China Classification Society

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDTENTS

Effective from: Jul. 1, 2019

Beijing

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China Classification Society

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDMENTS

PART 1 GENERAL

Effective from: Jul. 1, 2019

PART 1 GENERAL

The paragraph 1.1 is revised as follow:

"1.1 Unless expressly provided otherwise, *Rules for Construction of Ocean-going Steel Fishing Vessels* (hereinafter referred to as the Rules) apply to ocean-going steel fishing vessels of 24 m and over in length (hereinafter referred to as fishing vessels).

Unless in accordance with the specific provisions of the Rules, fishing vessels of 90 m and over in length are also to comply with the requirements of China Classification Society (hereinafter referred to as "CCS") *Rules for Classification of Sea-going Steel Ships*. Contents not covered in this Rules, such as fishing appliances and refrigeration apparatus are to comply with the relevant requirements of the Rules."

China Classification Society

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDMENTS

PART 2 HULL

Effective from: Jul. 1, 2019

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

1.1.1.2 Deleted.

1.1.1.3 The article number 1.1.1.3 is revised to “1.1.1.2”.

Section 2 HULL STRUCTURAL MEMBERS

The paragraph 1.2.4.1 is revised as follow:

“1.2.4.1 Primary members are to be so arranged as to ensure the effective continuity of the structure, and abrupt changes of depth or section are to be avoided. Where members about on both sides of a bulkhead, or on other members, arrangements are to be made to ensure that ther are in alignment. If the fish tank is of liquid storage type, the primary members in tank are to form a continuous line of support and wherever possible, a complete ring framing. The connections of the ring framing are to be made of rouded corners having an adequate radius, and. the radius of rounded corners is in general not to be less than the web depth of the adjacent members.”

1.2.5.6 The description “the depth of the members h>100 mm or” is deleted from the paragraph1.2.5.6.

Section 4 WELD DESIGN FOR HULL STRUCTURES

The paragraph 1.4.2 is revised as follow:

“**1.4.2 Welding consumables**

1.4.2.1 Welding consumables used for hull structures are to comply with the requirements of CHAPTER 3 of PART 8. The grade of welding consumables selected is to be suitable for the grade of hull structure steel, and is to comply with the requirements of Table 1.4.2.1.

Selection of welding consumables Table 1.4.2.1

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	×	×	×	×	×	×	×	×

Note: “×” 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 should not exceed 25 mm.

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

1.4.2.3 Low hydrogen electrodes are to be used for welding of the following structural members and components:

(1) Circumferential butt welds in the joining of block sections and butt welds of girders.

(2) End and side joints of the shell of ships with ice strengthening;

(3) Masts, derricks, boat davits, bollards and other outfits subjected to heavy loads and all other highly stressed fittings;

(4) Components for which high rigidity is required, such as stems,stern frames, propeller shaft brackets,and joints between them and the shell plating and the hull framing;

(5) Main engine seatings and the associated structural members.

1.4.2.4 It is recommended that low hydrogen welding consumables be used for the joining of higher strengrh structural steel or of steel with carbon equivalent over 0.41%."

The section 7 is revised as follows:

Section 7 COMPARTMENT TIGHTNESS TEST

1.7.1 General requirements

1.7.1.1 These test procedures are to confirm the watertightness of tanks and watertight boundaries and the structural adequacy of tanks which consist of the watertight subdivisions of ships. These procedures may also be applied to verify the weathertightness of structures and shipboard outfitting. The tightness of all tanks and watertight boundaries of ships during new construction and those relevant to major conversins or major repairs [1] is to be confirmed by these test procedures prior to the delivery of the ship.

1.7.2 Application

1.7.2.1 All gravity tanks [2] and other boundaries requiring watertight or weathertight verification are to be tested in accordance with this procedure and proven to be tight and structurally adequate as follows:

(1) gravity tanks for their tightness and structural adequacy;

(2) watertight boundaries other than tank boundaries for their watertightness; and;

(3) weathertight boundaries for their weathertightness.

1.7.2.2 The testing of structures not listed in Table 1.7.2.2 are to be specially considered.

Test requirements for tanks and boundaries Table 1.7.2.2

No.	tanks or boundaries to be tested	Test type	Test head or pressure	Remark
1	Double bottom tanks	Leak and structural[note 1]	The greater of: ● top of the overflow ● to 2.4m above top of tank [note2], or ● to bulkhead deck	
2	Double bottom voids [note4]	Leak	See 1.7.4.4 (4) through 1.7.4.4 (6), as applicable	including pump room double bottom and bunker tank protection double

[1]Major repair means a repair affecting structural integrity .

[2]Gravity tank means a tank that is subject to vapor pressure not more than 70 kPa.

				hull required by MARPOL Annex I l
3	Double side tanks	Leak and structural note1	The greater of - top of the overflow, - to 2.4 m above top of tank note2, or - to bulkhead deck	
4	Double side voids	Leak	See 1.7.4.4 (4) through 1.7.4.4 (6), as applicable	
5	Deep tanks other than those listed elsewhere in this Table	Leak and structural note1	The greater of - top of the overflow, - to 2.4 m above top of tank note2,	
6	Peak tanks	Leak and structural note 1	The greater of - top of the overflow, - to 2.4 m above top of tank note2	After peak to be tested after installation of stern tube
7	(1) Forepeak space with equipment	Leak	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
	(2) Forepeak voids	Leak	See 1.7.4.4 (4) through 1.7.4.4 (6), as applicable	
	(3) Afterpeak space with equipment	Leak	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
	(4) Afterpeak voids	Leak	See 1.7.4.4 (4) through 1.7.4.4 (6), as applicable	After peak to be tested after installation of stern tube
8	Cofferdams	Leak	See 1.7.4.4 (4) through1.7.4.4 (6), as applicable	
9	(1) Watertight bulkheads	Leak	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable note 6	
	(2) Superstructure end bulkheads	Leak	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
10	Watertight doors below working deck	Leak note 5 and 6	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
11	Double plate rudder blades	Leak	See 1.7.4.4 (4) through 1.7.4.4 (6), as applicable	
12	Shaft tunnels clear of deep tanks	Leak note 3	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
13	Shell doors	Leak note 3	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
14	Weathertight hatch covers and closing appliances	Leak note 3 and 6	See 1.7.4.4 (3) through1.7.4.4 (6), as applicable	Hatch covers closed by tarpaulins and battens excluded
15	Dual purpose tanks/dry cargo hatch covers	Leak note 3 and 6	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	Hatch covers closed by tarpaulins and battens excluded
16	Chain lockers	Leak and structural note1	Top of chain pipe	
17	L.O. sump. tanks and other similar tanks/spaces under main engines	Leak note7	See 1.7.4.4 (3) through 1.7.4.4 (6), as applicable	
18	Ballast ducts	Leak and structural note 1	The greater of: • Ballast pump maximum pressure, or • Setting of any pressure relief valve	
19	Fuel Oil tanks	Leak and structural note 1	The greater of: • Top of the overflow; • to 2.4m above the top of tank note 2, or • to top of tank note 2 plus setting of any pressure relief valve, or • to bulkhead deck	

Note 1: Refer to 1.7.4.2 (2).

Note 2: The top of a tank is the deck forming the top of the tank, excluding any hatchways.

Note 3: Hose Test may also be considered as a medium of the test. See 1.7.3.2.

Note 4: Including duct keels and dry compartments, and/or oil fuel tank protection and pump room bottom protection arranged in accordance with the provisions of MARPOL Annex I, Chapter 3, Part A regulation 12A and Chapter 4, Part A, regulation 22 respectively.

Note 5: Where water tightness of a watertight door has not been confirmed by prototype test, testing by filling watertight spaces with water is to be carried out (see SOLAS II-1/16.2 and Notification MSC / Circ.1176).

Note 6: As an alternative to the hose testing, other testing methods listed in 1.7.4.4 (7) through1.7.4.4 (9) may be applicable subject to adequacy of such testing methods being verified.(See SOLAS II-1/11.1). An alternative to the hose testing may only be used where a hose test is not practicable.

Note 7: Where L.O. sump tanks and other similar spaces under main engines intended to hold liquid form part of the watertight subdivision of the ship, they are to be tested as per the requirements of Item 5, Deep tanks other than those listed elsewhere in this table".

1.7.3 Test types and definitions

1.7.3.1 The following two types of tests are specified in this requirement:

(1) Structural test:

A test to verify the structural adequacy of tank construction. This may be a hydrostatic test or, where the situation warrants, a hydropneumatic test.

(2) Leak test:

A test to verify the tightness of a boundary. Unless a specific test is indicated, this may be a hydrostatic/hydropneumatic test or an air test. A hose test may be considered an acceptable form of leak test for certain boundaries, as indicated by Footnote 3 of Table 1.7.2.2.

1.7.3.2 The definition of each test type is shown in Table 1.7.3.2.

Test Type Table 1.7.3.2

Hydrostatic test (Leak and structural)	A test wherein a space is filled with a liquid to a specified head.
Hydropneumatic test: (Leak and structural)	A test combining a hydrostatic test and an air test, where in a space is partially filled with a liquid and pressurized with air.
Hose test (Leak)	A test to verify the tightness of a joint by a jet of water with the joint visible from the opposite side.
Air test (Leak)	A test to verify tightness by means of air pressure differential and leak indicating solution. It includes tank air test and joint air tests, such as compressed air fillet weld tests and vacuum box test.
Compressed Air Fillet Weld test (Leak)	An air test of fillet welded tee joints wherein leak indicating solution is applied on fillet welds.
Vacuum Box test (Leak)	A box over a joint with leak indicating solution applied on the welds. A vacuum is created inside the box to detect any leaks.
Ultrasonic test (Leak)	A test to verify the tightness of the sealing of closing devices such as hatch covers by means of ultrasonic detection techniques.
Penetration test (Leak)	A test to verify that no visual dye penetrant indications of potential continuous leakages exist in the boundaries of a compartment by means of low surface tension liquids (i.e. dye penetrant test)..

1.7.4 Test procedures

1.7.4.1 General

(1) Tests are to be carried out in the presence of a Surveyor at a stage sufficiently close to the completion of work with all hatches, doors, windows, etc. installed and all penetrations including pipe connections fitted,and before any ceiling and cement work is applied over the joints. Specific test requirements are given in 1.7.4.4 and Table 1.7.2.2. For the timing of the application of coating and the provision of safe access to joints, see 1.7.4.5, 1.7.4.6 and Table 1.7.4.1 (1).

Provisions for application of the safety access, coating and penetration test of different types of welded joints

Application of Leak Test, Coating and Provision of Safe Access for Type of Welded Joints Table 1.7.4.1 (1)

Type of welded joints		Leak test	Coating [Note 1]		Safe access [Note 2]	
			Before leak test	After leak test & structural tests	Leak test	Structural test
Butt	Automatic	Not required	Allowed [Note 3]	N/A	Not required	Not required
	Manual or Semi-automatic [Note 4]	Required	Not allowed	Allowed	Required	Not required

Fillet	Boundary including penetrating	Required	Not allowed	Allowed	Required	Not required

Note 1: Coating refers to internal (tank coating), where applied, and external (shell/deck) painting. It does not refer to shop primer.

Note 2: Temporary means of access for verification of the leak test.

Note 3: The condition applies provided that the welds have been carefully inspected visually to the satisfaction of the Surveyor.

Note 4: Flux Core Arc Welding (FCAW) semiautomatic butt welds need not be tested provided that careful visual inspections show continuous uniform weld profile shape, free from repairs, and the results of NDT testing show no significant defects.

1.7.4.2 Structural test procedures

(1) Type and time of test

① Where a structural tests is specified in Table 1.7.2.2. a hydrostatic test in accordance with1.7.4.4 (1) will be acceptable. Where practical limitations (strength of building berth, liquid density of liquid,etc) prevent the performance of a hydrostatic test, a hydropneumatic test in accordance with 1.7.4.4(2) may be accepted instead..

② A hydrostatic test or hydropneumatic test for the confirmation of structural adequacy may be carried out while the vessel is afloat, provided that the results of a leak test are confirmed to be satisfactory before the vessel is afloat.

(2) Testing schedule for new construction or major structural conversion

① Tanks which are intended to hold liquids, and which form part of the watertight subdivision of the ship, shall be tested for tightness and structural strength as indicated in Table 1.7.2.2.

② The tank boundaries are to be tested from at least one side. The tanks for structural test are to be selected so that all representative structural members are tested for expected tension and compression.

③ Structural test are to be carried out for at least one tank of a group of tanks having structural similarity (i.e. same design conditions, alike structural configurations with only minor lcalised differences determined to be acceptable by the attending Surveyor) on each vessel provided all other tanks are tested for leaks by an air test. The acceptance of leak testing using an air test instead of a structural test does not apply to cargo space boundaries adjacent to other compartments in tankers and combination carriers or to the boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships.

④ Additional tanks may require structural testing if found necessary after the structural testing of the first tank.

⑤ Where the structural adequacy of the tank of a vessel were verified by the structural testing required in Table 1.7.2.2, subsequent vessels in the series (i.e. sister ships built from the same plans at the same shipyard) may be exempted from structural testing of tanks, provided that:

a water-tightness of boundaries of all tanks is verified by leak tests and thorough inspections are carried out;

b structural testing is carried out for at least one tank of each type among all tanks of each sister vessel;

c additional tanks may require structural testing if found necessary after the structural testing of the first tank or if deemed necessary by the attending Surveyor.

