are not to be used instead of in-plane property test.

② In the Table, G is total nominal glass fiber content and is to be rounded to one digit after the decimal point. The calculation formula can be the calculation formula for G in 2.2.3.4(4). The formula for complex mat in 2.2.3.4(4) may be used as simplified formula, i.e. the laminate is simplified as a big complex mat, and mat and cloth are calculated respectively. If the laminating structure includes complex mat, the complex mat may be simplified as separate mat and cloth for calculation."

Section 2 RAW MATERIALS

The existing paragraph 3.2.3.3 is replaced by "The following properties in liquid, cured cast and standard fiber-reinforced plastic laminate (only for laminating resin) conditions are to be tested for the gel coat resin, laminating resin and topcoat resin (if any) on samples taken from each batch:".

A new subparagraph 3.2.3.3(3) is added as follows:

"(3) Properties for standard fiber-reinforced plastic laminate:

① bending strength;

② flexural modulus of elasticity."

The existing paragraph 3.2.3.4 is replaced by the following:

"3.2.3.4 The properties of unsaturated polyester resin, vinyl ester resin and gel coat/topcoat resin castings used for lay-up are as follows:

Properties for Resin Castings Used for Lay-up **Table 3.2.3.4**

Items	Standard	Unsaturated polyester/vinyl ester resin	Gel coat/Topcoat resin
Tensile strength (N/mm^2)	ISO527-4-1997	≥ 45	≥ 55
Elongation at break (%)	ISO527-4-1997	≥ 1.5	≥ 2.5
Flexuralmodulus ofelasticity (N/mm^2)	ISO178-2010	≥ 2700	≥ 2700
Flexural strength (N/mm^2)	ISO178-2010	≥ 80	≥ 100
Heat deflection temperature (℃)	ISO75-2-2013	≥ 60	≥ 60
Barcol hardness	ASTM D2583-2013	≥ 35	≥ 35
Water absorption(mg)	ISO62-2008	≤ 100	≤ 80
Note 1: Test samples are to be solidified for 24h under 50℃. Note 2: The size of test sample for water absorption is 50 mm × 50 mm × 4 mm, exposure time 672h at 23℃.			

"

A new paragraph 3.2.3.5 is added as follows:

"3.2.3.5 The preparation and test results of standard fiber-reinforced plastic laminate made by unsaturated polyester resin or vinyl ester resin are to meet the requirements of GB/T8237-2005."

The existing paragraph 3.2.3.5 is renumbered as 3.2.3.6 and the subsequent paragraphs are renumbered accordingly.

The existing Table 3.2.6.2(7) is replaced by the following:

"Basic Mechanical Properties of Rigid Foam Core Materials Table 3.2.6.2(7)

Core material	Density (kg/m^3)	Compressing strength (N/mm^2)	Compressing modulus of elasticity (N/mm^2)	Shearing strength (N/mm^2)	Shearing modulus of elasticity (N/mm^2)
	ISO 845-2009	ISO 844-2007	ISO 844-2007	ISO 1922-2012	ISO 1922-2012
PU plastic foam	80	0.40	11.0	0.34	5.20
	100	0.60	16.0	0.47	8.70
	120	0.86	21.0	0.60	12.0
	140	1.15	27.0	0.74	17.0
PVC plastic foam	80	0.40	12.0	0.35	7.60
	100	0.57	18.0	0.47	11.0
	120	0.75	25.0	0.60	14.6
	140	1.00	33.0	0.75	18.8

"

The existing Table 3.2.6.3(7) is replaced by the following:

"Basic Mechanical Properties of Balsa Wood Core Materials Table 3.2.6.3(7)

Density (kg/m^3)	Strength (N/mm^2)					Compressive modulus of elasticity (N/mm^2)		Shear modulus of elasticity(N/mm^2)
	Compressive		Tensile		Shear	ISO 844-2007		ISO 1922-2012
	ISO 844-2007		ASTM C297-2004		ISO 1922-2012	Direction of stress		
ISO 845-2006	Direction of stress					Parallel to grain	Perpendicular to grain	
	Parallel to grain	Perpendicular to grain	Parallel to grain	Perpendicular to grain				
96	5.00	0.35	9.00	0.44	1.10	2300	35.20	105
144	10.60	0.57	14.60	0.70	1.64	3900	67.80	129
176	12.80	0.68	20.50	0.80	2.00	5300	98.60	145

"

CHAPTER 5 SKIRT MATERIALS AND CONNECTORS

Section 3 TEST AND MECHANICAL PROPERTIES OF SKIRT MATERIALS

The existing Table 5.3.2.1 is replaced by the following:

"Mechanical Properties of Skirt Material **Table 5.3.2.1**

Grade of skirt piece	Breaking strength min. (N/5cm)		Tearing force min. (N)		Ripping strength min. (N/5cm)	Lap joint tensile strength min. (N/5cm)
	ISO 1421-1998		-		ISO 2411-2000	ISO 1421-1998
	Warpwise	Across warp	Warpwise	Across warp		
A	2940	2940	340	340	590	2940
B	4410	4410	585	585	680	4410
C	4900	4900	780	780	680	4900

"

CHAPTER 7 FIBER ROPES

Section 2 FIBER ROPES FOR OFFSHROE MOORING

The existing Table 7.2.2.4 is replaced by the following:

"Inspection Items Table 7.2.2.4

Inspection item	Standard	Sampling method and amount
Dry breaking strength and elongation	ASTM D885-2010	At least 1 sample per 5000kg fiber material
Wet yarn-on-yarn abrasion	ISO18692-2007	1 sample per 20000kg fiber material, at least 1 sampling test for each fiber rope order
Linear density	ISO18692-2007	At least 1 sample per 5000kg fiber material
Content of marine finish	ASTM D2257-2012	1 sample per 20000kg fiber material, at least 1 sampling test for each fiber rope order

"

PART THREE WELDING

CHAPTER 1 GENERAL

Section 2 TESTING

In the existing paragraph 1.2.5.1, the following sentence is added after the last sentence:

“On butt weld specimens, the values of tensile strength are to be recorded together with the position of fracture.”

