



RULES
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CHINA CLASSIFICATION SOCIETY

RULES FOR MATERIALS AND WELDING

AMENDMENTS

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PART ONE METALLIC MATERIALS

CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS

Section 1 GENERAL PROVISIONS

[3.1.1.4 Factories manufacturing steel plates, sections and mooring chain steels are to be approved in accordance with the requirements of CCS Guidelines for Survey of Marine Products.](#)

Section 9 CLAD STEEL PLATES

3.9.3.1 Any material suitable for the intended purposes, such as [austenitic](#) stainless steel, chromium steel, aluminum alloy, [titanium alloy](#) or copper-nickel alloy steel etc., may be accepted as cladding material.

3.9.6.3 The tensile test is to be carried out according to the following procedure:

Firstly, one test specimen representing the full clad steel plate (including the machined test specimen for reduced thickness) is to be tested. The tensile strength R_c obtained is not to be less than the value calculated from the following formula:

$$R_c = \frac{t_1 R_1 + t_2 R_2}{t_1 + t_2} \quad \text{N/mm}^2$$

where: t_1 — nominal thickness of base material, in mm;

t_2 — nominal thickness of cladding material, mm;

R_1 — specified minimum yield strength (R_{eH}) or proof strength ($R_{p0.2}$) or tensile strength (R_m) of base material, in N/mm²;

R_2 — specified minimum yield strength (R_{eH}) or proof strength ($R_{p0.2}$) or tensile strength (R_m) of cladding material, in N/mm²;

R_c — specified minimum yield strength (R_{eH}) or proof strength ($R_{p0.2}$) or tensile strength (R_m) of the clad steel plate, in N/mm².

Where the tensile strength R_c obtained is lower than the value calculated from the formula, the other specimen (from which the cladding material has been removed) is to be tested. The result obtained is to comply with the requirements for the base material. [The measured elongation A is not be less than the nominal value of the base material. When the nominal elongation value of the cladding material is less than that of the base material, it is allowed that the elongation of the clad steel plate is less than the nominal value of the base material, but it should not be less than the nominal value of the cladding material. Meanwhile, a tensile test of a base material specimen is to be additionally carried out, the elongation A of which is not to be less than the nominal value of the base material.](#)

3.9.7 Corrosion tests

3.9.7.1 Where the cladding material is stainless steel required to be corrosion-resistant, specimens for intergranular tests are to be prepared in accordance with Section 7 of Chapter 2 of this PART.

[3.9.7.2 Where the cladding material is duplex stainless steel required to be pitting corrosion-resistant, specimens for pitting corrosion tests are to be prepared in accordance with Section 9 of Chapter 2 of this PART.](#)

CHAPTER 5 STEEL FORGING

Section 1 GENERAL PROVISIONS

~~5.1.6.5 If the forging is supplied in the “as forged” condition, the manufacturer is to ensure that a suitable ultrasonic examination is carried out on the forging to verify the internal quality of the forging.~~

5.1.6.56 Where advanced non-destructive testing methods(ANDT) are applied, the requirements of Appendix 2 of PART THREE of the Rules for Materials and Welding are to be complied with.

5.1.6.67 Unless agreed by CCS Surveyor, these tests are to be carried out in the presence of the CCS Surveyor.

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

- (1) CCS inspection mark;
- (2) cast number or other marking which will enable the full history of the forging to be traced;
- ~~(3) test pressure (if any);~~
- (34) brand or grade of forging material;
- ~~(45) date of final inspection;~~
- (56) 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.

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);~~
- (89) method and results of non-destructive testing (where applicable).

Section 3 FORGINGS FOR SHAFTING AND MACHINERY

5.3.6.3 The non-destructive testing for other forgings may be carried out in accordance with the requirements given in the drawings approved by CCS [or recognized standards](#).

Section 4 FORGINGS FOR CRANKSHAFTS

5.4.5.2 The number of test specimens for crankshaft forgings is to comply with the following:

- (4) One set of specimens: ~~for carbon and carbon-manganese steels, one tensile test specimen is to be taken from each crankshaft forging;~~ for alloy steels, one tensile and a set of three impact test specimens are required.