⑥ Sister ships built (i.e.keel laid) two years or more after the delivery of the last ship of the series, may be tested in accordance with 1.7.4.2 (2) ⑤ of this Section at the discretion of CCS ,provided that:

a、 general workmanship has been maintained (i.e.there has been no discontinuity of shipbuilding or significant changes in the construction methodology or technology at the yard, shipyard personnel are appropriately qualified and demonstrate an adequate level of workmanship as determined by CCS); and;

b、 an NDT plan is implement and evaluated by CCS for the tanks not subject to structural tests. . Shipbuilding quality Standards for of the hull structure during new constructed are to be reviewed and agreed during the kick-off meeting. Structural fabrication is to be carried out in accordance with Appendix 2 to CHAPTER 4, PART 1, VOLUME 1 of *Rules for Classification of Sea-going Steel Ships*, or a recognized fabrication standard which has been accepted by CCS prior to the commencement of fabrication/construction. The work is to be carried out in. accordance with the Rules and under survey by CCS.

⑦ The watertight boundaries of spaces (except chain lockers) other than tanks for structural testing may be exempted, provided that the water-tightness of boundaries of exempted spaces is verified by leak tests and inspections.

⑧ Tanks which do not form part of the watertight subdivision of the ship, may be exempted from structural testing provided that the watertightness of boundaries of exempted spaces is verified by leak test and inspections.

1.7.4.3 Leak test procedures

(1) For the leak tests specified in Table 1.7.2.2, tank air tests, compressed air fillet weld tests, vacuum box tests in accordance with 1.7.4.4(4) through 1.7.4.4(6), or their combination, will be acceptable. Hydrostatic or hydropneumatic tests may also be accepted as leak tests provided that 1.7.4.5, 1.7.4.6 and 1.7.4.7 are complied with. Hose tests will also be acceptable for such locations as specified in Table 1.7.2.2, Footnote 3, in accordance with 1.7.4.4 (3)

(2) The application of the leak test for each type of welded joint is specified in Table 1.7.4.1 (1).

(3) Air tests of joints may be carried out in the block stage provided that all work on the block that may affect the tightness of a joint is completed before the test. See also 1.7.4.5(1) (for the application of final coatings)、1.7.4.6 (for the safe access to joints) and the summary in Table 1.7.4.1 (1).

1.7.4.4 Test methods

(1) Hydrostatic test

① Hydropneumatic tests, where approved, are to be such that the test condition, in conjunction with the approved liquid level and supplemental air pressure, will simulate the actual loading as far as practicable.The requirements and recommendations for tank air tests in 1.7.4.4 (4) will also apply to hydropneumatic tests. See also 1.7.4.7

② All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

(2) Hydropneumatic test

① Unless another liquid is approved, hydrostatic tests are to consist of filling the space with fresh water or sea water, whichever is appropriate for testing, to the level specified in 1.7.4.4 (4) . See also 1.7.4.7.

② All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

(3) Hose test

① Hose tests are to be carried out with the pressure in the hose nozzle maintained at least at 2×10^5Pa during the test. The nozzle is to have a minimum inside diameter of 12 mm and be at a perpendicular distance from the joint not exceeding 1.5 m. The water jet is to impinge directly upon the weld.

② Where a hose test is not practical because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by a careful visual examination of welded connections, supported where necessary by means such as a dye penetrant test or ultrasonic leak test or the equivalent.

(4) Tank air test

① All boundary welds, erection joints and penetrations, including pipe connections, are to be examined in accordance with approved procedure and under a stabilized pressure differential above atmospheric pressure not less than 0.15×10^5Pa, with a leak indicating solution such as soapy water/detergent or a proprietary brand applied.

② A U-tube with a height sufficient to hold a head of water corresponding to the required test pressure is to be arranged. The cross sectional area of the U-tube is not to be less than that of the pipe supplying air to the tank.

③ Arrangements involving the use of two calibrated pressure gauges to verify the required test pressure may be accepted.

④ A double inspection is to be made of tested welds. The first is to be immediately upon applying the leak indication solution; the second is to be after approximately four or five minutes in order to detect those smaller leaks which may take time to appear.

(5) Compressed air fillet weld test

① In this air test, compressed air is injected from one end of a fillet welded joint and the pressure verified at the other end of the joint by a pressure gauge. Pressure gauges are to be arranged so that an air pressure of at least 0.15 ×105Pa can be verified at each end of all passages within the portion being tested.

Note: Where a leak test is required for fabrication involving partial penetration welds, a compressed air test is also to be applied in the same manner as to fillet weld where the root face is large, i.e., 6-8 mm.

(6) Vacuum box test

① A box (vacuum testing box) with air connections, gauges and an inspection window is placed over the joint with a leak indicating solution applied to the weld cap vicinity. The air within the box is removed by an ejector to create a vacuum of 0.20×10^5~0.26×10^5Pa inside the box.

(7) Ultrasonic test

① An ultrasonic echo transmitter is to be arranged inside of a compartment and a receiver is to be arranged on the outside. The watertight/weathertight boundaries of the compartment are scanned with the receiver in order to detect an ultrasonic leak indication. A location where sound is detectable by the receiver indicates a leakage in the sealing of the compartment.

(8) Penetration test

① A test of butt welds or other weld joints uses the application of a low surface tension liquid at one side of a compartment boundary or structural arrangement. If no liquid is detected on the opposite sides of the boundaries after the expiration of a defined period of time, this indicates tightness of the boundaries. In certain cases, a developer solution may be painted or sprayed on the other side of the weld to aid leak detection.

(9) Other tests

① Other methods of testing may be considered by CCS upon submission of full particulars prior to the commencement of testing.

1.7.4.5 Application of coating

(1) Final coating

① For butt joints welded by an automatic process, the final coating may be applied any time before the completion of a leak test of spaces bounded by the joints, provided that the welds have been carefully inspected visually to the satisfaction of the Surveyor.

② Surveyors reserve the right to require a leak test prior to the application of final coating over automatic erection butt welds.

③ For all other joints, the final coating is to be applied after the completion of the leak test of the joint. See also Table 1.7.4.1 (1)

(2) Temporary coating

① Any temporary coating which may conceal defects or leaks is to be applied at the time as specified for the final coating (see 1.7.4.5 (1)). This requirement does not apply to shop primer.

1.7.4.6 Safe access to joints

For leak tests, safe access to all joints under examination is to be provided. See also Table 1.7.4.1 (1)

1.7.4.7 Hydrostatic or hydropneumatic tightness test

In cases where the hydrostatic or hydropneumatic tests are applied instead of a specific leak test, examined boundaries must be dew-free, otherwise small leaks are not visible ."

CHAPTER 2 HULL STRUCTURES

Section 1 LONGITUDINAL STRENGTH

The paragraph 2.1.1.2 is revised as follow:

"2.1.1.2 The proportions of principal dimensions of fishing vessels are to comply with the following requirements:

$$L/B > 5$$

$$B/D < 2.5$$"

The paragraph 2.1.4.2 is revised as follow:

“2.1.4.2 The strength deck and all continuous longitudinal members below the strength deck within 0.4*L* amidships may be included in the calculation of hull girder section modulus. The extension of the sheer strake above the strength deck and the continuous stringer angles may be included in the calculation.."

2.1.4.3 Deleted.

2.1.4.4 The article number 2.1.4.4 is revised to "2.1.4.3"; and the description “for the cases in 2.1.4.2 and 2.1.4.3 of this PART” in the paragraph is revised to “for the cases in 2.1.4.2 of this PART”.

The article number 2.1.4.5~2.1.4.8 is revised to “2.1.4.4~2.1.4.7”.

Section 2 SHELL PLATING

The paragraph 2.2.1.7 is revised as follow:

“2.2.1.7 Where 24m≤L<30m, the thickness of bottom shell plating within 0.4L amidships is to be equal to that of the bottom shell plating amidships.”

The paragraph 2.2.6.1 is revised as follow:

“2.2.6.1 Trawlers:

The thicknesses of sheer strakes in way of trawler gallows and the strakes below is to be 1 mm greater respectively than the thickness of the sheer strake and side shell plating within 0.4L amidships over an extent at least 1 m forward and 2 m aft of the gallows.

Inclined half-round chafing bars are to be arranged at the external side of the vessel from the top of bulwark to 0.3 m below the maximum draft waterline, over an extant at least 1 m forward and 2 m aft of the trawl gallows, spaced not more than 400 mm apart. If the inward indentation below the work deck is great, the chafing bars can only be arranged at the sites with an indentation of 400 mm compared to working deck.”

Section 6 DOUBLE BUTTOMS

2.6.1.1 The description "where L≥75 m” is deleted in the paragraph

The paragraph 2.6.1.2 is revised as follow:

“2.6.1.2 Cofferdams are to be provided between oil compartments in the double bottom and compartments intended for drinking water, boiler water .”

Section 8 DECK FRAMING

2.8.2.2 Deleted.

The article number 2.8.2.3~2.8.2.7 is revised to “2.8.2.2~2.8.2.6”

The title of Section 12 is revised as follows:

“Section 12 STEMS, STERN FRAMES, RUDDER POST, BULBOUS BOWS,

PROPELLER SHAFT BRACKETS AND PROPELLER DUCT”

2.12.8 Deleted.

Section 17 BULWARKS

The new paragraph 2.17.1.5 is added as follows:

"2.17.1.5 The thickness of bulwark plating in way of trawl gallows and purse winch seat is to be 2 mm greater than that requirements in 2.17.1.1 of this Section.”

The title of Section 19 is revised as follows:

"Section 19 SPECIAL STRUCTURES OF FISHING VESSELS"

The new paragraph 2.19.4 is added as follows:

"2.19.4 Transom counter

2.19.4.1 The thickness of transom plating is to comply with the requirements in 2.2.4.4 of this CHAPTER.

2.19.4.2 The scantlings of framing in way of the transom counter are to be equal to those of peak framing. Where necessary, web frames are to be adopted for strengthening. "

The new Section 20 is added as follows:

"Section 20 ADDITIONAL PROVISION FOR STRUCTURE OF FISHING VESSELS OF 90 m AND OVER IN LENGTH.

2.20.1 General requirements

2.20.1.1 This Section applies to fishing vessels in unrestricted service. For fishing vessels in restricted service, a reduction may be made in accordance with the provisions of PART TEN of *Rules for Classification of Sea-going Steel Ships*.

2.20.1.2 If not covered in this Section, the requirements of Chapters 1 to 4 of PART 2 of *Rules for Classification of Sea-going Steel Ships* are to be complied with.

2.20.2 Shell and inner bottom plating

2.20.2.1 The thicknesses of bottom shell plating and the thickness of bilge plating, within 0.4L amidships are to be 0.5 mm greater respectively than that required in Section 3, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.2.2 The thicknesses of bottom shell plating within 0.075 *L* from ends is to be 0.5 mm greater than that required in Section 3, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.2.3 The thicknesses of bottom shell plating adjacent to plate keel within 0.25 *L* from the forward perpendicular is not to be less than that required in 2.20.2.1 of this Section.

2.20.2.4 The thickness of bottom shell plating in way of the bilge well is to be adequately increased, or effective anti-corrosion means are to be provided.

2.20.2.5 The thicknesses of side shell plating and sheer strakes within 0.4L amidships is to be 0.5 mm greater than that required in Section 3, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.2.6 The thicknesses of side shell plating within 0.075 *L* from ends is to be equal to that required in 2.20.2.2 of this Section.

2.20.2.7 For trawlers, the thickness of sheer strakes in way of trawl gallows and the strakes below is to be 1 mm greater respectively than that required in 2.20.2.5 of this Section over an extent at least 1 m forward and 2 m aft of the gallows.

2.20.2.8 For seine boats, the thickness of shell plating in way of purse winch seat is to be increased by 1 mm over a suitable extent.

2.20.2.9 The thicknesses of inner bottom plating in the area of fish holds is to be 1 mm greater than that required in Section 6, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.3 Decks and bulkhead plating

2.20.3.1 The thicknesses of strength deck is to be 0.5 mm greater than that required in Section 4, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.3.2 The thickness of deck under turn table is to be increased by 1 mm.

2.20.3.3 The thickness of deck under trawl winch, seine winch, trawl gallows, purse winch seat, windlass, etc. is to be 2 mm greater than that required in Section 4, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.3.4 The thicknesses of bulkhead plating in the area of fish holds is to be 1 mm greater than that required in Section 12, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.4 Bottom, side, deck and bulkhead framing

2.20.4.1 The web thickness of centre keelson and side keelson and the thickness of single bottom floors in the area of fish holds are to be 1 mm greater respectively than that required in Section 5, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.4.2 For trawlers, inclined half-round steel or equivalent chafing bars are to be arranged at the side plating and the external side of bulwark from the top of bulwark to 0.3 m below the designed load waterline over an extent at least 1 m forward and 2 m aft of the trawl gallows, spaced not more than 400 mm apart. If the inward indentation below the work deck is great, the chafing bars can only be arranged at the sites with an indentation of 400 mm compared to working deck.