CHAPTER 2 WELDING CONSUMABLES

Section 2 MECHANICAL PROPERTIES OF WELDING CONSUMABLES

The existing Table 2.2.2.3 is replaced by the following:

"Mechanical Properties of Consumables for Welding Structural Steels Table 2.2.2.3

Grade of welding consumables			1, 2, 3	1Y, 2Y 3Y, 4Y①	2Y40 3Y40 4Y40	3Y42 4Y42 5Y42	3Y46 4Y46 5Y46	3Y50 4Y50 5Y50	3Y55 4Y55 5Y55	3Y62 4Y62 5Y62	3Y69 4Y69 5Y69	0.5Ni	1.5Ni	3.5 Ni	5 Ni	9Ni
Deposited metal test	Yield strength⑦ R_{eH}(N/mm²)		≥305	≥375	≥400	≥420	≥460	≥500	≥550	≥620	≥690	≥375				
	Tensile strength⑧ R_m(N/mm²)		400-560	490-660	510-690	530-680	570-720	610-770	670-830	720-890	770-940	≥460		≥420	≥500	≥600
	ElongationA(%)		≥22			≥20		≥18			≥17	≥22		≥25		
	CharpyV-notch-impact test	Test temperature (℃)	②									-60	-80	-100	-120	-196
		Average impactenergy⑥ (J)	≥47③			≥47		≥50	≥55	≥62	≥69	≥34				
Butt weld test	Transverse tensilestrength% (N/mm²)		≥400	≥490	≥510	≥530	≥570	≥610	≥670	≥720	≥770	≥490		≥450	≥540	≥640
	CharpyV-notch-impact test	Testtemperature (℃)	②									-80	-80	-100	-120	-196
		Average impactenergy⑥ (J)	≥47④			≥47		≥50	≥55	≥62	≥69	≥34				
	Bend test		After test, length of crack or other defects on specimen surface is not to be more than 3 mm.⑤													

Notes: ① Manual arc welding electrodes are to comply with Grade 2Y and above.

② The temperature of impact test for welding consumables of Grade 1 and Grade 1Y is to be 20℃;
for those of Grades 2, 2Y, 2Y40 to be 0℃;
for those of Grades 3, 3Y, 3Y40, 3Y42 ,3Y46, 3Y50, 3Y55, 3Y62, 3Y69 to be -20℃;
for those of Grades 4Y, 4Y40, 4Y42, 4Y46, 4Y50, 4Y55, 4Y62, 4Y69 to be -40℃;
for those of Grades 5Y42, 5Y46, 5Y50, 5Y55, 5Y62, 5Y69 to be -60℃.

③ The average impact energy of deposited metal test of automatic welding is not to be less than 34J for welding consumables with R_{eH}< 400 N/mm²; not to be less than 39J for those with R_{eH}≥ 400 N/mm².

④ The average impact energy of butt joints of vertical welding and automatic welding is not to be less than 34J for welding consumables with R_{eH}< 400 N/mm²; not to be less than 39J for those with R_{eH}≥ 400 N/mm².

⑤ Except for 5Ni and 9Ni steel specimens to be bend tested with a former of diameter four times the plate thickness, the diameter of former is to comply with the requirements of 1.2.4.2 of this PART.

⑥ Energy values from individual impact test specimens are not to be less than 70% of the specified values.

⑦ In case of no marked yield stress, the proof stress $R_{P0.2}$ is to be reported.

⑧ Where the tensile strength exceeds the specified maximum value, special consideration is to be given by CCS."

Section 3 ELECTRODES FOR MANUAL ARC WELDING

In the existing paragraph 2.3.1.1, the words "and passed the hydrogen test according to 2.3.6.6 of this Section" arereplaced by "and passed the hydrogen test according to 2.3.6.3 of this Section".

A new paragraph 2.3.2.6 is added as follows:

"2.3.2.6 Where an electrode is submitted solely to approval for use in contact welding using automatic gravity or similar welding devices, deposited metal tests, fillet weld tests and, where appropriate, butt weld tests similar to those for normal manual electrodes are to be carried out using the process for which the electrode is recommended by the manufacturer. Where a covered electrode is submitted to approval for use in contact welding using automatic gravity or similar welding devices in addition to normal manual welding, fillet weld and, where appropriate, butt weld tests, using the gravity of other contact device as recommended by the manufacturer, are to be carried out in addition to the normal approval tests.

In the case of a fillet welding electrode using automatic gravity or similar contact welding devices, the fillet welding is to be carried out using the welding process recommended by the manufacturer, with the longest size of the electrode manufactured. The manufacturer's recommended current range is to be reported for each electrode size.

Where approval is requested for the welding of both normal strength and higher strength steel, the assemblies are to be prepared using higher strength steel."

In the existing paragraph 2.3.4.4, the sentence "For all butt weld test assemblies, the back sealing runs are to be made with 4 mm diameter electrodes or the smaller diameter electrodes of the same type in the welding position appropriate to each test sample, after cutting out the root run to clean metal." is replaced by "For all butt weld test assemblies, the back sealing runs are to be made with 4 mm diameter electrodes in the welding position appropriate to each test sample, after cutting out the root run to clean metal."

The existing paragraph 2.3.6 is replaced by the following:

"2.3.6 Hydrogen test

2.3.6.1 The diffusible hydrogen test is to adopt mercury method or heat conduction method specified in ISO36901-2012. For welding consumables with level of hydrogen content of H10 and H15, glycerin method specified in 2.3.6.2 may also be adopted.

2.3.6.2 The procedure for hydrogen test with glycerin method is as follows:

(1) Four plates of any grade of structural steel are to be prepared as hydrogen test specimens. The specimens are to be 12mm in thickness, 25mm in width and 125mm in length.

(2) Before welding, the specimens are to be cleaned and weighed to the nearest 0.1 g.

(3) Prior to welding, the electrodes are to be baked according to the drying process recommended bythe manufacturer, so as to fully dry the electrodes. On the 25 mm surface of each test specimen, a singlebead of welding about 100 mm in length is to be deposited with a 4 mm electrode, using about 150 mm ofthe electrode. The welding is to be carried out with as short an arc as possible and with a current of about150 A.

(4) Within 30 s of the completion of the welding of each specimen, the slag is to be removed and the specimen quenched in water having a temperature of approximately 20℃. After a further 30 s, the specimens are to be cleaned and placed in an apparatus suitable for the collection of hydrogen by displacement of glycerin. All four specimens are to be welded and placed in the hydrogen collecting apparatus within 30 min by a single operator.

(5) The specimens are to be kept immersed in the glycerin having a temperature of 45℃for a period of 48 h and, after removal, are to be cleaned in water and spirit, dried and weighed to the nearest 0.1 g to determine the amount of weld deposited.

The amount of gas evolved is to be measured to the nearest 0.05 cm^3 and corrected for temperature and pressure to 0℃and 101.325 kPa.

2.3.6.3 The average content of diffusible hydrogen per 100 g is tocomply with the requirements of Table 2.3.6.3.

Average Content of Diffusible Hydrogen **Table 2.3.6.3**

Level of hydrogen content	Mercury method/heat conduction method	Glycerin method
H15	$15cm^3$	$10cm^3$
H10	$10cm^3$	$5cm^3$
H5	$5cm^{3①}$	

Note: ① For welding material with the level of hydrogen content of H5, only mercury method may be used."

The existing subparagraph 2.3.9.2(4) is replaced by the following:

"(4) Where an electrode is approved solely for gravity welding, at least onedeposited metal test assembly is to be prepared and tested using the gravity or similar welding device as recommended by themanufacturer. If this electrode is approved also for normal welding the testsare to beperformed according to (1) of this paragraph."