Section 5 FORGINGS FOR GEARING

5.5.1.2 Gear wheel and rim forgings with a minimum tensile strength not less than 400 N/mm² and not in excess of 760 N/mm² may be made in carbon or carbon-manganese steel. Gear wheel or rim forgings where the minimum tensile strength is in excess of 760 N/mm², and all pinion or pinion sleeve forgings, are to be made in a suitable alloy steel. [Specifications for alloy steel are to be submitted to CCS for approval.](#)

5.5.6.1 The mechanical properties for gear forgings made in carbon or carbon-manganese steel and alloy steel are to comply with the requirements of Tables 5.3.5.1 and 5.4.6.2 of this Chapter [respectively](#). For carburized gear forgings to which low temperature tempering heat treatment has applied, the up limit of tensile strength in Table 5.3.5.1 is not applicable.

CHAPTER 6 STEEL CASTINGS

Section 3 CASTINGS FOR MACHINERY CONSTRUCTION

6.3.4.1 At least one tensile test specimen [and one set of three Charpy V-notch impact test specimens are is](#) to be made on at least one test sample representing each casting or batch of castings from the same cast.

CHAPTER 8 ALUMINIUM ALLOYS

Section 2 ALUMINIUM ALLOY PLATES AND SECTIONS

8.2.4.2 Aluminium alloys are generally to be supplied in any of the following conditions:

- O — annealed
- H111 — annealed and slightly hardened (e.g. straightening)
- H112 — strain hardened from working at elevated temperatures
- H116 — with specified resistance to corrosion [after strain-hardened](#) for aluminium alloys where the magnesium content not less than 3.0%
- H32 — deformation hardened and stabilization processed
- H321 —for aluminium alloys with a magnesium content not less than 3.0%, deformation hardened and stabilization processed
- T5 — hot worked and artificially aged
- T6 — solution heat treated and artificially aged

CHAPTER 9 OTHER NON-FERROUS MATERIALS

Section 1 COPPER ALLOY PROPELLERS

9.1.7 Marking and certification

9.1.7.1 Each [cast](#) propeller [eastng](#) 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-final weight](#);
- 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 mark, ~~where the casting is found satisfactory.~~

9.1.7.2 Each satisfactorily inspected [cast](#) propeller [eastng](#) is to be provided with a certificate containing the following details:

- a) purchaser's name and order number;
- b) ship's name [or the shipbuilding project number](#), if known;
- c) description of the casting [in the drawing](#) (e.g. 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 testing;
- k) results of mechanical tests;

Section 4 TITANIUM ALLOY PLATES

9.4.5.2 A tensile specimen and a set of 3 Charpy impact specimens (for plate thicknesses of more than 10 mm) and 2 bend test specimens are to be taken from each sample according to the following requirements:

(1) The tensile specimen is to be the flat proportional specimen specified in item 1 of Table 2.2.2.1, Chapter 2 of this PART (specimen may be P7 specimen with width of 12.5 mm [according to the relevant recognized standards](#)). For a plate thickness of more than 40 mm, a round bar specimen specified in Item 2 may also be used (but specimen diameter may be 5 mm), with the axis of the specimen located at 1/4 of the thickness of the plate.

(2) If the plate thickness is not more than 40 mm, the impact specimens are to be such that their edges are within 2 mm from the rolled surface; if the plate thickness is more than 40 mm, the axis of the specimen is to be located at 1/4 of the thickness of the plate. The axis of the specimen is to be perpendicular to the rolling direction and the notch of the specimen is to be perpendicular to the rolled surface.

(3) For each of the two bend test specimens, at least one tension face is to be kept as the original rolled surface and the axis is to be perpendicular to the rolling direction. If specimens of plates with a thickness of more than 5 mm are 15 mm in width, their thickness may be reduced to 5 mm on one side.