2.20.4.3 Side stringers are to be fitted in accordance with the relevant requirements of Section 15, CHAPTER 2, PART TWO of *Rules for Classification of Sea-going Steel Ships* from the collision bulkhead to 0.25 L from the forward perpendicular. Where the side stringers are not fitted, the section modulus of main frames is to be 25% more than that required in Section 7, CHAPTER 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.4.4 The section modulus of side framing in the area of fish holds is to be increased by 10% more than that required in Section 7, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.4.5 The deck framing under trawl winch, seine winch, trawl gallows, purse winch seat and windlass is to be adequately strengthened.

2.20.4.6 The deck framing may be calculated according to the relevant requirements of Section 8, CHAPTER 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*, but the span l of deck beam is not to be less than B/3 when calculating the section modulus of deck beam, with B being breadth of the vessel.

2.20.4.7 The section modulus of deck framing in the area of fish holds is to be increased by 10% more than that required in Section 8, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.4.8 The section moduli of bulkhead stiffeners and girders in the area of fish holds are to be increased respectively by 10% more than that required in Section 12, Chapter 2, PART TWO of *Rules for Classification of Sea-going Steel Ships*.

2.20.5 Stern ramp and transom counter

2.20.5.1 The thickness t of stern ramp plating and the section modulus W of stiffeners of stern trawlers are not to be less than those obtained respectively as follows:

$$t = 8 + 0.1L \text{ in mm}$$

$$W = 16sl^2 \text{ in cm}^3$$

Where: L——length of vessel, in m;

s——spacing of stiffeners, in m;

l——stiffeners of span, in m.

The thickness of side plating of the stern ramp is to be 1 mm greater than that required in 2.20.2.2 of this PART. It is recommended that chafing bars or plates of increased thickness be fitted to the ramp and ramp sides liable to excessive wear.

2.20.5.2 The thickness of transom plating is to comply with 2.20.2.6 of this Section.

2.20.5.3 The scantlings of framing in way of the transom counter are to be equal to those of the peak framing. Where necessary, web frames are to be adopted for strengthening.

2.20.6 Fish hatch

2.20.6.1 The thickness of hatch coamings is to comply with the relevant requirements of Section 20, CHAPTER 2, PART TWO of *Rules for Classification of Sea-going Steel Ships,* but not to be less than 8 mm.

2.20.7 Bulwarks and guardrails

2.20.7.1 The thickness of bulwark plating in way of working deck is not to be less than that obtained from the following formula:

$$t = 0.067L + 2 \quad \text{mm}$$

Where: *L*——length of vessel, in m.

2.20.7.2 The thickness of bulwark plating in way of trawl gallows and purse winch seat is to be 2 mm greater than that required in 2.20.7.1 of this Section.

2.20.7.3 The spacing of bulwark stays is, in general, not to be more than 2 frame spaces apart. The bulwark stays are to be fitted at every frame in way of trawl gallows, purse winch seat, forward bulwarks and raised bulwarks at stern."

CHAPTER 3　OUTFITS

The section 1 is revised as follows:

"Section 1　RUDDERS

3.1.1　General requirements

3.1.1.1　Application

(1) The Section applies to ordinary profile rudders, and to some enhanced profile rudders with special arrangements for increasing the rudder force.Rudders not conforming to the profilr types included in this Section will be subject to special consideration.

(2) This section applies to rudders made of steel. Rudders made of material different from steel will be subject to special consideration.

3.1.1.2　Design considerations

(1) Effective means are to be provided for supporting the weight of the rudder without excessive bearing pressure, e.g. by a rudder carrier attached to the upper part of the rudder stock. The hull structure in way of the rudder carrier is to be suitably strengthened.

(2) Suitable arrangements are to be provided to prevent the rudder from lifting.

(3) In rudder trunks which are open to the sea, a seal or stuffing box is to be fitted above the deepest load waterline, to prevent water from entering the steering gear compartment and the lubricant from being washed away from the rudder carrier. If the top of the rudder trunk is below the deepest waterline, two separate stuffing boxes are to be provided.

3.1.1.3　Materials:

(1) Welded parts of rudders are to be made of materials complying with relevant requirements for hull structural steel in PART 7.

(2) I Material factor k for normal and high tensile steel plating may be taken into account when specified in each individual rule requirement. The material factor k is to be taken as defined in 1.5.1 of this PART, , unless otherwise specified.

(3) Steel grade of plating materials for rudders and rudder horns are to be in accordance with Section 3, CHAPTER 1 of this PART.

(4) Rudder stocks, pintles, coupling bolts, keys and cast parts of rudders are to be made of rolled, forged or cast carbon manganese steel in accordance with PART 7.

(5) For rudder stocks, pintles, keys and bolts the minimum yield stress is not to be less than 200N/mm^2. The requirements of this Section are based on a material's yield stress of 235N/mm^2. If material is used having a yield stress differing from 235N/mm^2 the material factor K is to be determined as follows:

$$K = \left(\frac{235}{R_{eH}}\right)^e$$

Where: e = 0.75 for R_{eH}>235N/mm^2;

e = 1.00 for R_{eH}≤235N/mm^2;

R_{eH}——yield stress of the material used, and is not to be taken greater than 0.7R_m or 450N/mm^2, whichever is the smaller value, in N/mm^2;

R_m——Tensile strength of the material used, in N/mm^2.

3.1.1.4　Welding and design details

(1) Slot-welding is to be limited as far as possible. Slot welding is not to be used in areas with large in-plane stresses transversely to the slots or in way of cut-out areas of semi-spade rudders.

When slot welding is applied, the length of slots is to be minimum 75 mm with breadth of 2t, where t is the rudder plate thickness, in mm. The distance between ends of slots is not to be more than 125 mm. The slots are to be fillet welded around the edges and filled with a suitable compound, e.g. epoxy putty. Slots are not to be filled with weld.

Continuous slot welds are to be used in lieu of slot welds. When continuous slot welding is applied, the root gap is to be between 6-10 mm. The bevel angle is to be at least 15°.

(2) In way of the rudder horn recess of semi-spade rudders, the radii in the rudder plating are not to be less than 5 times the plate thickness, but in no case less than 100 mm. Welding in side plate is to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.

(3) Welds between plates and heavy pieces (solid parts in forged or cast steel or very thick plating) are to be made as full penetration welds. In way of highly stressed areas e.g. cut-out of semi-spade rudder and upper part of spade rudder, cast or welding on ribs is to be arranged. Two sided full penetration welding is normally to be arranged. Where back welding is impossible welding is to be performed against ceramic backing bars or equivalent. Steel backing bars may be used and are to be continuously welded on one side to the heavy piece.

(4) Requirements for welding and design details of rudder trunks are described in 3.1.9.2 of this Section.

(5) Requirements for welding and design details when the rudder stock is connected to the rudder by horizontal flange coupling are described in 3.1.6.1 (4) of this Section.

(6) Requirements for welding and design details of rudder horns are described in 3.1.9.1 (3) of this Section.

3.1.1.5 Equivalence

(1) CCS may accept alternatives to requirements given in this Section, provided they are deemed to be equivalent.

(2) Direct analyses adopted to justify an alternative design are to take into consideration all relevant modes of failure, on a case by case basis. These failure modes may include, amongst others: yielding, fatigue, buckling and fracture. Possible damages caused by cavitation are also to be considered

(3) Where deemed necessary by CCS, lab tests, or full scale tests may be requested to validate the alternative design approach.

3.1.2 Rudder force and rudder torque

3.1.2.1 Rudder blades without cut-outs

(1) The rudder force C_R upon which the rudder scantlings are to be based is to be determined from the following formula:

$$C_R = 132 K_1 K_2 K_3 A V^2 \quad \text{in N}$$

Where: C_R——rudder force, in N;

A——area of rudder blade, in m^2;

V——maximum service speed, in kn. When the speed is less than 10 kn, V is to be replaced by the following:

$$V_{min} = (V + 20) / 3$$

For astern condition the maximum astern speed V_{astern} is to be useed, however, in no case less than:

$$V_{astern} = 0.5\ V$$

K_1——factor depending on the aspect ratio λ of the rudder area;

$K_1 = (\lambda + 2) / 3$, with λ not to be taken greater than 2;

$\lambda = b^2/A_t$;

b——*mean* height of rudder area, in m. The mean rudder breadth and mean height of rudder are calculated according to the coordinate system in Figure 3.1.2.1;

A_t——sum of rudder blade area A and area of rudder post or rudder horn, if any, within the height b, in m^2;

K_2——coefficient depending on the type of the rudder and the rudder profile according to Table 3.1.2.1; data may be provided by tests with approval of CCS;

K_3——factor, taken as follows:

= 0.8 for rudders outside the propeller jet

= 1.15 for rudders behind a fixed propeller nozzle

=1.0 otherwise.

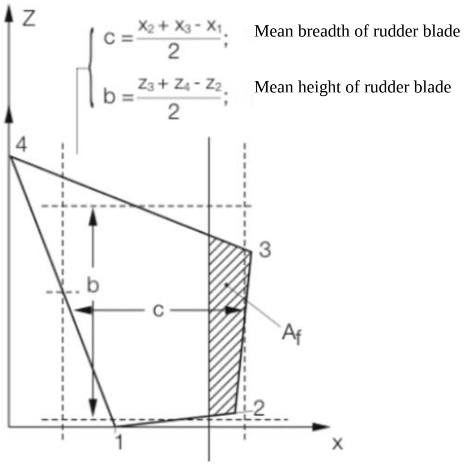
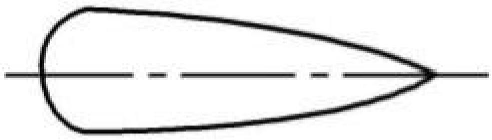
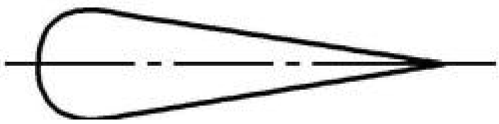
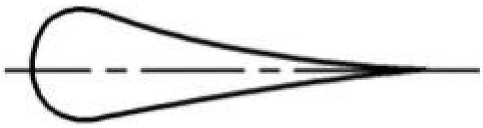
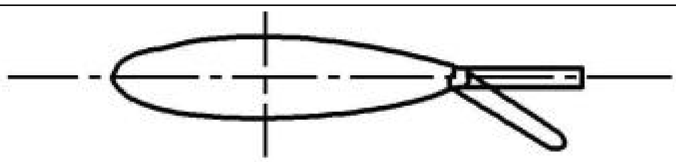
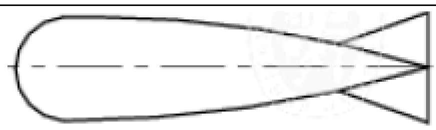
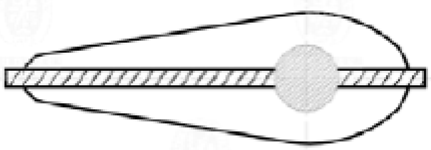


Figure 3.1.2.4 Coordinate system of rudder dimension

Factor K_2 Table 3.1.2.1

Profile Type		K_2	
		Ahead condition	Astern condition
NACA-00 series Göttingen		1.1	0.80
Flat side		1.1	0.90
Hollow		1.35	0.90
Lift rudders		1.7	To be specially considered; if not known: 1.30
Fish tail		1.4	0.8
Single plate		1.0	1.0
Mixed profiles (e.g.HSVA)	——	1.21	0.9

(2) The rudder torque Q_R is to be calculated for both the ahead and astern condition as follows:

$$Q_R = C_R r \ \mathrm{N \cdot m}$$

Where: r——levers, $r = c\,(\alpha\text{-}k)$, in *m;*

c——mean breadth of rudder area, in m, as shown in Figure 3.1.2.1;

α ——coefficient, taken as 0.33 for ahead condition and 0.66 for astern condition; special consideration may be given for high lift rudders, and taken as 0.40 for ahead condition and 0.66 for astern condition if *no* test data may be provided

k——factor, $k=A_f/A$;

A_f——portion of the rudder blade area situated ahead of the centre line of the rudder stock, in m^2;

For the ahead conditions, r_{min}=0.1c, in m.

3.1.2.2 Rudder blades with cut-outs (semi-spade rudders)

The total rudder force C_R is to be calculated in accordance to 3.1.2.1 (1) of this Section. The pressure distribution over the rudder area, upon which the determination of rudder torque and rudder blade strength is to be based, is to be derived as follows:

The rudder area may be divided into two rectangular or trapezoidal parts with areas A_1 and A_2, so that $A=A_1+A_2$. See Figure 3.1.2.2.