Section 4 WIRE-FLUX COMBINATIONS FOR SUBMERGEDARC AUTOMATIC WELDING

In the existing paragraph 2.4.3.3, the first sentence is replaced by the following:
"Two longitudinal tensile specimens (one if approved as wire-flux combinations for two-run technique at the same time) and a set of three impact test specimens are to be taken from each test assembly as shown in Figure 2.4.3.2 for tensile and impact tests respectively."

In the existing paragraph 2.4.5.4, the first sentence is replaced by the following:

"As shown in Figure 2.4.5.4(1), two transverse tensile specimens, two bend specimens and a set of three impact test specimens are to be cut from each assembly, and one longitudinal tensile specimen cut from the thicker assembly. The impact test specimens are to be cut in positions as shown in Figure 2.4.5.4(2)."

The existing Figure 2.4.5.4(1) is replaced by the following:

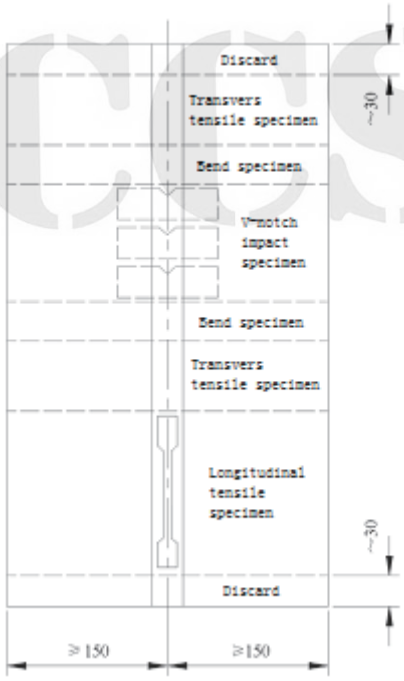


Figure 2.4.5.4(1)

The existing paragraph 2.4.5.5 is replaced by the following:

"2.4.5.5 Where the combination is to be approved for the two-run technique only, in addition to the specimens required by 2.4.5.4, the chemical composition of the deposited metal is to be analyzed for the thicker assembly. The chemical analysis report is to include the content of allsignificant alloying elements. The results of the analysis are not to exceed the limit values specified in the standards or by the manufacturer."

Section 6 CONSUMABLES FOR USE IN ELECTRO-SLAG OR ELECTRO-GAS VERTICAL WELDING

The existing paragraph 2.6.2.1 is replaced by the following:

"2.6.2.1 Two butt weld test assemblies are to be prepared, one with plates 20 mm to 25 mm in thickness and the other with plates 35 mm to 40 mm in thickness. Each plate is not to be less than 250 mm in width and of sufficient length to allow the cutting out of test specimens of the number and size as specified in 2.6.2.3 of this Section."

The existing Figure 2.6.2.3(1) is replaced by the following:

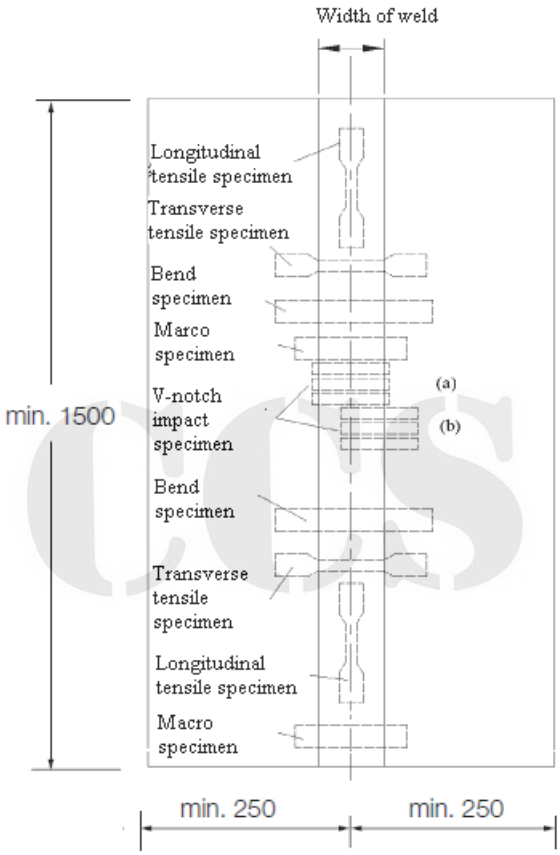


Figure 2.6.2.3(1)

In the existing paragraph 2.6.3.2, the last sentence is replaced by the following:

"And one longitudinal tensile, one transverse tensile, two bend specimens, two sets of impact test specimens (the notch of impact specimens positioned in the centre the weld and at 2 mm from the fusion line of the weld respectively)and one macro specimen are to be taken from the assembly for tensile, bend, impact tests and macro examination respectively."

Section 8 WELDING CONSUMABLES FOR STAINLESS STEEL

The existing paragraph 2.8.2.1 is replaced by the following:

"2.8.2.1 Welding consumables for stainless steels are graded according to applicable parent stainless steel. Detailed grades are as follows: 304, 304L, 304LN, 316, 316L, 316LN, 317, 317L, 317LN, 309, 309L, 347, 2205, 2550 and 2750."

The existing Table 2.8.2.1 is deleted.

The existing Table 2.8.3.4 is replaced by the following:

"Mechanical Properties of Deposited Metal of Welding Consumables for Stainless Steel

Table 2.8.3.4

Grade of welding consumables		Austenitic stainless steel			Austenitic/ferritic duplex stainless steel		
		304L 316L 317L 309L	304LN 316LN 317LN 347	304 316 317 309	2205	2550	2750
Proof strength (N/mm^2)	$R_{p0.2}$	≥270	≥290	≥290	≥450	≥550	≥550
	$R_{p1.0}$ ①	≥310	≥330	≥330	≥490	≥590	≥590
Tensile strength R_m (N/mm^2)		≥500	≥550	≥550	≥620	≥690	≥790
Elongation A_5 (%)		≥25	≥22	≥25	≥25	≥15	≥15
Charpy V-notch impact test	Test temperature (℃)	-20/-196②			-20		
	Average impact energy (J)	≥29					

Notes: ① Unless otherwise agreed, the value of proof strength $R_{p1.0}$ is generally not to be used as a criterion for acceptance.

② Austenitic stainless steel is to be subjected to impact test at -20℃. When used in deep cold condition, austenitic stainless steel is to be subjected to impact test at -196℃. If required by an agreement, impact test may also be carried out according to the agreement."

The existing Table 2.8.4.3 is replaced by the following:

"Mechanical Properties of Butt Joints of Welding Consumables for Stainless Steel Table 2.8.4.3

Grade of welding consumables		Austenitic stainless steel			Austenitic/ferritic duplex stainless steel		
		304L 316L 317L 309L	304LN 316LN 317LN 347	304 316 317 309	2205	2550	2750
Tensile strength R_m (N/mm^2)		≥480	≥550	≥520	≥620	≥690	≥790
Charpy V-notch impact test	Test temperature (℃)	-20/-196①			-20		
	Average impact energy (J)	≥27					
Bend test	Former diameter	3*t*				6*t*	
	Bending angle	120°					
	Requirement	After test, length of crack or other defects on specimen surface is not to be more than 3 mm.					