CHAPTER 10 EQUIPMENT

Section 4 STEEL WIRE ROPES

10.4.2.3 Boat falls are to be of rotation-resistant and corrosion-resistant steel wire rope.

Construction of Steel Wire Ropes

Table 10.4.2.2

Purpose	Construction of rope			Construction of strands					Designation
	Strands	Wires	Core	Core	Core wire	Inner layer	Middle layer	Outer layer	
Stream wires Towlines Mooring lines	6	24	Fibre	Fibre	0	–	9	15	(0 + 9 + 15)
	6	37	Fibre	Wire	1	6	12	18	(1 + 6 + 12 + 18)
	6	26	Fibre	Wire	1	5	(5+5)	10	(1 + 5 + $\frac{5}{5}$ + 10)
	6	31	Fibre	Wire	1	6	(6+6)	12	(1 + 6 + $\frac{6}{6}$ + 10 ₂)
	6	36	Fibre	Wire	1	7	(7+7)	14	(1 + 7 + $\frac{7}{7}$ + 10 ₄)
	6	41	Fibre	Wire	1	8	(8+8)	16	(1 + 8 + $\frac{8}{8}$ + 10 ₆)
	6	30	Fibre	Fibre	0	–	12	18	(0 + 12 + 18)
Towlines and mooring lines used in association with mooring winches	6	31	Wire	Wire	1	6	(6+6)	12	(1 + 6 + $\frac{6}{6}$ + 12)
	6	36	Wire core	Wire	1	7	(7+7)	14	(1 + 7 + $\frac{7}{7}$ + 14)
	6	41	Wire core	Wire	1	8	(8+8)	16	(1 + 8 + $\frac{8}{8}$ + 16)

PART TWO NON-METALLIC MATERIALS

CHAPTER 2 PLASTICS MATERIALS

Section 2 RAW MATERIALS

2.2.7.6 The working conditions of epoxy resin chocks intended for approval are a static load usually not greater than 0.7 N/mm² caused by equipment weight (not greater than 0.9 N/mm² for diesel engines with rated speed lower than 300 r/min), maximum static load (equipment weight plus bolt fastening force) not greater than 4.5 N/mm² on chocks and temperature not greater than 80°C. The requirements for properties of the castings are given in Table 2.2.7.6. For items not mentioned in the table, the results are to comply with limit values specified in the standards or by the manufacturer.

Requirements for Properties of Resin Chock Castings

Table 2.2.7.6

Compressive strength N/mm ²	Compressive modulus N/mm ²	Barcol hardness	Heat deflection temperature °C	Flammability	Water absorption ^① %	Oil absorption ^① %
ASTM D695	ASTM D695	ASTM D2583	ISO 75-2	ASTM D635	ISO 62	ISO 62
≥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.

2.2.7.7 Where the castings are to be used for installation of stern tubes and stern bushes, the measured tensile strength and modulus of elasticity in tension are to be provided, in addition to the requirements of [2.2.7.7](#) [2.2.7.6](#). The tensile strength is not to be less than 34 MPa (ASTM D638).

2.2.9 Cast epoxy putty for low-temperature tanks

2.2.9.1 Bi-component thermosetting epoxy putty used to bind saddle of low-temperature [liquefied gas liquid cargo](#) (such as LEG, LPG, LNG) tanks and supporting frame is subject to CCS approval before use.

2.2.9.2 Product manufacturers are to provide complete construction technical files, including recommended design principle, construction methods and requirements for reference.

2.2.9.3 Samples are to be cast in accordance with the construction procedures and the following performances are to be tested after the samples are set, [and the result is to meet the standards or the limits set by the manufacturer](#):

- (1) Barcol hardness;
- (2) density;
- (3) compressive strength and compressive modulus of elasticity (~~tests are carried out at~~ 20°C, -50°C, -110°C, -195°C);
- (4) shearing strength (~~tests are carried out at~~ 20°C, -50°C, -110°C, -195°C);
- (5) linear expansion coefficient (-30°C~+30°C);
- (6) creep (at 70°C, for 2000 h, creep under 2.5 MPa and 7 MPa are tested respectively);
- (7) compressive deformation (20°C, -195°C);
- (8) compressive yield strength (20°C, -195°C).