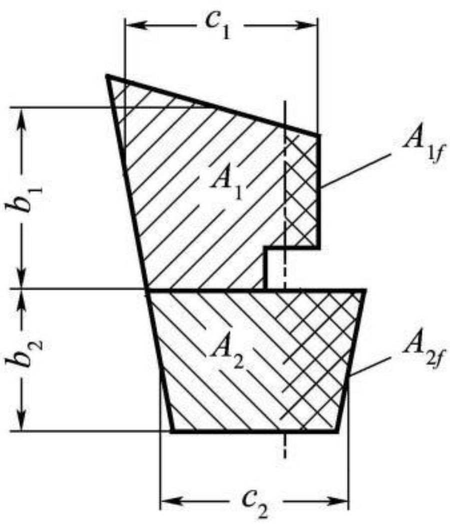


Figure 3.1.2.2 Areas A_1 and A_2

The levers r_1 and r_2 are to be determined as follows:

$$r_1 = c_1(\alpha - k_1), \text{ in m;}$$

$$r_2 = c_2(\alpha - k_2), \text{ in m;}$$

Where: c_1, c_2——breadth of partial areas A_1, A_2 determined, where applicable, in accordance with Figure 3.1.2.1;;

$k_1 = A_{1f}/A_1$;

$k_2 = A_{2f}/A_2$;

A_{1f}——portion of A_1 situated ahead of the centre line of the rudder stock, in m^2;

A_{2f}——portion of A_2 situated ahead of the centre line of the rudder stock, *in* m^2;

α——*factor*, taken as follows:

α = 0.33, for ahead conditions;

α = 0.66, for astern conditions;

For parts of a rudder behind a fixed structure such as the rudder horn:

α = 0.25, for ahead conditions;

α = 0.55, for astern conditions;

The resulting force of each part may be taken as:

$$C_{R1} = C_R A_1 / A \text{ N}$$

$$C_{R2} = C_R A_2 / A \text{ N}$$

The resulting torque of each part may be taken as:

$$Q_{R1} = C_{R1} r_1 \text{ N m}$$

$$Q_{R2} = C_{R2} r_2 \text{ N m}$$

The total rudder torque is to be calculated for both the ahead and astern condition as follows:

$$Q_R = Q_{R1} + Q_{R2} \text{ N m}$$

For ahead condition Q_R is not to be taken less than:

$$Q_{R\min} = 0.1C_R\,(A_1C_1 + A_2C_2)\,/A \text{ N·m}$$

3.1.3 Rudder strength calculation

3.1.3.1 The rudder force and resulting rudder torque as given in 3.1.2 of this Section causes bending moments and shear forces in the rudder body, bending moments and torques in the rudder stock, supporting forces in pintle bearings and rudder stock bearings and bending moments, shear forces and torques in rudder horns and heel pieces. The rudder body is to be stiffened by horizontal and vertical webs enabling it to act as a bending girder.

3.1.3.2 The bending moments, shear forces and torques as well as the reaction forces are to be determined by a direct calculation or by an approximate simplified method considered appropriate by CCS. For rudders supported by sole pieces or rudder horns these structures are to be included in the calculation model in order to account for the elastic support of the rudder body. Guidelines for calculation of bending moment and shear force distribution are given in Appendix 1 to this Chapter.

3.1.4 Rudder stock scantlings

3.1.4.1 The rudder stock diameter required for the transmission of the rudder torque is to be dimensioned such that the torsional stress τ_t is not exceeding the following value:

$$\tau_t = 68/K \text{ N/mm}^2$$

The rudder stock diameter for the transmission of the rudder torque d_t is therefore not to be less than:

$$d_t = 4.2\sqrt[3]{Q_R K} \text{ mm}$$

Where: Q_R——total rudder torque [N•m] as calculated in 3.1.2.1(2) and 3.1.2.2 of this Section;

K——material factor for the rudder stock as given in 3.1.1.3(5) of this Section.

3.1.4.2 Rudder stock scantlings due to combined loads

If the rudder stock is subjected to combined torque and bending, the equivalent stress in the rudder stock is not to exceed *118 / K ,N/mm²*. K is material factor for the rudder stock as given in 3.1.1.3(5).

The equivalent stress σ_c is to be determined by the formula:

$$\sigma_c = \sqrt{\sigma_b^2 + 3\tau_t^2} \quad \text{in N/mm}^2$$

Where: bending stress $\sigma_b = 10.2M/d_c^3 \times 10^3$, in N/mm²

torsional stress: $\tau_t = 5.1Q_R/d_c^3 \times 10^3$, in N/mm².

The rudder stock diameter D_p is not to be less than that obtained from the following formula:

$$d_c = d_t\sqrt[6]{1 + (M/Q_R)^2\,4/3} \text{ in mm}$$

Where: M——bending moment, in N•m, at the station of the rudder stock considered.

3.1.4.3 Before significant reductions in rudder stock diameter due to the application of steels with yield stresses exceeding 235N/mm² are granted, CCS may require the evaluation of the rudder stock deformations. Large deformations of the rudder stock are to be avoided in order to avoid excessive edge pressures in way of bearings.

3.1.5 Rudder blade

3.1.5.1 Permissible stresses

The section modulus and the web area of a horizontal section of the rudder blade are to be such that the following stresses will not be exceeded:

(1) In general

① bending stress $\sigma_b \le 110/K$, in N/mm²

② shear stress $\tau \le 50/K$, in N/mm²

③ equivalent stress $\sigma_e = \sqrt{\sigma^2 + 3\tau^2} \le 120/K$, in N/mm²

K——material factor for rudder plating, see 3.1.1.3 (2) of this Section.

(2) In way of the recess for the rudder horn pintle on semi-spade rudders

① bending stress: $\sigma_b \le 75$, in N/mm^2 (in way of rudder recess sections)

② shear stress $\tau \le 50$, in N/mm^2

③ equivalent stress $\sigma_e = \sqrt{\sigma^2 + 3\tau^2} \le 100$, in N/mm^2

Note: The stresses in (2) apply equally to high tensile and ordinary steels.

3.1.5.2 Rudder plating

The thickness t of the rudder side, top and bottom plating are not to be less than the values obtainted from the following formula:

$$t = 5.5s\beta\sqrt{K}\sqrt{d + C_R 10^{-4} / A} + 2.5 \quad \text{in mm}$$

Where: d—summer load waterline draught, in m;

C_R——rudder force, in N, see 3.1.2.1 in this Section;

A——area of rudder blade, in m^2;

$\beta = \sqrt{1.1 - 0.5(s/b)^2}$, if b / s≥2.5, maximum value for β is taken *as* 1;

s——smallest unsupported width of plating, in m;

b——greatest unsupported width of plating, in m;

K——material factor of rudder blade, see 3.1.1.3 (2) of this Section.

The thickness of the nose plate of rudder blades is not to be less than 1.2 times that of rudder side plating, but need not be greater than 22 mm. The thickness of web plates is not to be less than the greater of 70% of the rudder side plating thickness and 6 mm.

The rudder plating in way of the solid part is to be of increased thickness per 3.1.5.3 (4).

3.1.5.3 Connection of rudder blade structure with solid parts

(1) Solid parts in forged or cast steel, which house the rudder stock or the pintle, are to be provided with protrusions;

These protrusions are not required when the web plate thickness is less than:

-10 mm for web plates welded to the solid part on which the lower pintle of a semi-spade rudder is housed and for vertical web plates welded to the solid part of the rudder stock coupling of spade rudders; -20 mm for other web plates.

(2) The solid parts are in general to be connected to the rudder structure by means of two horizontal web plates and two vertical web plates.

(3) Minimum section modulus of the connection with the rudder stock housing.

The section modulus of the cross-section of the structure of the rudder blade *Ws*, formed by vertical web plates and rudder plating, which is connected with the solid part where the rudder stock is housed is not to be less than the value obtained from the following formula:

$$W_s = c_s d_c^{\,3}\left(\frac{H_E - H_X}{H_E}\right)\frac{K}{K_s}10^{-4} \quad \text{in cm}^3$$

Where: c_S ——factor, to be taken as:

c_S =1.0, if there is no opening in the rudder plating or if such opening are closed by a full penetration welded plate;

c_S =1.5, if there is an opening in the considered cross section of the rudder;

d_c ——diameter of rudder stock in way of lower bearing, in mm, calculated according to 3.1.4 of this Section;

H_E — vertical distance between the lower edge of the rudder blade and the upper edge of the solid part, in m;

H_X — vertical distance between the considered cross-section and the upper edge of the solid part, in m;

K — material factor for the rudder blade plating as given in 3.1.1.3(2);

Ks — material factor for the rudder stock as given in 3.1.1.3(5).

The actual section modulus of the cross-section of the structure of the rudder blade is to be calculated with respect to the symmetrical axis of the rudder. The breadth of the rudder plating, in m, to be considered for the calculation of section modulus is to be not greater than the value calculated by the following formula:

$$b = s_V + 2H_x/3\text{m}$$

Where: s_v ——spacing between two vertical webs, in m, see Figure 3.1.5.3.

Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted.

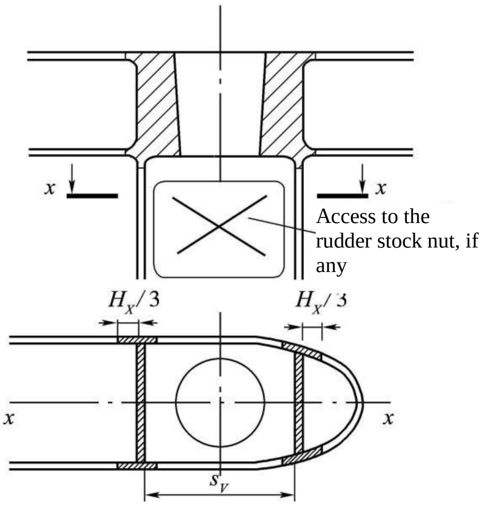


Figure 3.1.5.3 Cross-section of the connection between rudder blade structure and rudder stock housing

(4) The thickness of the horizontal web plates connected to the solid parts, in mm, as well as that of the rudder blade plating between these webs, is to be not less than the greater of the following values:

$$t_H = 1.2t\text{mm}$$

$$t_H = 0.045 d_S^2/S_H\text{mm}$$

Where: t——defined in 3.1.5.2 of this Section;

d_S——diameter, in mm, to be taken equal to:

$d_S = d_c$, as per 3.1.4.2 of this Section, for the solid part housing the rudder stock;

$d_S = d_p$, as per 3.1.7.1 of this Section, for the solid part housing the pintle;

S_H——spacing between the two horizontal web plates, in mm.

The increased thickness of the horizontal webs is to extend fore and aft of the solid part at least to the next vertical web.

(5) he thickness of the vertical web plates welded to the solid part where the rudder stock is housed as well as the thickness of the rudder side plating under this solid part is to be not less than the values obtained, in mm, from Table 3.1.5.3.

Thickness of side plating and vertical web plates Table 3.1.5.3

Type of rudder	Thickness of vertical web plates (in mm)		Thickness of rudder plating (in mm)	
	Rudder blade without opening	Rudder blade with opening	Rudder blade without opening	Area with opening
Rudder supported by sole piece	1.2t	1.6t	1.2t	1.4t
Semi-spade and spade rudders	1.4t	2.0t	1.3t	1.6t

Where: t is the thickness of the rudder plating, in mm, as defined in 3.1.5.2 of this Section.

The horizontal web plates and rudder plating the thickness of which has been increased are to extend below the solid piece at least to the next horizontal web.

3.1.5.5 Single plate rudders

(1) Mainpiece diameter

The mainpiece diameter is calculated according to 3.1.4.1 and 3.1.4.2 of this Section respectively. For spade rudders the lower third may taper down to 0.75 times stock diameter.

(2) rudder blade thickness

The rudder blade thickness t is not to be less than that obtained from the following formula:

$$t = 1.5sV\sqrt{K} + 2.5 \text{mm}$$

Where: s——spacing of stiffeners, *in* m, and is not to exceed 1 m;

V——speed, in knots, see 3.1. 2.1 (1) of this Section;

K——material factor of rudder blade, see 3.1.1.3 (2) of this Section.

(3) Stiffeners

The thickness t_a of stiffeners is not to be less that of rudder blade:

$$t_a = t_b \text{mm}$$

The section modulus W of stiffener is not to be less than that obtained from the following formula:

$$W = 0.5sC_1^2V^2K \text{cm}^3$$

Where: C_1——horizontal distance from the aft edge of the rudder to the centreline of rudder stock, in m;

K——Material factor, as given in 3.1.1.3(2) or 3.1.1.3 (5) of this Section respectively.

3.1.6 Rudder stock couplings

3.1.6.1 Horizontal flange couplings

(1) The diameter d_b of coupling bolts is not to be less than that obtained from the following formula:

$$d_b = 0.62\sqrt{d_s^3 K_b / n e_m K_s} \text{ in mm}$$

Where: d_s——rudder stock diameter, taken equal to the greater of the diameters dt or dc according to 3.1.4.1 and 3.1.4.2, in mm;

n —— total number of bolts, which is not to be less than 6;

Em——mean distance of the bolt axes from the centre of the bolt system, in mm;

K_s——material factor for the stock as given in 3.1.1.3(5) of this Section;

K_b——material factor for the bolts as given in 3.1.1.3(5) of this Section;

(2) The thickness of the coupling flanges t_f, in mm, is not to be less than the greater of the following formulae:

$$t_f = d_b\sqrt{K_f / K_b} \text{ in mm}$$

$$t_f = 0.9d_b \text{ in mm}$$

Where: K_f——material factor for flange as given in 3.1.1.3(5) of this Section;

K_b——material factor for the bolts as given in 3.1.1.3(5) of this Section;

d_b ——bolt diameter calculated for a number of bolts not exceeding 8, in mm;

(3) The width of material between the perimeter of the bolt holes and the perimeter of the flange is not to be less than $0.67d_b$;

(4) The welded joint between the rudder stock and the flange is to be made in accordance with Figure 3.1.6.1 or equivalent;

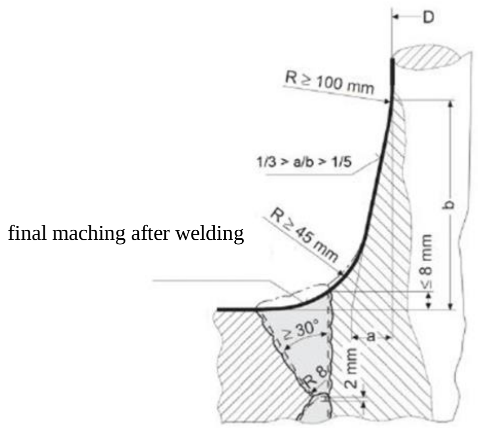


Figure 3.1.6.1 Welded joint between rudder stock and coupling flange

(5) Coupling bolts are to be fitted bolts and their nuts are to be locked effectively.