Note: ① Austenitic stainless steel is to be subjected to impact test at -20℃. When used in deep cold condition, austenitic stainless steel is to be subjected to impact test at -196℃. If required by an agreement, impact test may also be carried out according to the agreement."

A new paragraph 2.8.4.5 is added as follows:

"2.8.4.5 In addition to the requirements mentioned above, duplex stainless steels butt joints are to be sampled for pitting corrosion test according to Section7, Chapter 2, PART ONE of the Rules."

CHAPTER 3 APPROVAL OF WELDING PROCEDURES

Section 1 GENERAL PROVISIONS

In the existing paragraph 3.1.3.2, the first sentence "Welding procedure approval tests are generally required when a new material or new welding procedure is adopted."is replaced by: "Welding procedure approval tests are generally required to verify that a manufacturer is adequately qualified to perform welding operations using a particular procedure when a new material or new welding procedure is adopted."

In the existing subparagraph 3.1.4.3(2), the words "the specified yield strength of steel is not more than 390 N/mm^2" are replaced by "the minimum value of the specified yield strength of steel is not more than 390 N/mm^2".

The existing Table 3.1.4.5a is replaced by the following:

"Application of Steel Thickness **Table 3.1.4.5a**

Thickness of test piece ① t (mm)	Range of approval	
	Butt and T-joint welds with single run or single run from both sides	Butt and T-joint welds with multi-run and fillet welds②
$t \leq 3$	(0.7~1.1) t	(1~2) t
$3 < t \leq 12$	(0.7~1.1)t	3mm ~2t
$12 < t \leq 100$	(0.7~1.1)t③	(0.5 ~ 2) t (maximum 150 mm)
$t > 100$	not applicable	50 mm ~2t

Notes: ① For multi-process procedures, the recorded thickness contribution of each process is to be used as a basis for the range of approval for the individual welding process.
② For fillet welds, the range of approval is to be applied to both base metals.
③ For high heat input processes over 50 kJ/cm, the upper limit of the range of approval is to be 1.0 × t."

Section 2 WELDING PROCEDURE APPROVAL TESTS FOR BUTT WELDS

In the existing Table 3.2.2.3, note ①"The greater is to be taken (t being the thickness of test plate, in mm)." is replaced by "The greater is to be taken (t being the thickness of test plate, in mm). Where the thickness of test plate exceeds 100 mm, appropriate reduction of the dimensions of test plate may be carried out as agreed by CCS."

The existing paragraph 3.2.3.2 is replaced by the following:

"3.2.3.2 The visual inspection and non-destructive testing of steel and aluminum alloy test sample are to be respectively in accordance with the requirements for level B of ISO 5817 and ISO 10024 (excess weld metal, excessive convexity and excess penetration for which level C applies) or other equivalent standards."

The existing paragraph 3.2.5.2 is replaced by the following:

"3.2.5.2 The requirements for longitudinal tensile test results of weldmetal are as follows:

(1) For unapproved welding consumables, the properties are generally to meet the minimum requirements for approval level of applicable welding consumables specified in Chapter 2 of this PART. If the welding consumables used are not within the range specified in Chapter 2, the properties are not to be lower than the specified minimum value of parent metal.

(2) For type Cindependent tanks of ships carrying liquefied gases in bulk, the properties are not to be lower than the specified minimum value of parent metal or minimum value considered during design."

The existing paragraph 3.2.5.5 is replaced by the following:

“3.2.5.5 The macro examination is to reveal a regular weld profile, full penetration and the absence of defects such as cracks and lack of fusion.”

The existing paragraph 3.2.5.7 is deleted.

The existing paragraph 3.2.6.3 is replaced bythe following:

“3.2.6.3 The macro examination is to reveal a regular weld profile, full penetration and the absence of defects such as cracks and lack of fusion.”

The existing paragraph 3.2.6.4 is deleted.

Section 3 WELDING PROCEDURE APPROVAL TESTS FOR FILLET WELDS

The existing paragraph 3.3.4.1 is replaced by the following:

“3.3.4.1 The macro examination is to reveal a regular weld profile, sufficient root penetrationand the absence of defects such as cracks, lack of fusion.”

The existing paragraph 3.3.4.4 is replaced by the following:

“3.3.4.4 The visual inspection and non-destructive testing of steel and aluminum alloy test sample are to be respectively in accordance with the requirements for level B of ISO 5817 and ISO 10024 (excess weld metal, excessive convexity and excess penetration for which level C applies) or other equivalent standards.”

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

The existing paragraph 3.4.4.3 is replaced bythe following:

“3.4.4.3 Non-destructive testing is to be in accordance with the requirements for level B of ISO 5817 (excess weld metal, excessive convexity and excess penetration for which level C applies) or other equivalent standards.”

The existing headingof Chapter 5 is replaced by:

“CHAPTER 5 WELDING OF HULL STRUCTURES”

Section 1 GENERAL PROVISIONS

In the existing paragraph 5.1.1.1, “, aluminum alloys” is deleted.

The existing Table 5.1.4.4 is replaced by the following:

“Maximum Heating Temperature on Steel Surface for Line Heating or Spot Heating

Table 5.1.4.4

Item		Standard
Conventional process AH32-EH32, AH36-EH36	Water cooling just after heating	Under 650℃
	Air cooling after heating	Under 900℃
TMCP type AH36-EH36 (Ceq.>0.38%)	Air cooling and subsequent water cooling after heating	Under 900℃(starting temperature of water cooling to be under 500℃)
TMCP type AH32-DH32, AH36-DH36 (Ceq.type AH	Water cooling just after heating or air cooling	Under 1000℃
TMCP type EH32, EH36 (Ceq.type EH	Water cooling just after heating or air cooling	Under 900℃

”

A new paragraph 5.1.5 is added as follows:

“5.1.5 Selection of welding consumables

5.1.5.1 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 ofhull structural steel, and is to comply with the requirements of Table 5.1.5.1.

Selection of Welding Consumables **Table 5.1.5.1**

Hull structural steel grade / Grade of welding consumables	A	B	D	E	AH32 AH36	DH32 DH36	EH32 EH36	FH32 FH36	AH40	DH40	EH40	FH40
1	×											
2	×	×	×									
3	×	×	×	×								
1Y	×				×②							
2Y	×	×	×		×	×						
3Y	×	×	×	×	×	×	×					
4Y	×	×	×	×	×	×	×	×				
2Y40	①	①	①		×	×			×	×		
3Y40	①	①	①	①	×	×	×		×	×	×	
4Y40	①	①	①	①	×	×	×	×	×	×	×	×

Notes:“×” 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.