2.2.10 Cargo bearer

2.2.10.1 [Cargo bearer refers to a laminated product made of beech, birch and other hardwood sheets impregnated in thermosetting resin and pressed at high temperature. It is used for support of LEG, LPG, LNG and other low temperature liquid cargo tanks.](#)

2.2.10.2 [Cargo bearer is to be approved by CCS.](#)

2.2.10.3 [The size, density, type of wood used and type of resin used are to be indicated in the quality certification documents and packaging of cargo bearer.](#)

2.2.10.4 [Cargo bearer is to be free from bubbling, cracks, dead joints, wormholes, decay, pollution and attached foreign matters, etc. The surface of the machined cuts are to be smooth and the lamination be even. There are not to be defects such as separation of adhesive layer, stripping of surface and bulging.](#)

2.2.10.5 [The designer is to take into account that deformation of the cargo bearer after long-term dynamic](#)

compression can still meet the design requirements.

2.2.10.6 The cargo bearer is to be tested for the following properties and the results are to meet the standards or limits set by the manufacturer:

(1) density;

(2) compressive strength (perpendicular and parallel) (20°C, -196°C);

(3) deformation (perpendicular and parallel) (20°C, -196°C);

(4) water absorption;

(5) oil absorption (lubricating oil);

(6) water resistance (after 4 weeks submerged in artificial seawater, compressive strength tested in perpendicular and parallel direction);

(7) oil resistance (after 4 weeks submerged in lubricating oil, compressive strength tested in perpendicular and parallel direction);

(8) thermal conductivity (perpendicular);

(9) coefficient of linear thermal expansion (perpendicular);

(10) shear strength (perpendicular, parallel and interlaminar, at 20°C and -196°C);

(11) coefficient of friction (applicable to sliding supports. Friction coefficient of the friction pair combination after installation is to be measured at room temperature, e.g.: the friction pair composed of cargo bearer and stainless steel, or the friction pair composed of bearer and bearer, etc.).

2.2.10.7 If the cargo bearer is used in an area where it may be in contact with water and oil, protective measures may be taken. The protective measures taken are to be compatible with the cargo bearer and not to affect the wood and resin composition of the bearer. After taking protective measures, the bearer is to be submerged as mentioned in 2.2.10.6(6)(7) to verify the effectiveness of the protective measures. The result of compressive strength test after submerging is not to be lower than 97% of that before submerging. Or, the data for design are to be taken after the bearer is stabilized after being submerged in water and oil.

2.2.10.8 If the cargo bearer is used above deck, its compressive strength, shear strength and deformation at 80°C are to be tested. The testing directions are to be the same as those in 2.2.10.6, and the results are to meet the recognized standards or the limits set by the manufacturer.

CHAPTER 3 FIBER-REINFORCED PLASTIC HULL MATERIALS

Section 1 GENERAL PROVISIONS

3.1.3 Procedure approval

Mechanical Properties of Test Specimen

Table 3.1.3.3(5)

Items	Standard	CSM & BLAXIAL / BLAXIAL type complex mat / CSM & BLAXIAL type complex mat
Tensile strength (N/mm ²)	ISO 527-4	800 G ² - 80 G + 37
Tensile modulus (N/mm ²)	ISO 527-4	38000 G - 5000
Bending strength (N/mm ²)	ISO 14125	502 G ² + 107
Flexural modulus (N/mm ²)	ISO 14125	38000G - 6500
Compressive strength (N/mm ²)	ISO 604	150 G + 72
Compressive modulus (N/mm ²)	ISO 604	7000
Interlaminar shear strength (N/mm ²)	ISO 14130	glass fiber ≥ 20 carbon fiber and aramid fiber ≥ 17
Fiber content <u>by weight</u> (% by mass)	ISO 1172 (glass fiber) ASTM D3171 (carbon fiber / aramid fiber)	G
Barcol hardness	ASTM D2583	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 three digits after the decimal point, e.g. 0.502. 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.

PART THREE WELDING

CHAPTER 2 WELDING CONSUMABLES

Section 2 MECHANICAL PROPERTIES OF WELDING CONSUMABLES

2.2.2 Consumables for welding structural steels

2.2.2.3 The mechanical properties of consumables for welding structural steels are to comply with the requirements given in Table 2.2.2.3.