3.1.6.2 Vertical flange couplings of rudder stock and rudder blades

The diameter d_b of coupling bolt is not to be less than that obtained from the following formula:

$$d_b = 0.81 d_s / \sqrt{n} \times \sqrt{K_b / K_s} \text{ in mm}$$

Where: d_s——rudder stock diameter in way of coupling flange, in mm;

n ——total number of bolts, which is not to be less than 8;

K_b——material factor for bolts as given in 3.1.1.3(5) of this Section;

K_s——material factor for stock as given in 3.1.1.3(5) of this Section.

(2) The first moment of area of the bolts about the centre of the coupling, m, is to be not less than:

$$m = 0.00043 d_s^3 \text{cm}^3$$

(3) The thickness of the coupling flanges is to be not less than the bolt diameter, and the width of the flange material between the perimeter of the bolt holes and the perimeter of the flange is to be not less than $0.67d_b$;

(4) Coupling bolts are to be fitted bolts and their nuts are to be locked effectively.

3.1.6.3 Cone couplings with key

(1) Tapering and coupling length

Cone couplings without hydraulic arrangements for mounting and dismounting the coupling are to have a taper c on diameter of 1:8 − 1:12.

where: $c = (d_0 - d_u) / l$, see Figure 3.1.6.3.

The cone coupling is to be secured by a slugging nut. The nut is to be secured, e.g. by a securing plate as shown in Figure 3.1.6.3.

The cone shapes are to fit exactly. The coupling length l is to be, in general, not less than $1.5d_0$

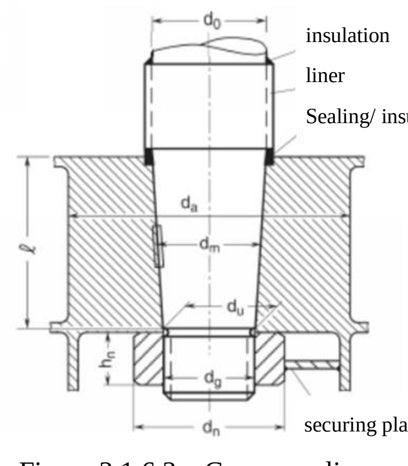


Figure 3.1.6.3 Cone couplings with key

(2) Dimensions of key

For couplings between stock and rudder a key is to be provided, the shear area a_s of which, is not to be less than:

$$a_s = \frac{17.55 Q_F}{d_k R_{eH1}} \text{ in cm}^2$$

Where: Q_F——designed yield moment of rudder stock;

$$Q_F = 0.02664 d_t^3 / K \text{N·m}$$

Where the actual diameter d_{ta} is greater than the calculated diameter d_t, the diameter d_{ta} is to be used. However, d_{ta} applied to the above formula need not be taken greater than $1.145d_t$;

d_t——stock diameter, in mm, according to 3.1.4.1 of this Section;

K ——material factor for stock as given in 3.1.1.3(5) of this Section;

d_k——mean diameter of the conical part of the rudder stock, in mm, at the key;

R_{eH1}——minimum yield stress of the key material, in N/mm^2.

The effective surface area a_k, in cm^2 , of the key (without rounded edges) between key and rudder stock or cone coupling is not to be less than:

$$a_k = \frac{5Q_F}{d_k R_{eH2}} \text{ in cm}^2$$

Where: R_{eH2}——minimum yield stress of key, r stock or coupling material, in N/mm^2.

(3) The dimensions of the slugging nut are to be as follows, as shown in Figure 3.1.6.3:

external thread diameter : $d_g \geq 0.65d_o$

height : $h_n \geq 0.6d_g$;

outer diameter: $d_n \geq 1.2d_u$ *or* $1.5d_g$, whichever is greater.

(4) It is to be proved that 50% of the design yield moment is solely transmitted by friction in the cone couplings. This can be done by calculating the required push-up pressure and push-up length according to 3.1.6.4(2) for a torsional moment $Q'_F = 0.5Q_F$;

(5) Notwithstanding the requirements of 3.1.6.3(2) and 3.1.6.3(4), where a key is fitted to the coupling between stock and rudder and it is considered that the entire rudder torque is transmitted by the key at the couplings, the scantlings of the key as well as the push-up force and push-up length are to be subject to special consideration.

3.1.6.4 Cone couplings with special arrangements for mounting and dismounting the couplings

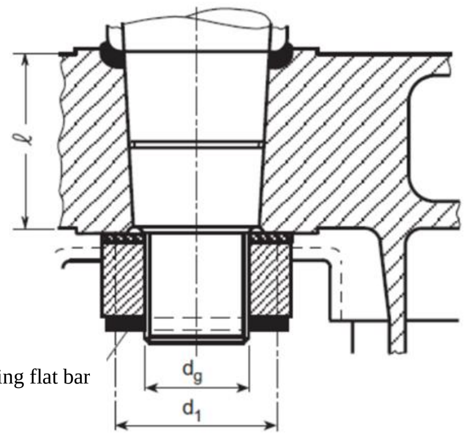


Figure 3.1.6.4 Cone ccouplings with special arrangements for mounting and dismounting the couplings

(1) Where the stock diameter exceeds 200 mm, the press fit is recommended to be effected by a hydraulic pressure connection. In such cases the cone is to be more slender, c≈1: 12 and ≈1: 20.

In case of hydraulic pressure connections the nut is to be effectively secured against the rudder stock or the pintle.

For the safe transmission of the torsional moment by the coupling between rudder stock and rudder body the push-up pressure and the push-up length are to be determined according to 3.1.6.4(2) and 3.1.6.4(3) respectively.

(2) Push-up pressure

The push-up pressure is not to be less than the greater of the two following values:

$$p_{req1} = \frac{2Q_F \times 10^3}{d_m{}^2 l \pi \mu_0} \quad \text{in N/mm}^2$$

$$p_{req2} = \frac{6M_b \times 10^3}{l^2 d_m} \quad \text{in N/mm}^2$$

Where: Q_F——design yield moment of rudder stock, in N·m, as defined to 3.1.6.3(2) of this Section;

d_m ——mean cone diameter, in mm; see Figure 3.1.6.3;

l——cone length, in mm;

μ_0——frictional coefficient, equal to 0.15;

Mb——bending moment in the cone coupling (e.g. in case of spade rudders), in N ·m.

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure, in N/mm ?, is to be determined by the following formula:

$$p_{perm} = \frac{0.8R_{eH}(1-\alpha^2)}{\sqrt{3+\alpha^4}} \quad \text{in N/mm}^2$$

Where: R_{eH}1——minimum yield stress of the material of the gudgeon, in N/mm^2;

$\alpha = d_m / d_a$;

Dm——diameter, in mm. See Figure 3.1.6.3;

d_a——outer diameter of the gudgeon to be not less than 1.25 d0, in mm, see Figure 3.1.6.3.

(3) Push-up length

Push-up length *l*, in *mm*, is to comply with the following formula:

$$\Delta l_1 \leq \Delta l \leq \Delta l_2$$

Where:

$\Delta l_1 = \dfrac{p_{req} d_m}{E\left(\dfrac{1-\alpha^2}{2}\right)c} + \dfrac{0.8R_{tm}}{c}$, in mm;

$\Delta l_2 = \dfrac{1.6R_{eH} d_m}{Ec\sqrt{3+\alpha^4}} + \dfrac{0.8R_{tm}}{c}$, in mm;

R_{tm}——mean roughtness, in mm, taken equal lto 0.01;

c——taper of diameter according to 3.1.6.4 (1) of this section, in mm.

In any case, the push -up length is not to be less than 2 mm.

Note:Where hydraulic connections the required push-up force P_e for the cone may be determined by the following formula:

$$P_e = p_{req} d_m \pi l \left(\frac{c}{2} + 0.02\right) \text{N}$$

The value 0.02 is a reference for the friction coefficient using oil pressure. It varies and depends on the mechanical treatment and roughness of the details to be fixed. Where due to the fitting procedure a partial push-up effect caused by the rudder weight is given, this may be taken into account when fixing the required push-up length, subject to approval by CCS.

3.1.7 Pintles

3.1.7.1 Scantlings

The pintle diameter d_p is not to be less than:

$$d_p = 0.35\sqrt{BK_p} \text{ in mm}$$

Where: *B*——relevant bearing force, in N;

K_p——material factor for pintle as given in 1.1.3.5 of this Section.

The pintles diameter of trawlers is to increase by 5% over the value calculated by the formula.

3.1.7.2 Couplings

(1) Tapering

Pintles are to have a conical attachment to the gudgeons with a taper on diameter not greater than: 1:8 to 1:12 for keyed and other manually assembled pintles applying locking by slugging nut, 1:12 to 1:20 on diameter for pintles mounted with oil injection and hydraulic nut.

(2) Push-up pressure for pintle

The required push-up pressure for pintle p_{req} is to be determined by the following formula:

$$p_{req} = 0.4\frac{B_1 d_0}{d_m^2 l} \quad \text{in N/mm}^2$$

Where: B_1 ——supporting force in the pintle, in N;

d_0 ——pintle diameter, in mm. See Figure 3.1.6.3.

The push up length is to be calculated similarly as in 3.1.6.4(3) of this Section, using required push-up pressure and properties for the pintle.

3.1.7.3 The minimum dimensions of threads and nuts are to be determined according to 3.1.6.3(3).

3.1.7.4 Pintle housing

The length of the pintle housing in the gudgeon is not to be less than the pintle diameter d_p.,d_p is to be measured on the outside of liners.

The thickness of the pintle housing is not to be less than $0.25d_p$.

3.1.8 Rudder stock bearing, rudder shaft bearing and pintle bearing

3.1.8.1 Liners and bushes

(1) Rudder stock bearing

Liners and bushes are to be fitted in way of bearings. The minimum thickness of liners and bushes $t_{\min}$ is to be equal to :

$t_{\min}$=8mm for metallic materials and synthetic material

$t_{\min}$=22mm for lignum material

(2) Pintle bearing

The thickness of any liner or bush t, is not to be less than the minimum thickness defined in 3.1.8.1(1) and the following value.

$$t = 0.01\sqrt{P} \text{ in mm}$$

Where: P——relevant bearing force, in N.

3.1.8.2 Minimum bearing surface

An adequate lubrication is to be provided.

The bearing surface A_b (defined as the projected area: length × outer diameter of liner) is not to be less than:

$$A_b = P/q_a \text{mm}^2$$

Where: P——reaction force, in N, in bearing as determined in 3.1.3.2 of this Section;

q_a——allowable surface pressure according to Table 3.1.8.2.

The maximum surface pressure qa for the various combinations is to be taken as reported in the table below. Higher values than given in Table 3.1.8.2 may be taken in accordance with makers' specifications if they are verified by tests:

Maximum surface pressure q_a Table 3.1.8.2

Bearing material	q_a(N/mm^2)
Lignumvitae	2.5
White metal, oil lubricated	4.5
Synthetic material with hardness between 60 and 70 Shore D①	5.5②
Steel② and bronze and hot-pressed bronze-graphite materials	7.0

① Indentation hardness test at 23℃ and with 50% moisture, are to be carried out according to a recognized standard. Synthetic bearing materials are to be of an approved type;

②Surface pressures exceeding 5.5 N/mm^2 may be accepted in accordance with bearing manufacturer's specification and tests, but in no case more than 10 N/mm^2;

③ Stainless and wear-resistant steel in an approved combination with stock liner.

3.1.8.3 Bearing dimensions

The length/diameter ratio of the bearing surface is not to be greater than 1.2.

The bearing length Lp of the pintle is to be such that $D_P \leq L_P \leq 1.2D_P$. Where, D_P=actual diameter of pintle and rudder stock measured on the outside of liners.

3.1.8.4 Bearing clearances

With metal bearings, clearances should not be less than d / 1000 + 1.0 mm (where d is the outer diameter of rudder stock or pintle) on the diameter. If non-metallic bearing material is applied, the bearing clearance is to be specially determined considering the material's swelling and thermal expansion properties. This clearance is not to be taken less than 1.5 mm on bearing diameter unless a smaller clearance is supported by the manufacturer's recommendation and there is documented evidence of satisfactory service history with a reduced clearance.

3.1.9 Strength of rudder horns and rudder trunk

3.1.9.1 Rudder horns

Rudder horns supporting semi-spade type rudders may be cast or fabricated, and their horizontal sectional shape may be referred to the section of propeller posts. When the connection between the rudder horn and the hull structure is designed as a curved transition into the hull plating, special consideration is to be given to the effectiveness of the rudder horn plate in bending and to the stresses in the transverse web plates. The radius at the shell connection is not to be less than 0.8L + 150 mm, *L* being the length of ship, in m.