5.1.5.2 For the joining of steels of different strength levels, the welding consumables in general may be ofa type suitable for the lower strength level except at structural discontinuities or areas of stressconcentration. For the joining of steels of the same strength level but of different toughness grades, thewelding consumables in general may be of a type suitable for the lower toughness grade except for thestructural members subjected to complicated forces or severe construction conditions.

5.1.5.3 Low hydrogen welding consumables are in generalto be used for the joining of higher strength structural steel or of steel with carbon equivalent over 0.41%."

The subsequent paragraphs are renumbered accordingly.

Section 3 INSPECTION AND REPAIRING OF WELDS

The existing paragraph 5.3.2.2 is replaced by the following:

"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 suitablenumber of additional magnetic particle or dye penetrant examinations where necessary. Non-destructive testing is generally to meet the requirements of Chapter 7 of CCS Guidelines for Inspection of Hull Welds or recognized methods of examination and acceptance criteria."

The existing paragraph 5.3.2.4 is replaced by the following:

"5.3.2.4 The number (n) ofnon-destructive testing points in the strength deck and shell within 0.6L amidships (except where enhanced testing is required in 5.3.2.6)may be calculated by the following formula:

$$n = 0.16k(i + 0.1W_T) + 0.04W_L$$

where: n — the number of non-destructive testing points within 0.6L amidships;
k — average breadth of plates within 0.6L amidships, in m, which may be obtained from the following formula:

$$k = \frac{\text{circumference at transverse midship section (excluding opening)}}{\text{number of strakes seen at transverse section}};$$

i — amount of intersections of butt welds within 0.6L amidships;
W_T — whole length of transverse welds within 0.6L amidships, in m;
W_L — whole length of longitudinal welds joining the blocks within 0.6L amidships, in m.

L is the distance on the summer load waterline from the forward side of the stem to the after side of the rudder post, or to the center of the rudder stock if there is no rudder post. L is not to be less than 96%, and need not be greater than 97%, of the extreme length on the summer load waterline. For pontoon hulls, L is the distance on the summer load waterline from the forward side of the fore end plate to the after side of the after end plate. For ships without rudder stocks, L is 97% of the extreme length on the summer load waterline.

The density of non-destructive testing points is to be decreased in number with the decrease of structure importance and stress.

Where non-destructive testing is carried out at an intersection, the direction of testing is to be paralleled to the direction of the transverse welds.

Testing points are generally to be tested by radiographic method."

The existing paragraphs 5.3.2.6 and 5.3.2.7 are replaced by the following:

“5.3.2.6 The welds in the essential areas of hull structures are to be subject to non-destructive testing by radiographic or ultrasonic method (unless otherwise specified) according to the following requirements:

(1) For intersection of butt welds on tank watertight bulkhead, inner bottom plate and hopper tank sloping plate, onein four.

(2) For butt connections of longitudinals and girders at bottom, side and deck,

within 0.4*L* amidships — one in ten;
outside 0.4*L* amidships — one in twenty.

(3) For butt welds at insert plate boundary ofstrength deck hatch corner, at least 2 non-destructive testing at each corner, as shown in Figure 5.3.2.6(3).

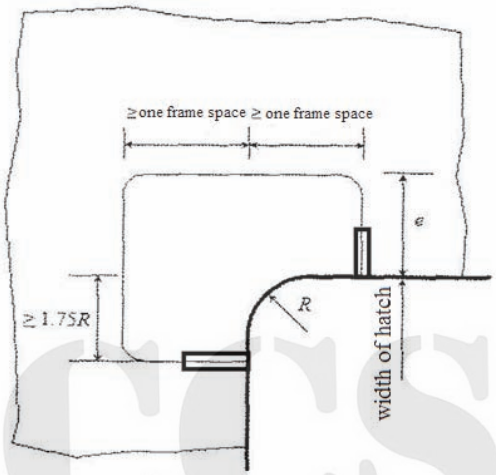


Figure 5.3.2.6(3)

(4) For butt connections 50mm and above in thickness (such as stern frames, shaft brackets, stabilizer recesses, masts and deck stringers),100% non-destructive testing.

(5) When full-penetration fillet welds are used at following positions,non-destructive testingis to be carried out according to the following requirements:

a. connection of main engine foundation girders to top plate:100%;

b. rudder horn and shaft bracket to shell plate of hull structure:100%;

c. connection of rudder side plating to cast rudder stock:100%;

d. edge reinforcement or pipe penetration both to strength deck, sheer strake and bottom plating within 0.6*L* amidships, when the dimensions of the opening exceeds 300 mm:100%;

e. toe connections of longitudinal hatch coaming end bracket to the deck plating: within 0.6*L* amidships:100%; outside 0.6*L* amidships — one in two;

f. connection of inner bottom with transverse bulkheads, lower stools or transverse floors, or connection of lower stools with transverse bulkheads: 35%;

g. connection of hopper tank sloping plates with inner bottom or inner side: 25%;

h. connection of transverse corrugated bulkheads with topside tanks: 35%;

i. deck stringer/sheer strake joint: 10%, and within 0.6*L* amidships:1 m increase for the testing at each erection weld.

(6) For welds with large section, especially welds of steel castings and steel forgings as well aswelds welded under stress or low temperature, welds beveled on one side or both sides (plate thickness 30mm or above) and thick fillet welds, such as welds on stern frames, welded mast and bulkhead stool, 100% surface crack examination is to be carried out.

5.3.2.7 Following locations are to be sampled for non-destructive testing:

(1) restart/stop pointsof automatic butt welds (electro slag, electro gas, submerged arc welding);

(2) butt connections of bilge keel;

(3) butt welds on inner hull and watertight bulkhead of oil tanker;

(4) butt welds on longitudinal continuous hatch coaming and top plate of container ship;

(5) butt connection of longitudinal continuous hatch coaming (including the top plate) more than 0.15*L* inlength, of ships other than container ships;

(6) butt welds at structure change near superstructure;

(7) welds of critical locations determined by direct calculation of structural strength or fatigue strength evaluation;

(8) full penetration welds which are inaccessible or very difficult to inspect in service (such as welds at inner sharp angle within bulb bow of ship);

(9) other strength welds which are deemed important, subject to high stress or may have significant impactafter failure."

The existing Sections 5 to 7 are moved to Chapter 11.

CHAPTER 8 WELDING OF IMPORTANT MACHINERY COMPONENTS

Section 4 NON-DESTRUCTIVE INSPECTION AND WELD REPAIRS OF PROPELLERS

In the existing paragraph 8.4.4.3, the last sentence is replaced by the following:

"Weld repairs are to be undertaken only when they are considered to be necessary and detailed repair information (including sketches or photographs showing the location and major dimensions of the grooves prepared for welding) and inspection procedure are to be submitted to and approved by CCS in advance."

The existing paragraph 8.4.5.3 is replaced by the following:

"8.4.5.3 The use of any welding procedure without prior approval is subject to a satisfactory approval test witnessed by the Surveyor (For detailed test requirements see Table 8.4.5.3). All weld repairs are to be made by certified welders strictly in accordance with approved procedures."