Mechanical Properties of Consumables for Welding Structural Steels Table 2.2.2.3

Grade of welding consumables	1,2,3	1Y 2Y 3Y 4Y ^①	2Y40 3Y40 4Y40 5Y40	3Y42 4Y42 5Y42	3Y46 4Y46 5Y46	3Y50 4Y50 5Y50	3Y55 4Y55 5Y55	3Y62 4Y62 5Y62	3Y69 4Y69 5Y69	3Y89 4Y89 5Y89	3Y96 4Y96 5Y96	1.5Ni	3.5Ni	5Ni	9Ni		
Deposited metal test	Yield strength ^② R_{eH} (N/mm ²)	≥305	≥375	≥400	≥420	≥460	≥500	≥550	≥620	≥690	≥890	≥960	≥375			≥400	
	Tensile strength ^③ R_m (N/mm ²)	400-560	490-660	510-690	520-680	540-720	590-770	640-820	700-890	770-940	940-1100	980-1150	≥460	≥420	≥500	≥640	
	Elongation A(%)	≥22			≥20			≥18			≥17	≥14	≥13	≥22	≥25		
	Charpy V-notch impact test	④											-80	-100	-120	-196	
Butt Butt weld test	Transverse tensile strength (N/mm ²)	≥400	≥490	≥510	≥520	≥540	≥590	≥640	≥700	≥770	940	980	≥490	≥450	≥540	≥640	
	Charpy V-notch impact test	④											-80	-100	-120	-196	
	Average impact energy ^⑤ (J)	≥47 ^⑥			≥47			≥50	≥55	≥62	≥69	≥69	≥69	≥34			
	Bend test	After testing, the test specimens are not to reveal any open defects in any direction greater than 3 mm ^⑦															

Notes: ① Manual arc welding electrodes are to comply with Grade 2Y and above ([i.e., Grade 1Y is not applicable to manual welding electrodes](#)).

- ② The temperature of impact test for welding consumables of Grade 1 and Grade 1Y is to be 20°C; for those of Grades 2, 2Y, 2Y40 to be 0°C; for those of Grades 3, 3Y, 3Y40, 3Y42, 3Y46, 3Y50, 3Y55, 3Y62, 3Y69, 3Y89, 3Y96 to be -20°C; for those of Grades 4Y, 4Y40, 4Y42, 4Y46, 4Y50, 4Y55, 4Y62, 4Y69, 4Y89, 4Y96 to be -40°C; for those of Grades 5Y40, 5Y42, 5Y46, 5Y50, 5Y55, 5Y62, 5Y69, 5Y89, 5Y96 to be -60°C.
- ③ The average impact energy of deposited metal test of submerged arc automatic welding is not to be less than 34 J for welding consumables with $R_{eH} < 400$ N/mm²; not to be less than 39 J for those with $R_{eH} \geq 400$ N/mm².
- ④ The average impact energy of butt joints of vertical welding and submerged arc automatic welding is not to be less than 34 J for welding consumables with $R_{eH} < 400$ N/mm²; not to be less than 39 J for those with $R_{eH} \geq 400$ 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. The acceptance values of impact test for 5Y89 and 5Y96 grades will be specially considered by CCS.
- 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.

CHAPTER 3 APPROVAL OF WELDING PROCEDURES

Section 1 GENERAL PROVISIONS

3.1.4 Application of approved welding procedures

3.1.4.9 The upper limit of heat input approved is 25% greater than that used in the test or 55 kJ/cm, whichever is smaller. For high heat input processes over 50 kJ/cm, the upper limit is 10% greater than that used in the test. Welding heat input is generally to be calculated as follows:

$$HI = \frac{U \times I \times 60}{v \times 1000}$$

where: HI: heat input (kJ/cm) U: arc voltage (V) I: welding current (A) v: travel speed (cm/min). If the heat input is corrected by thermal efficiency coefficient or other means of calculation is adopted, this is to be stated. Generally, correction by the thermal efficiency coefficient may not be considered. For multi-wire welding method and composite heat source welding method, the heat input is to be calculated as the sum of that of each wire or heat source.