The bending moments and shear forces are to be determined by a direct calculation or in line with the guidelines given in 2.4 and 2.5 of Appendix 1 for semi spade rudder with one elastic support and semi spade rudder with 2-conjugate elastic support respectively.

The section modulus around the horizontal *x-axis* W is not to be less than:

$$W = M_b K/67 \text{cm}^3$$

Where: M_b —bending moment at the section considered, in N ·m.

Shear stress τ is not to be greater than:

$$\tau = 48/K \text{N/mm}^2$$

K——material factor as given in 3.1.1.3(2) or 3.1.1.3(5) of this Section.

(1) Equivalent stress

At no section within the height of the rudder horn is the equivalent stress to exceed 120/K, in N/mm^2. The equivalent stress σ_v is to be calculated by the following formula:

$$\sigma_v = \sqrt{\sigma_b^2 + 3\left(\tau^2 + \tau_T^2\right)} \quad \text{in N/mm}^2$$

Where: $\sigma_b = M_b/W_x$, in N/mm^2;

$\tau = B_1/A_h$, N/mm^2;

Wx—section modulus of rudder horn around *x-axis*, in cm^3;

B_1 ——supporting force in the pintle bearing, in N;

Ah——effective shear area of rudder horn in y direction, in mm^2;

$\tau_T = M_T 10^3/(2A_T t_h)$, in N/mm^2;

M_T—— torsional moment, in N ·m;

A_T——area in the horizontal section enclosed by the rudder horn, in mm^2;

t_h ——plate thickness of rudder horn, in mm;

K——Material factor, see 3.1.1.3 (2) or 3.1.1.3 (5) respectively in this Section.

(2) Rudder horn plating

The thickness t of the rudder horn side plating t is not to be less than:

$$t = 2.4\sqrt{LK} \text{ in mm}$$

Where: L——length of ship, in m;

K——material factor , see 3.1.1.3 (2) of this Section.

(3) Welding and connection to hull structure

The rudder horn plating is to be effectively connected to the aft ship structure, e.g. by connecting the plating to side shell and transverse/ longitudinal girders, in order to achieve a proper transmission of forces, see Figure 3.1.9.1.

Brackets or stringer are to be fitted internally in horn, in line with outside shell plate, as shown in Figure 3.1.9.1.

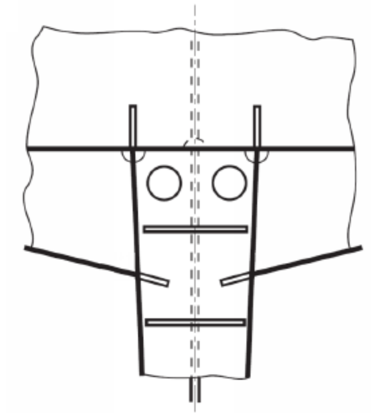


Figure 3.1.9.1 Connection of rudder horn to aft ship structure

Transverse webs of the rudder horn are to be led into the hull up to the next platform deck in a sufficient number.

Strengthened plate floors are to be fitted in line with the transverse webs in order to achieve a sufficient connection with the hull.

The centre line bulkhead (wash-bulkhead) in the after peak is to be connected to the rudder horn. Scallops are to be avoided in way of the connection between transverse webs and shell plating. The weld at the connection between the rudder horn plating and the side shell is to be full penetration. The welding radius is to be as large as practicable and may be obtained by grinding.

3.1.9.2 Rudder trunk

(1) Materials, welding and connection to the hull

This requirement applies to both trunk configurations (extending or not below stern frame).

The steel used for the rudder trunk is to be of weldable quality, with a carbon content not exceeding 0.23% on ladle analysis or a carbon equivalent CEQ not exceeding 0.41%.

Plating grades for rudder trunks are in general to be complied with the requirements in Section 3, Chapter 1 of this PART.

The weld at the connection between the rudder trunk and the shell or the bottom of the skeg is to be full penetration.

The fillet shoulder radius r, in mm (see Figure 3.1.9.2) is to be as large as practicable and to comply with the following formulae:

$r = 60$, when $\sigma \geq 40 / K$, in N/mm^2

$r = 0.1d_c$, and not to be less than 30 mm, when $\sigma < 40/K$, in N/mm^2

Where: d_c——rudder stock diameter axis as defined in 3.1.4.2;

σ——bending stress in the rudder trunk, in N/mm^2;

K——Material factor, see 3.1.1.3 (2) or 3.1.1.3 (5) respectively in this Section.

The radius may be obtained by grinding. If disk grinding is carried out, score marks are to be avoided in the direction of the weld. The radius is to be checked with a template for accuracy.

Four profiles at least are to be checked. A report is to be submitted to the Surveyor.

Rudder trunks comprising of materials other than steel are to be specially considered by CCS.

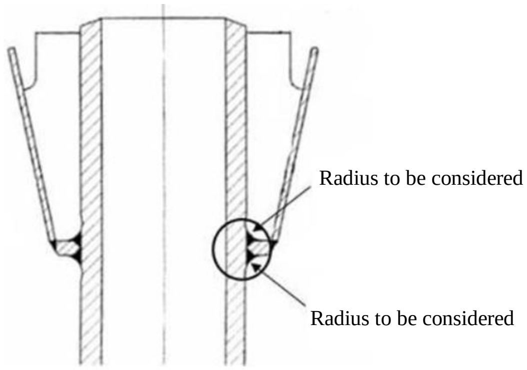


Fig. 3.1.9.2

(2) Scantlings

Where the rudder stock is arranged in a trunk in such a way that the trunk is stressed by forces due to rudder action, the scantlings of the trunk are to be such that: the equivalent stress due to bending and shear does not exceed 0.35 R_{eH}.

The bending stress on welded rudder trunk σ is to be in compliance with the following formula:

$$\sigma \leq 80/K \text{N/mm}^2$$

Where: σ——bending stress in the rudder trunk, as defined in 3.1.9.2 (1);

K——material factor for the rudder trunk as given in 3.1.1.3(2) or 3.1.1.3(5) of this Section, not to be taken as less than 0.7;

R_{eH}——yield stress of the material used, in N/mm^2.

For calculation of bending stress, the span to be considered is the distance between the mid-height of the lower rudder stock bearing and the point where the trunk is clamped into the shell or the bottom of the skeg.

3.1.10 Others

3.1.10.1 Quadrants and tillers

(1) The section modulus W of the tiller at any section from the centre of the rudder stock about the vertical axis is not to be less than that obtained from the following formula:

$$W = 0.14(1 - D_s / R)D_t^3 \qquad \text{in mm}^3$$

Where: D_s——distance from the section under consideration to the centerline of the stock on the tiller, not greater than the bore diameter of the pin, in mm, see Figure 3.1.10.1;

d_t——stock diameter, in mm, at the tiller, calculated according to 3.1.4.1 of this Section;

R——radius of quadrant or length of tiller, in mm.

For quadrants having more than one arm, the combined section modulus of the arms is not to be less than that required in the above formula.

For tillers of rectangular section, the breadth to depth ratio is not to be more than 2;

(2) Depth of boss of the quadrant or tiller $h \geq 1.0Dt$, and its outside diameter $D_o \geq 1.8D_t$. See Figure 3.1.10.1. Where the depth of boss of the tiller h is greater than D_t, the required outer diameter D_o may be reduced accordingly. It is to ensure that $hD_o^2 \geq 1.8D_t^3$, and D_o is not to be less than 1.6D_t in any case.

The definition of D_t is the same as that specified in 3.1.10.1 (1);

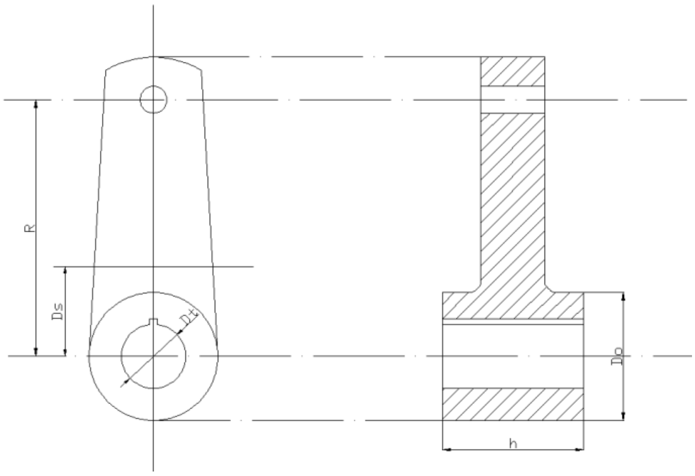


Fig. 3.1.10.1

(3) Where the boss of a tiller (quadrant) is composed of two half pieces, at least one key is to be fitted and each end of the key is to be secured by at least 2 bolts. The bolts are to be pretightened and the prestressing force on each bolt is to correspond to 70% of the permissible stress of bolt material. Where double keys are used, the prestressing force may be reduced appropriately. The total cross-sectional area Ab of all bolts is not to be less that obtained by the following formula:

$$A_b = 0.2D_t^3/b \text{mm}^2$$

Where: D_t——diameter of the rudder stock, in mm, at the tiller, calculated according to 3.1.4.1 of this Section;

b——distance between centerlines of bolt at both ends, in mm.

(4) The cross-sectional area A_x and moment of inertia I_x of the rod connecting the tiller (quadrant) to the tiller are not to be less than those obtained from the following formulas:

$$A_x = 0.12D_t^3/R \text{mm}^2$$

$$I_x = 10^{-6}\text{x}6.6D_t^3l^2/R \text{mm}^4$$

Where: D_t——diameter of the rudder stock, in mm, at the tiller of a passive rudder, calculated according to 3.1.4.1 of this Section;

l——length of connecting rod, in mm;

R——length of the tiller of the passive rudder, in mm.

(5) For a rotary vane type steering gear, the rotor and blades of the gear are to comply with the requirements of 3.1.10.1(1) and 3.1.10.1(2) for boss of the tiller and the tiller.

3.1.10.2 Connection of rudder tiller to stock

(1) The connection of the rudder tiller to stock is to be such that mechanical forces are transmitted from the steering gear to the rudder stock in any operational condition. The torque T_d transmitted by such connection is not to be less than twice the design torque of the steering gear, but need not be greater than the design yield torque Q_F of the stock calculated according to 3.1.6.3(2) of this Section. The design torque of the steering gear is corresponding to the design pressure in 13.1.6.5 of Chapter 9, PART 3 of the Rules.

(2) For torque transmission by friction, the average surface pressure p_r for the connection of tiller to stock is not to be less than that obtained from the following formula:

$$p_r \geq \frac{2T_{fr}}{\pi D_m^{\ 2} lf} \times 10^3 \quad \text{in N/mm}^2$$

Where: T_{fr}—— torque transmitted by friction, in N m;

= T_d, for keyless connection;

= $0.5T_d$, key connection;

T_d——torque transmitted through connection of tiller to stock, in N•m, determined according to 3.1.10.2(1) of this Section;

D_m——diameter of the rudder stock or mean diameter of the taper, in mm;

l——length of the effectively connected portion of the tiller, in mm;

f——coefficient of friction, taken as 0.15 for hydraulic fit or 0.18 for dry fit.

(3) For conical connection, nuts are to be used for securing against axial displacement. It is to be ensured that the size of nuts is to sustain the weight of rudder and rudder stock without considering the force of friction between rudder tiller and rudder stock, and reference may be made to the requirements of 3.1.6.3(3) of this Section.

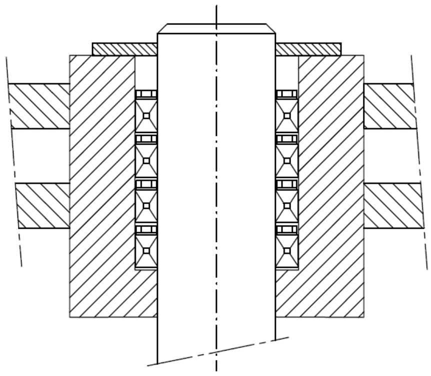
(4) Where the tiller is connected to the stock by means of several expansion sleeves or conical sleeves, as indicated in Figure 3.1.10.2, the influence of axial forces is also to be taken into account. In this case, the torque T_{d1} transmitted by the connection of tiller to stock is not to be less than that obtained from the following formula:

$$T_{d1} = \sqrt{T_d^2 + (2WD_m)^2 10^{-4}} \text{ in N m}$$

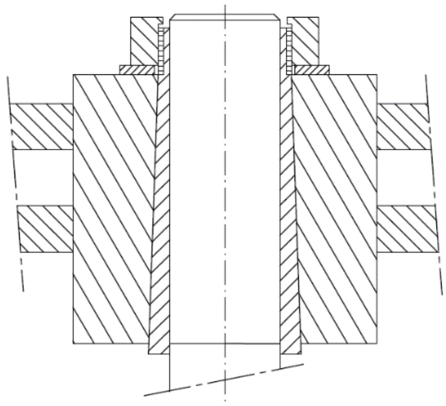
Where: T_d—— torque, in N m, determined according to 3.1.10.2 (1) of this Section;

W——weight of rudder and rudder stock, in kg;

D_m——diameter of the rudder stock, in mm;



(a) expansion sleeve



(b) conical sleeve

Fig. 3.1.10.2

(5) The taper of cone on diameter is to be not greater than 1:15 for keyless conical connection and not greater than 1:10 for keyed conical connection.