A new Table 8.4.5.3 is added as follows:

"Test requirements for approval of repair welding techniques for propeller Table 8.4.5.3

Material of propeller	Min. dimension of assembly(mm)	Test item	Requirements for test results
Cast copper propeller	30×300×250	Visual inspection and surface liquid penetrant testing: weld length	No surface cracking
		Radiographic testing: weld length	In compliance with recognized standards
		Transverse tensile: 2	Cu1: $R_m \geq 370 N/mm^2$ Cu2: $R_m \geq 410 N/mm^2$ Cu3: $R_m \geq 500 N/mm^2$ Cu4: $R_m \geq 550 N/mm^2$
		Macro: 3	No cracking or pores over3mm in diameter
Cast steel propeller	30×300×400	Visual inspection and surface liquid penetrant testing: weld length	Satisfying requirements for Zone A in Table8.4.3.5
		Radiographic testing: weld length	In compliance with recognized standards
		Transverse tensile: 2	R_m satisfies the minimum requirements specified for base metal
		Side bends: 2	Diameter of former: austenitic stainless steel 3*t*, other materials 4t; after the specimens are bent, they are not to exhibit cracking over 2 mm in length on the surface
		Macro: 2	No cracking or defects similar to cracking, no slag inclusionsor pores over 3 mm in diameter
		Impact: where there are impact requirements for base metal, one set for the center weld and the fusion line respectively	The impact temperature and impact energy satisfy the requirements for base metal

"

In the existing paragraph 8.4.7.2, the last sentence is replaced by the following:

"Subject to prior approval, however, local stress relieving may be considered for minor repairs."

The existing paragraph 8.4.8.1 is replaced by the following:

"8.4.8.1 On completion of weld repair and heat treatment (if adopted), the weld repairs and adjacent material are to be ground smooth and are to be subject to re-inspection in accordance with the relevant requirements in 8.4.3 of this Section."

A new Chapter 11 is added as follows:

“CHAPTER 11 WELDING AND RIVETING OF NON-FERROUS MATERIALS

Section 1 GENERAL PROVISIONS

11.1.1 Application

11.1.1.1 This Chapter applies to welding and riveting of aluminum and titanium material for hull and offshore installations.

11.1.2 Material

11.1.2.1 Welding consumables for aluminum alloy structure are to comply with the relevant requirements of Chapter 2 of this PART.

11.1.2.2 The principle for selection of welding consumables for titanium and titanium alloy material is to comply with the relevant requirements of Section 3 of this Chapter.

11.1.3 Procedure specification and inspection standards

11.1.3.1 Before the commencement of construction, the proposed procedure specification and inspectionstandards are to be submitted to CCS for approval, and a welding procedure test (where necessary) will becarried out on this account, according to the requirements of Chapter 3 of this PART. Welding constructionand inspection are to be carried out in accordance with the plans, procedure specification and inspectionstandards approved by CCS.

11.1.3.2 Welding procedure test for titanium and titanium alloy may be carried out with reference to relevant requirements of CCS Guidelines for Inspection of Hull Welds.

Section 2 WELDING OF ALUMINUM ALLOYS

11.2.1 General requirements

11.2.1.1 This Section applies to the welding of weldable aluminum alloys complying with therequirements of Chapter 8, PART ONE of the Rules.

11.2.1.2 The welding procedure specification for aluminum alloys is to be submitted to CCS for approval. The procedure specification is to include measures for preventing and rectifying welding deformation.

11.2.1.3 The welding procedure approval tests for aluminum alloys are to be carried out according to the relevant requirements in Chapter 3 of this PART.

11.2.1.4 The welders engaged in the welding of aluminum alloys are to be trained in the operational skill and certified accordingly upon qualification tests.

11.2.2 Preparations before welding

11.2.2.1 Protective means against moisture, dust, cold and wind are to be provided at the welding site. The wind speed is to be less than 1.5 m/s during the welding operation.

11.2.2.2 Aluminum alloys may be cut by machining or plasma technique. Edge preparation may be performed by machining such as planing or grinding. Any other proposed method is to be agreed by CCS Surveyor.

11.2.2.3 Wires, welding grooves and adjacent areas are to be thoroughly cleaned, by chemical means where necessary, and kept dry. After cleaning, the welding is to be applied as soon as possible. Usually, the cleaned parts are to be welded within 24 h, otherwise they are to be effectively protected or cleaned again.

11.2.2.4 Preheating is to be considered for the areas to be welded in any one of the following cases:

(1) aluminum alloys with thickness over 8 mm;

(2) ambient temperature below 0℃;

(3) ambient humidity over 80%.

Flame is unacceptable for preheating of aluminum alloys.

The preheating temperature of aluminum-magnesium alloys is generally to be 50℃±10℃.

11.2.2.5 Where inert gas-shielded arc welding is employed, the purity of the shielding gas is to be checked for compliance with the welding procedure specification, prior to welding.

11.2.3 Welding

11.2.3.1 It is recommended that tungsten inert gas arc welding (TIG) or metal inert gas arc welding (MIG) be adopted for aluminum alloy structures. Both ends of important welds are to be provided with temporary run-on and run-off tabs.

11.2.3.2 Main butt welds are to be downhand butt welded with an angle of inclination less than 20° as faras possible.

11.2.3.3 To minimize the deformation, the following are to be complied with while welding:

(1) starting at the center of the seam and welding outward symmetrically or welding with back stepsequence for a single long weld;

(2) starting at the center weld and welding outward symmetrically for long and close-spacedwelds;

(3) the dimensions of the welds are not to be enlarged as far as possible so long as the design requirementsare met.

11.2.3.4 The continuity of welding is to be kept; where for any reason the welding is interrupted, thelocation of stopping is to be cleaned before striking the arc; and the succeeding weld is to be overlapped onthe previous one for an adequate length. Where the multi-run welding technique is employed, care is to betaken to the cleaning and the interpass temperature between two runs.

11.2.3.5 Root runs are to be cut out to clean metal and weld defects removed by machining such as planingor grinding.

11.2.3.6 For full penetration butt welds, back chipping is required to eliminate all defects after the frontside is welded.

11.2.3.7 Where multi-run welding is used, the surface of each run of the deposit is to be thoroughlycleaned before the next run is deposited, and the interpass temperature is to be controlled at 60℃or loweras far as possible.

11.2.3.8 If spatters are visibly attached to the nozzle during MIG welding, the nozzle is to be renewed orcleaned. If the tungsten electrode is found oxidized or defective in shape during TIG welding, it is to berenewed or repaired by grinding. If the tungsten electrode touches the molten bath or the wire, the weldingis to be stopped immediately, and the welds having tungsten inclusions are to be thoroughly cleaned. Thewire and tungsten electrode stained are also to be cleaned.

11.2.3.9 Where steel-aluminum transition joints are welded, heat input is to be strictly controlled inorder to prevent harmful effects to the joints.