Section 2 WELDING PROCEDURE APPROVAL TESTS FOR BUTT WELDS

3.2.7 Additional requirements for welding procedures approval tests of stainless steels

3.2.7.1 For austenitic stainless steel, in addition to the relevant requirements of 3.2.4.1 and 3.2.5 above, the following requirements are to be complied with:

- (1) generally only the center of the weld is subject to the impact test (test temperature is -20°C). In deep cold condition (at -100°C or below), generally the center of the weld, fusion line, heat affected zones 1 mm, 3mm and 5mm from the fusion line respectively are to be subject to a set of three impact tests individually (test temperature is -196°C), and with the approval of CCS, only the weld center needs to be tested. The impact energy is not to be less than 27 J;
- (2) the hardness test may be omitted;
- (3) the intergranular corrosion test of welds is to be carried out in accordance with the requirements of Section 7, Chapter 2, PART ONE of the Rules (for austenitic stainless steel used in non-corrosive medium, it may be omitted).

CHAPTER 5 WELDING OF HULL STRUCTURES

Section 3 INSPECTION AND REPAIRING OF WELDS

5.3.2 Inspection

5.3.2.1 On completion of welding of hull structures, visual inspection is to be carried out by the shipyard or the manufacturer on all the finished welds. The surface of welds is to be uniform, with a smooth transition to the base metal and free from excessive reinforcements and defects such as cracks, lack of fusion and one-side welds with incomplete root penetration. Surface pores and undercuts are to be limited to the permissible extent.

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

- (1) restart/stop points of 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 0.15L in

length, 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) [longitudinal butt welds joining the blocks](#) ~~transverse erection welds~~ for catamarans [or multi-hull ships](#);

(10) other strength welds which are deemed important, subject to high stress or may have significant impact after failure.

CHAPTER 9 WELDING OF PRESSURE PIPES

Section 1 GENERAL PROVISIONS

9.1.2 Material

9.1.2.1 The [following welding](#) requirements [in this Chapter](#) apply to ~~the types of steels used in~~ the fabrication of Class I and II piping systems operating at ambient or elevated temperatures, [and the applicable types of steels are given as follows](#) :

(1) carbon and carbon-manganese steels having minimum tensile strength (R_m) of 320, 360, 410, 460 or 490 N/mm²;

(2) low alloy steels having chemical compositions of 0.3Mo, 1Cr0.5Mo, 2.25CrMo or 0.5Cr0.5Mo0.25V.

9.1.2.2 ~~The welding requirements in this Chapter may also apply to The above materials may also be used in~~ the fabrication of Class III piping systems [made of the above materials](#) and repair welding of pipelines.

Section 3 INSPECTION OF WELDING QUALITY

9.3.2 Visual inspection

9.3.2.1 [On completion of welding of piping, visual inspection is to be carried out by the shipyard or the manufacturer on all the welds.](#) The surface of welds is to be free from cracks, overlaps, pores, undercuts, unfilled cavities and depressions. In case of the above defects, repairs by welding are to be performed.

CHAPTER 11 WELDING AND RIVETING OF NON-FERROUS MATERIALS

Section 2 WELDING OF ALUMINUM ALLOYS

11.2.4 Inspection and repairing of welds

11.2.4.1 Final welds are to be subjected to visual inspection and non-destructive testing. The methods of ~~non-destructive testing-examination~~ and acceptance criteria are to be agreed by CCS, [and generally comply with Chapter 7 of CCS Guidelines for Inspection of Hull Welds or recognized standards.](#)

11.2.4.2 The range of non-destructive testing 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.~~[The range of non-destructive testing is generally to meet the following requirements:](#)

[\(1\) Generally, not less than 5% of butt welds of the main hull strength deck and the shell plating within 0.5L amidships, and generally not less than 2% of them beyond 0.5L amidships, are to be radiographic tested. The radiographic testing is to be arranged at appropriate positions according to the structural features, mainly distributed at intersecting welds and welds in high stress areas.](#)

(2) Fillet welds of important structures are to be ultrasonically tested.

(3) If necessary, the surveyor may require an increase in the quantity of non-destructive testing.