(6) For keyed connection, the shear area A_s of the key is not to be less than that obtained from the following formula:

$$A_s = \frac{70\left(T_d - k_{key}T_{fr}\right)}{D_k R_{eH}} \text{ in cm}^2$$

Where: T_d——torque transmitted through connection of tiller to stock, in N•m, calculated according to 3.1.10.2 of this Section.

k_{key}——coefficient, determined as follows:

= 0.7, where boss of tiller is composed of two half pieces and secured by bolts;

= 0.9, for hydraulic fitting of tiller to stock;

=1.0, in other cases.

T_{fr}——torque transmitted by friction, in N•m, calculated according to the following formula:

$$T_{fr} = 0.5\pi p_r D_m^2 lf \times 10^{-3}$$

Where: p_r——average surface pressure for the connection of tiller to stock, in N/mm^2, determined according to 3.1.10.2(2) of this Section. Where hydraulic fitting or shrinkage fit is adopted for the conical connection, the average push-up surface pressure is to be taken;

Dm, *l*, *f* —— same as in 3.1.10.2(2) of this Section;

d_k——mean diameter, in mm, of rudder stock cone in way of the position where the key is fitted;

R_{eH}——yield stress of key material, in N/mm^2.

(7) For keyed connections, the compressed area A_k of keys (round edge portion not included) is not to be less than that obtained from the following formula:

$$A_k = \frac{22\left(T_d - k_{key}T_{fr}\right)}{D_k R_{eH}} \text{ in cm}^2$$

Where: T_d, k_{key}, T_{fr}, D_k——the same as in 3.1.10.2 (6);

R_{eH}——yield stress of key material, in N/mm^2.

(8) Where two keys are fitted, the shear area A_s and compressed area A_k of each key may be taken as 2/3 of the value obtained for one key;

(9) The keyway is to have an adequately rounded end. The radius of curvature is usually not to be less than 5% of the thickness of the key. The compressive stress on the stock/tiller keyway is not to exceed 90% of the yield stress of the material used.

(10) Where the hydraulic fitting or shrinkage fit is adopted for the conical connection, the push-up length and the average push-up surface pressure are to be determined in accordance with the following requirements:

①The push-up length S is to meet the following:

$$S_1 \le S \le S_2$$

The minimum push-up length S_1 $S_1 = \frac{1}{k_1}[\frac{2p_r D_m k_2^2}{E(k_2^{\ 2}-1)} + 0.02]$ in mm

The maximum push-up length S_2 $S_2 = \frac{1}{k_1}[1.6 R_{eH} D_m \frac{k_2^2}{E\sqrt{3k_2^4+1}} + 0.02]$ in mm

Where: p_r——average surface pressure for the connection of tiller to stock, in N/mm^2, determined according to 3.1.10.2(2) of this Section;

k_1——taper of cone on diameter;

k_2=（D_m+ t_a）/D_m;

D_m——mean diameter of cone, in mm;

t_a——mean thickness of boss of tiller, in mm;

R_{eH}——yield stress of material of boss of tiller or rudder stock, whichever is less, in N/mm^2;

E——elastic modulus, to be taken as 2.06×10^5, in N/mm$^{2.}$

②The average push-up surface pressure P is to be calculated by the following formula:

$$P = \frac{SE(k_2^2-1)k_1}{2D_m k_2^2} \quad \text{in N/mm}^2$$

Where:k_1, k_2, D_m *and* E——same as (1) above;

S——the push-up length to be determined in accordance with (1) above, in mm.

3.1.11 Accessories of hand steering gear

3.1.11.1 The diameter of steering chains d is not to be less than that obtained from the following formula:

$$d = 0.32\sqrt{\frac{D_t^3}{R}} + 5 \quad \text{in mm}$$

Where: D_t——diameter of the rudder stock at the tiller , in mm;

R——radius of quadrant or length of tiller, in mm.

Steering chains with a diameter of not more than 15 mm can be replaced by flexible galvanized wire ropes of equivalent breaking strength.

3.1.11.2 The diameter of steering rods is to be 1.2 times that of steering chains.

3.1.11.3 The diameter of leading block sheaves for steering chains, measured at the centre of the chains, is not to be less than 12 times that of steering chains; and the diameter of the sheave pins is not to be less than twice that of steering chains.

3.1.11.4 The turnbuckle screw with a effective locking devices are to be fitted to the leads of steering chain on each side of the ship.

3.1.11.5 The spring buffer are to be fitted to the leads of steering chain on each side of the ship, and the dimensions of spring buffer are to be selected according to the safe working load of rudder chain or rudder cable.”

Section 2 ANCHORING AND MOORING EQUIPMENT

3.2.5.1 The description "ordinary chain cable" in 3.2.5.1 is revised to "CCSAM1”

3.2.5.2 The description"Table 3.2.1.1" in 3.2.5.2 is revised to "3.2.2 of this Section".

The Appendix 1 after Chapter 3 is added as follows:

“Appendix 1 GUIDELINES FOR CALCULATION OF BENDING MOMENT AND SHEAR FORCE DISTRIBUTION

1 Application:

1.1 The evaluation of bending moments, shear force and support forces for the system rudder-rudder stock may be carried out for some basic rudder types as outlined in 2.1 to 2.5 of this Appendix.

2 The force on rodder-rudder stock

2.1 Spade rudder

Data for the analysis

l_{10}~ l_{30}——length of the individual girders of the system, in m;

I_{10}~ I_{30}——moment of inertia of these girders, in cm^4.

Load of rudder body

$$P_R = C_R / (l_{10} 10^3) \text{ kN/m}$$

Moments and forces

The moments and forces may be determined by the following formula

$$M_b = C_R (l_{20} + (l_{10}(2c_1 + c_2)/3(c_1 + c_2))) \text{ N m}$$

$$B_3 = M_b / l_{30} \text{N}$$

$$B_2 = C_R + B_3 \text{N}$$

Where: C_R——rudder force, in N.

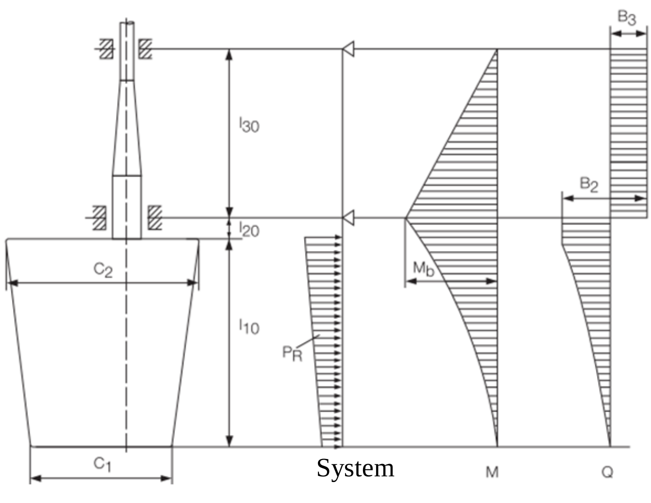


Figure 2.1 Spade rudder

2.2 Spade rudder with trunk

Data for the analysis

l_{10}~ l_{30}——length of the individual girders of the system, in m;

I_{10}~ I_{30}——moment of inertia of these girders, in cm^4.

Load of rudder body

$$P_R = C_R / ((l_{10} + l_{20}) 10^3) \text{ kN/m}$$

Moments and forces

For spade rudders with rudders trunks the moments, and forces may be determined by the following formula:

M_R is the greatest of the following values:

$$M_{CR1} = C_{R1}(C_{G1} - l_{10})\ \text{N m}$$

$$M_{CR2} = C_{R2}(l_{10} - C_{G2})\ \text{N m}$$

Where: C_{R1}——rudder force over the rudder blade area A_1,in N;
C_{R2}——rudder force over the rudder blade area A_2, in N;
C_{G1}——Vertical position of the gravity of rudder blade area A_1, in m;
C_{G2}-Vertical position of the gravity of rudder blade area A_2, in m;

$$C_R = C_{R1} + C_{R2}\text{N}$$

$$B_3 = (M_{CR2} - M_{CR1}) / (l_{20} + l_{30})\ \text{N}$$

$$B_2 = C_R + B_3\text{N}$$

Where: C_R——rudder force, in N.

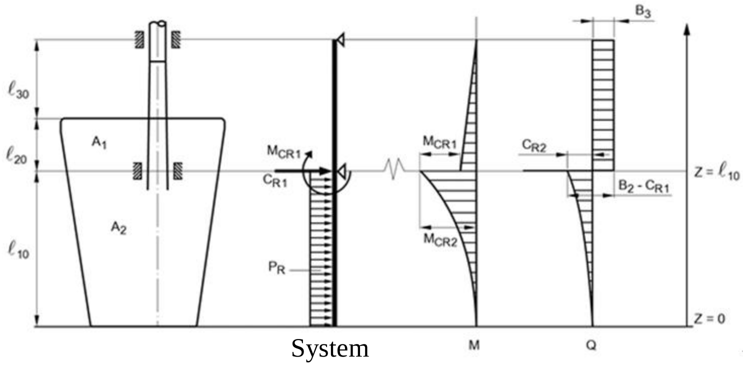


Figure 2.2 Spade rudder with trunk

2.3 Rudder supported by tail frame

Data for the analysis

l_{10}~ l_{50}——length of the individual girders of the system, in m;

I_{10}~ I_{50}——moments of inertia of these girders, in cm^4.

The rudder supported by a sole piece the length, $l_{20}$is the distance between lower edge of rudder body and centre of sole piece and I_{20} is the moment of inertia of the pintle in the sole piece..

I_{50}—— moment of inertia of sole piece around the z-axis, in cm^4;

l_{50}——effective length of sole piece, in m.

Load of rudder body

$$P_R = C_R / (l_{10} 10^3)\ \text{kN/m}$$

Where: C_R——rudder force, in N;

Z——spring constant of support in the sole piece;

$$Z = 6.18 I_{50} / l_{50}^3 \text{kN/m}$$

Moments and forces

Moments and shear forcse are indicated in Figure 2.3.

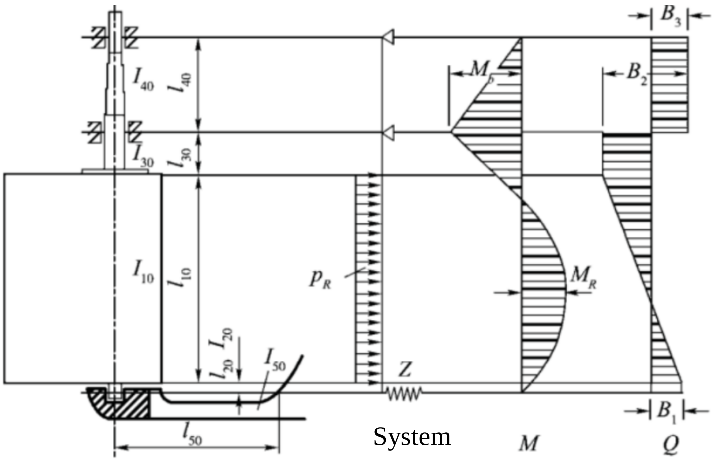


Figure 2.3　Rudder supported by sole piece

2.4　Semi spade rudder with one elastic support

Data for the analysis

l_{10}~ l_{50}——length of the individual girders of the system, in m;

I_{10}~ I_{50}——moment of inertia of these girders, in cm^4.

Z——spring constant of support in the rudder horn;

Z= 1/（f_b+f_t）, kN/m, for the support in the rudder horn. See Figure 2.4.1.

f_b——unit displacement of rudder horn due to a unit force of 1 kN acting in the centre of suppor, in m/kN;

f_b = 1.3h^3/（6.18I_n）m/kN (guidance value)

I_n——moment of inertia of forizontal section of rudder horn around the x-axis , in cm^4;

f_t——unit displacement due to torsion, in m/kN;

$f_t = he^2\sum（u_i/t_i）/（3.14×10^8 F_T^{\,2}）$ m/kN

F_T——mean section area of rudder horn, in m^2.

u_i——breadth of of the individual plates forming the mean horn sectional area, in mm;

t_i——thickness within the individual breadth u_i, in mm;

h——height of the rudder horn, in m, defined in Figure 2.4.1. This value is measured downwards from the upper rudder horn end, at the point of curvature transition, to the mid-line of the lower rudder horn pintle;

e——distance as defined in Figure 2.4.2, in m, measured to h/2 of the height of the rudder horn.

Load of rudder body

$$P_{R10}=C_{R2}/（l_{10}10^3）\text{ kN/m}$$

$$P_{R20}=C_{R1}/（l_{20}10^3）\text{ kN/m}$$

Where: C_{R1}, C_{R2}——see 2.2 of this Appendix.

Moments and forces

Moments and shear forces are indicated in Figure 2.4.1.

Rudder horn

The loads on the rudder horn are as follows:

M_H——bending moment, in N m，M_H=B_1z;

$$M_{H\max} = B_1 h \text{ N m}$$

Q_H——shear force, in N, Q_H=B_1;

M_T——torsional moment, in N m, M_T= $B_1e_{（z）}$;

An estimate for B_1 is:

$$B_1 = C_R b/ (l_{20} + l_{30})\ \text{N}$$

b——distance between the centre point of the force over rudder blade and lower bearing along z-axis in m.