11.2.3.10 For intersections of major structures at a small angle, beveling and welding are generally to beperformed at the back side, and the leg length of the fillet weld is to comply with the design. The deformation of aluminum alloy structures resulted from the welding is preferably not to be rectified by hammering. Heating for rectification, where employed, is to be carried out in accordance with instructions of the aluminum alloy manufacturer.

11.2.4 Inspection and repairingof welds

11.2.4.1 Final welds are to be subjected to visual inspection and non-destructive examination. The methods of examination and acceptance criteria are to be agreed by CCS.

11.2.4.2 The range of non-destructive examination of welds of main hull structures is to be agreed between the shipyard and the Surveyor. It is recommended that at least 5% of butt welds of main hull structures be radiographic tested. Fillet welds of important structures are to be ultrasonically tested. The defects are to be evaluated in accordance with the standards acceptable to CCS.

11.2.4.3 The surface of welds is to be free from defects such as cracks, tungsten inclusions, unfilled cavities, pores, burning damages and overlaps. Undercuts are not permitted for plates of 3 mm or less in thickness. For plates over 3 mm in thickness, the depth of undercuts is not to begreater than 0.5 mm, theirtotal length is not to be greater than 10% of the length of a single weld and not to exceed 100 mm.

11.2.4.4 The weld repairs for aluminum alloys are generally not to be carried out more than twice, unlessagreed by CCS.

11.2.4.5 Weld repairs are to be carried out using the same welding consumables and procedures as thoseadopted for the original welds. After repairing, the welds are to be inspected again.

Section 3 WELDING OF TITANIUM AND TITANIUM ALLOYS

11.3.1 General requirements

11.3.1.1 This Section applies to the welding of weldable titanium alloys complying with the requirements of Chapter 9, PART ONE of the Rules.

11.3.1.2 The titanium alloy components are to be designed to keep their structural continuity and the smooth transition of weld joints to avoid stress concentration.

11.3.1.3 Titanium and titanium alloys are to be welded according to relevant welding procedure specifications.

11.3.1.4 The welders engaged in the welding of titanium and titanium alloys are to have been trained in the operational skill and certified accordingly upon qualification tests.

11.3.1.5 Personnel engaged in quality inspection of welding is to be subject to technical training so as to have a correct command of quality assessment standards.

11.3.2 Welding consumables

11.3.2.1 The argon-shielded arc welding wires used for titanium and titanium alloys are usually to be of a material homogeneous with the base material.

11.3.2.2 In order to improve plasticity of weld joints, wires with an alloying level lower than that of the base material may be used.

11.3.2.3 For welding of titanium materials of different grades, wire materials are to be selected according to the base material with better corrosion resistance and lower strength level or as required by design.

11.3.3 Preparations before welding

11.3.3.1 Form and size of the edge preparation are to be determined according to factors such as joint type, thickness of base material, welding position, welding method, with or without backing and conditions for use, beveled edges with as less filler metal as possible are to be considered.

11.3.3.2 Titanium alloy materials and their beveled edges may be cut by machining, flame, water jet or plasma, among which flame cutting and plasma cutting are to avoid sparks on the surface of titanium alloy material, and cutting edge and beveled edge are still to be processed and removed from polluted layer by mechanical means. Grinding wheels, saw blades and files which have been used for steel cutting can not be used again to cut titanium alloys. The surface of processed edges is to be smooth and flat, without defects and impurities that will affect quality. The surface of beveled edges is to have silver-white metallic luster.

11.3.3.3 Dirt such as oil, water and dust as well as oxide scale on surfaces of wires and beveled edges and within 20 mm to 50 mm of both sides are to be removed, using degreasing, mechanical cleaning or chemical cleaning according to surface contamination and thickness of scale.

11.3.3.4 Thoroughly cleaned wires and weldments are to be kept clean and dry to avoid recontamination. Oxidized parts at ends are to be cut, and oxidized wire surface is to be cleaned by chemical means. Welding is to be carried out as quickly as possible after cleaning. If welding is not carried out for 4h, cleaning is to be carried out again.

11.3.3.5 Titanium alloys are to be welded under following conditions:

(1) Titanium alloys are generally to be welded in independent locations. If welding is carried out at workshops, it is to be divided from the steel operation area to form an independent and enclosed titanium welding area.

(2) Welding is to be far from air intakes and open doors and windows, and the welding site is to be cushioned with rubber, etc.

(3) The ambient temperature is to be not less than 5℃, and the relative humidity is to be not more than 80%.

(4) During operation, the wind speed is to be less than 1.5 m/s.

11.3.4 Assembly and alignment

11.3.4.1 The jigs used for the alignment of weld joints or for cooling runs in adjacent areas are to be of copper or other nonmagnetic materials.

11.3.4.2 During assembly, tools and jigs used as well as beveled edges are to be kept clean. The procedure for tack welding is to be the same as that for normal welding. Tack welds are to be free of such defects as cracks, pores and slag inclusions, otherwise timely removal of these defects and rewelding are to be carried out. Rewelding is to be carried out at adjacent areas.

11.3.4.3 Oxide layers (only silver-white and yellow ones allowed) are to be removed from the surface of tack welds, and the transition of both sides of welds are to be made smooth to facilitate restarting, otherwise rectification is to be carried out.

11.3.5 Welding

11.3.5.1 The usual welding methods for titanium alloy components include argon-shielded tungsten arc welding, metal argon-shielded arc welding and plasma welding.

11.3.5.2 Titanium can not be connected by penetration welding to many metals such as steel. Mixing with steel and other metals is prohibited in penetration welding of titanium.

11.3.5.3 The parameters of the welding procedure is to be selected to ensure adequate penetration depth and good protection to avoid defects, and welding rules requiring small energy input are to be adopted so far as practicable.

11.3.5.4 A reasonable welding sequence, welding method or rigid fixing is to be adopted to reduce welding deformation and stress.

11.3.5.5 During argon-shielded tungsten arc welding, contact of the tungsten electrode with weld metal is to be avoided. If contact occurs, the contaminated layer is to be removed and the tip of the tungsten electrode is to be repaired by grinding before further welding.

11.3.5.6 The continuity of welding is to be kept. If the welding is interrupted, the succeeding weld is to be overlapped on the previous one for 10 mm to 20 mm. Where the multi-run welding technique is employed, care is to be taken to the cleanliness between two runs and the interpass temperature, craters are to be filled and the restart point is to be fused and fully penetrated.

11.3.5.7 During argon-shielded welding, the purity of argon is not to be less than 99.99%, and reliable argon shield is to be provided to both front and back of the weld. Protection by a welding torch and an additional trailing protection are to be adopted for the front side of the weld at the same time. The back of the weld may be protected by introducing shielding gas into the groove of the jig backing plate, providing a gas shield to the back or filling argon into the weldment, depending on shape and size of the weldment.

11.3.5.8 During welding, gas is to fed in advance and cut off with a time delay. The delay for cutting off gas is to be so determined that the weld at the stop point after cooling will be silver white or light yellow.

11.3.5.9 During multi-layer multi-run welding, the metal surface of each weld layer is to be examined and cleaned as required to ensure the quality of each run. Light yellow and light blue scales are to be erased using stainless steel wire brushes and residual impurities are to be removed using clean white silk cloth and acetone (or alcohol). Such defects as tungsten inclusions and cracks created during welding are to be cut away in time using a power-driven hard alloy knife. For butt welding and full penetration fillet welding which are continuous at both sides, a back sealing run is to be applied after the root run is cut out to clean metal. The root run is to be gouged as required by the welding procedure. For titanium alloy welds, root runs are to be cut to clean metal by chipping, planing or grinding rather than carbon arc-air gouging.

11.3.5.10 After welding, slag, overlap, spatter and other dirt on the surface of the weldment are to be removed. Local rectification is to be carried out to welds when necessary.

11.3.5.11 To prevent delayed cracking, hydrogen content in the welding atmosphere is to be controlled strictly during welding. Thick walls or important components are to be subject to stress relieving heat treatment after welding.

11.3.6 Inspection and repairing of welds

11.3.6.1 Final welds are to be subjected to visual inspection and non-destructive examination. The methods of examination and acceptance criteria are to be agreed by CCS.

11.3.6.2 The original surface color of all titanium welds and heat affected zones is to be inspected. The color of welds and adjacent zones is to be silver white or yellow. For other colors, oxidation tint is to be removed or repair is to be carried out.

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 examinations and the procedures and standards used are to be in compliance with the standards acceptable to CCS (such as JB/T4730).

11.3.6.4 The welds are to have a uniform and sound profile, with a smooth transition to the parent metal, and are to be free from cracks, lack of fusion, overshoot undercuts, pores, slag inclusions and craters.

11.3.6.5 No cut with a depth equal or greater than 0.5 mm is allowed on the surface of titanium alloy welds. Such cuts, if any, are to be removed. After removal of such cuts, the weld surface is not to be lower than the surface of the parent metal.

11.3.6.6 Titanium alloy weld repairs are to be carried out using the same welding consumables and proceduresas those adopted for the original welds. The weld repairs for the same position are generally not to be carriedout more than twice, unless agreed by CCS. The surface of the repaired welds is to be subjected to dye penetranttesting again.

11.3.6.7 Where tools and jigs are used for temporarily fixing connection welds, the surface of weld marks left after their removal is also to be subjected to dye penetranttesting.

Section 4 RIVETING

11.4.1 General requirements

11.4.1.1 This Section applies to the riveting of aluminum alloy hull structures only.

11.4.1.2 Riveting is to be carried out in accordance with the approved procedure specification.

11.4.1.3 The manufacturer is to prepare a detailed riveting procedure specification and submit it to CCS for approval.

11.4.1.4 The material of rivets used is to be suitable for the structural material and comply with therelevant requirements ofChapter 8, PART ONE of the Rules. The sealing filler used in the riveted seams is to be suitable for the structural material, and is not to cause electro-chemical corrosion or any other chemical reaction.

11.4.2 Preparation of rivet holes

11.4.2.1 Rivet holes are generally to be drilled by electric or pneumatic means only. Care is to be taken for properly drilling cold-work hardened materials.

11.4.2.2 Where countersunk rivets or semi-countersunk rivets are used and the plate is to be reamed, the angle of the reamer cone is to be suitable for the rivet. When the plate thickness is the same as the depth of the hole, the latter may be reduced by 0.5 mm.

11.4.2.3 The rivet holes of structural members, which are to be riveted, are to be aligned with each other and are to have good fit with rivets. The rivet holes are to be smooth and free from burrs or sharp edges.

11.4.2.4 The diameter, out-of-roundness and center deviation of finished rivets are to comply withtolerances in the relevant standards. The vertical deviation of the axis of rivet holes in respect to the surface of the structural member is to be less than one tenth of the thickness of the structural member.

11.4.3 Preparations before riveting

11.4.3.1 Generally, riveting is to be carried out after welding, perforating and rectifying of the area to be riveted and adjacent areas are finished.

11.4.3.2 The riveted surfaces are to be smooth, clean, tight and free from inclusions. The anticorrosive paint or sealing filler is to be applied only after the structure is thoroughly dried. The thickness of the sealing filler is to be approximately the same for the entire length.

11.4.3.3 In order that the riveting work will be done satisfactorily, suitably spaced locating holes are to be drilled to a diameter slightly smaller than that of rivets at riveting positions to temporarily fixing structural members with bolts before riveting.

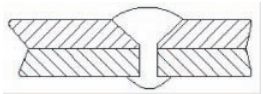
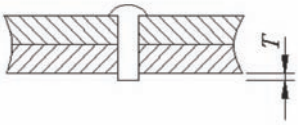
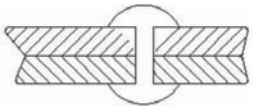
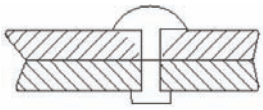
11.4.3.4 Before riveting, the rivets, rivet holes and hole reaming are to be checked for compliance with specified requirements.

11.4.4 Riveting of structures

11.4.4.1 Riveting is to proceed fore and aft symmetrically from the center.

11.4.4.2 The exposed length of the rivet shank is to be as required in Table 11.4.4.2.

Exposed Length of Rivet Shank **Table 11.4.4.2**

Rivet diameter *d*(mm)	Type of closing heads	Shape of closing heads	Extension length *T*(mm)	Remark
3~25	Semi-countersunk head		0.8*d*~1.2 *d*	From the values given for flat closing heads, the larger one is to be taken, and approximately 1 mm is to be added to exposed length of three layers 
3~25	Cup head		1.5 *d*~1.7 *d*	
3~13	Flat head		1.3 *d*~1.4 *d*	

11.4.4.3 The air hammer and dolly used are to be suitable for the diameter of rivets used.

11.4.4.4 Except that the agreement of the Surveyor is to be obtained in special cases, the flat head of flat head rivets is to be positioned as follows:

(1) The flat head is to be on the section side where a plate and a section are riveted together.

2) The flat head is to be on the side of the thicker material where the materials to be riveted are different in thickness.

(3) The flat head is to be on the side of the harder material where the materials to be riveted are different in hardness.

11.4.4.5 Where two different metallic materials are to be riveted together, an anticorrosive and insulating material is to be used between them to prevent electro-chemical corrosion.

11.4.4.6 Riveting is to be finished in a single operation as far as practicable and further rectification is not suitable.

11.4.5 Inspection of riveted seams

11.4.5.1 The riveting pitch, row spacing and rivet diameter are to comply with the requirements of plans.

11.4.5.2 After riveting, the surfaces of the structural members around rivets are to be tightly pressed against each other and no obvious indention is to be found at riveting positions.

11.4.5.3 The dimensions of the heads of rivets are to comply with relevant standards. The rivets are to be free from loosening, head eccentricity, cracks, etc.”