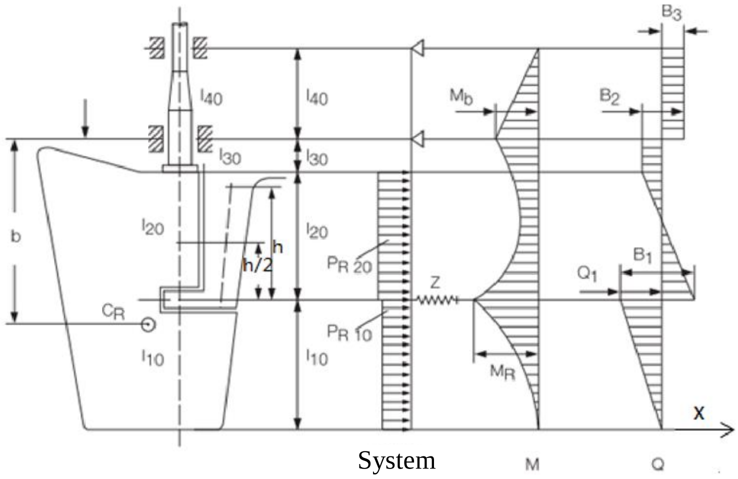


Figure 2.4.1 Semi spade rudder with one elastic support

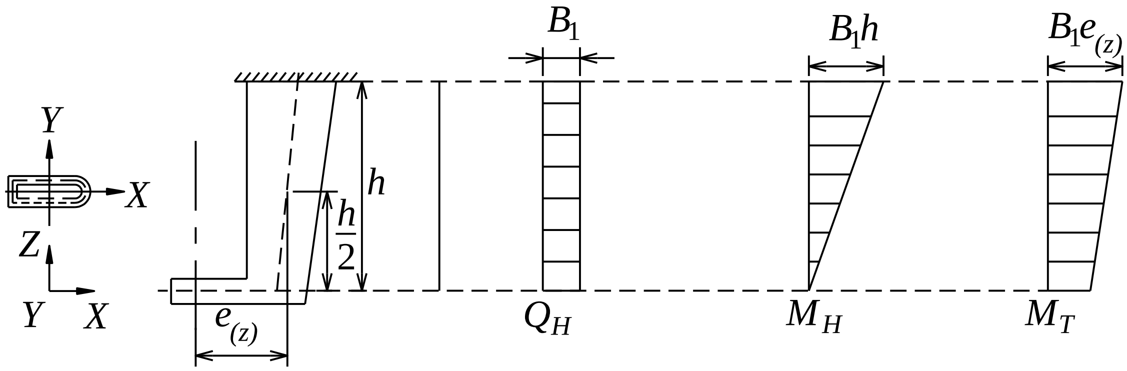


Figure 2.4.2 Rudder horn of semi spade rudder with one elastic support

2.5 Semi spade rudder with 2-conjugate elastic support

Data for the analysis

K_{11}, K_{22}, K_{12}——rudder horn compliance constants calculated for rudder horn with 2-conjugate elastic supports. See Figure 2.5.1. The 2-conjugate elastic supports are defined in terms of horizontal displacements, y_i by the following equations:

at the lower rudder horn hearing:

$$y_1 = -K_{12}B_2 - K_{22}B_1$$

at the upper the rudder horn bearing:

$$y_2 = -K_{11}B_2 - K_{12}B_1$$

Where: y1, $y2$——horizontal displacements at the upper and lower rudder horn bearings, respectively, in m;

$B1$, $B2$—— horizontal support forces at the upper and lower rudder horn bearings, respectively, in kN;

K_{11}, K_{22}, K_{12}——obtained from the following formula, in m/kN:

$$K_{11} = 1.3 \times \frac{\lambda^3}{3EJ_{1h}} + \frac{e^2\lambda}{GJ_{th}}$$

$$K_{22} = 1.3 \times \left[\frac{\lambda^3}{3EJ_{1h}} + \frac{\lambda^2 (h-\lambda)}{2EJ_{1h}} \right] + \frac{e^2\lambda}{GJ_{th}}$$

$$K_{12}=1.3\times\left[\frac{\lambda^3}{3EJ_{1h}}+\frac{\lambda^2(d-\lambda)}{EJ_{1h}}+\frac{\lambda(h-\lambda)^2}{EJ_{1h}}+\frac{(h-\lambda)^3}{3EJ_{2h}}\right]+\frac{e^2\lambda}{GJ_{th}}$$

Where: h——height of the rudder horn, in m, as defined in Figure 2.5.1. This value is measured downwards from the upper rudder horn end, at the point of curvature transition, to the mid-line of the lower rudder horn pintle;

λ——length, in m, as defined in Figure 2.5.2. This lengh is measured downwards from the upper rudder horn end, at the point of curvature transition, to the mid-line of the upper rudder horn bearing. For $\lambda = 0$, the above formula converges to those of spring constant Z for a rudder horn with 1-elastic support, and assuming a hollow cross section for this part ;

e——rudder horn torsion lever, in m, as defined in Figure 2.5.1, value taken at $z = h / 2$;

J_{1h}——moment of inertia of rudder horn about x-axis, in m^4.for the region above the upper rudder horn bearings. Note that J_{1h} is an average value over the length λ. See Figure 2.5.1;

J_{2h}——moment of inertia of rudder horn about x-axis, in m^4.for the region between the upper and lower rudder horn bearings. Noted that J_{2h} is an average value over the length h-λ, see Figure 2.5.1;

Jth——torsional stiffness factor of rudder horn, in m^4, for any thin wall closed sections:

$$J_{th}=4F_T^2/\sum_i\frac{u_i}{t_i}\quad \text{m}^4$$

F_T——mean of areas enclosed by the inner and outer boundaries of the thin-walled sections of rudder horn, in m^2;

u_i——length of the individual plates forming the mean horn sectional area, in mm;

t_i——thickness of the individual plates mentioned above, in mm.

Noted that the J_{th} value is taken as an average value, valid over the rudder horn height.

Load of rudder body

$$P_{R10}=C_{R20}/(l_{10}10^3)\ \text{kN/m}$$

$$P_{R20}=C_{R10}/(l_{20}10^3)\ \text{kN/m}$$

Where: C_{R1}, C_{R2}——see 2.2 of this Appendix.

Moments and forces

Moments and shear forces are indicated in Figure 2.5.1.

Rudder horn bending moment

The bending moment acting on the generic section of the rudder horn is to be obtained from the following formula, in N m

Between the lower and upper supports provided by the rudder horn:

$$M_H=F_{A1}z\ \text{N m}$$

Above the rudder horn upper support :

$$M_H=F_{A1}z+F_{A2}(z-d_{lu})\ \text{N m}$$

Where: F_{A1}——support force at the rudder horn lower support, in N, to be obtained according to Figure 2.5.1 and taken equal to B_1;

F_{A2}——support force at the rudder horn upper support , in N, to be obtained according to Figure 2.5.1 and taken equal to B_2;

z——distance, in m, defined in Figure 2.5.2, to be taken less than the distance h, in m ,defined in the same figure;

d_{lu}——distance, in m, between the rudder horn upper and lower bearings according to Figure 2.5.1, $d_{lu}=h-\lambda$.

Rudder horn shear force

The shear force Q_H acting on the generic section of the rudder horn, is to be obtained, in N, from the following formula between the lower and the upper rudder horn bearings:

$$Q_H = F_{A1} \text{ N}$$

Above the rudder horn upper bearings :

$$Q_H = F_{A1} + F_{A2} \text{ N}$$

The torque M_T acting on the generic section of the rudder horn is to be obtained from the following formula Between the lower end and the upper rudder horn upper bearings:

$$M_T = F_{A1} e_{(z)} \text{ N m}$$

Above the upper rudder horn upper bearings:

$$M_T = F_{A1} e_{(z)} + F_{A2} e_{(z)} \text{ N m}$$

Where: F_{A1}, F_{A2}—— support forces, in N

e (z) ——torsionlever, in m, as defined in Figure 2.5.2.

Rudder horn shear stress calculation

For a generic section of the rudder horn, located between its upper and lower bearings, the following stresses are to be calculated:

τ_s——shear stress, to be obtained from the following formula:

$$\tau_s = F_{A1}/A_H \text{ N/mm}^2$$

τ_T——torsional stress,. to be obtained for hollow rudder horn from the following formula:

$$\tau_T = M_T 10^3/(2F_T t_H) \text{ N/mm}^2$$

For solid rudder horns, τ_T is to be considered by CCS on a case by case basis.

For a generic section of the rudder horn, located in the region above its upper bearing, the following stresses are to be calculated:

τ_s——shear stress, to be obtained from the following formula:

$$\tau_s = (F_{A1}+F_{A2})/A_H \text{ N/mm}^2$$

τ_T——torsional stress,. to be obtained for hollow rudder horn from the following formula:

$$\tau_T = M_T 10^3/(2F_T t_H) \text{ N/mm}^2$$

For solid rudder horns, τ_T is to be considered by CCS on a case by case basis..

Where: F_{A1}, F_{A2}——support forces, in N;

A_H——effective shear sectional area of the rudder horn in y direction, in mm^2;

M_T——torque, in N m;

F_T——mean of areas enclosed by the inner and outer boundaries of the thin walled section of rudder horn, in m^2;

t_H——plate thickness of rudder horn, in mm; For a generic section of the rudder horn the maximum value of τ_T is obtained at the minimum value of t_H.

Rudder horn bending stress calculation

For a generic section of the rudder horn within the length h , the following stresses are to be calculated:

σ_B——bending stress, to be obtained from the following formula:

$$\sigma_B = M_H/W \text{ N/mm}^2$$

Where: M_H——bending moment at the section considered, in N m;

W——section modulus around the x-axis, in cm^3, see Figure 2.5.2.

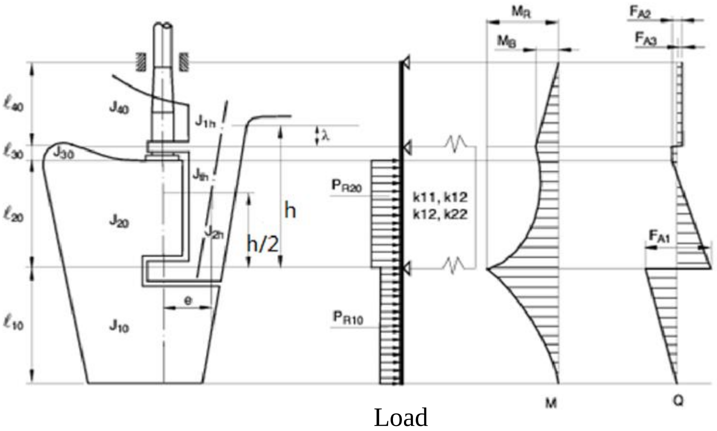


Figure 2.5.1 Semi spade rudder with 2- elastic supports

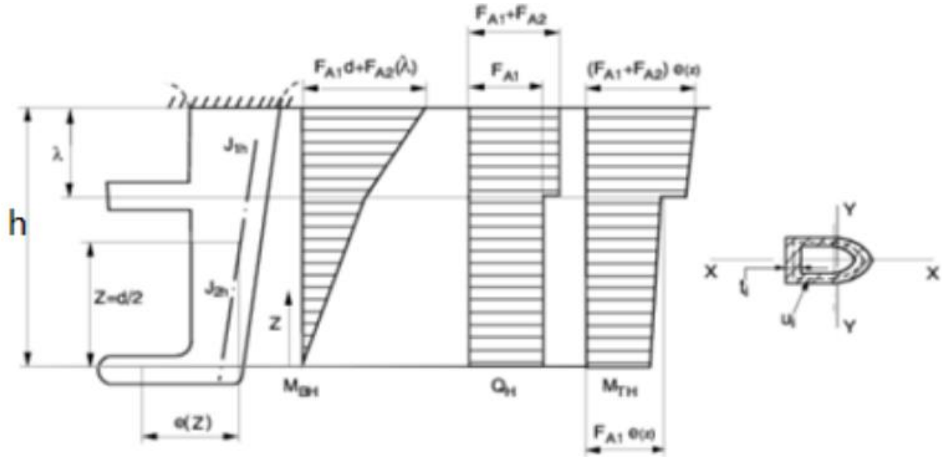


Figure 2.5.2 Rudder horn of semi spade rudder with 2-elastic supports

China Classification Society

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDTENTS

PART 3   ENGINE AND FISHING MACHINERY EQUIPMENT

Effective from: Jul. 1, 2019

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

The new paragraph 1.1.2.2 is added as follows:

"1.1.2.2 The fishing vessel machinery is to be so designed and arranged as to ensure normal operation under the ambient temperature conditions as shown in Table 1.1.2.2. For fishing vessels in specific waters, the ambient temperature can be selected according to actual conditions of the navigation area.

Ambient temperature Table 1.1.2.2

Environment	Location	Temperature (℃)
Air	fishing vessel	0 to 45
	Within specific space or on machinery installations	According to the actual temperatures of specific sites or equipment
	On the open deck	-25 to 45
Seawater	All positions	32

"

The article numbers 1.1.2.2 and 1.1.2.3 are revised to 1.1.2.3 and 1.1.2.4.

The paragraph 1.1.5 is revised as follow:

"**1.1.5 Astern power**

1.1.5.1 In order to maintain sufficient manoeuvrability and secure control of the vessel in all normal circumstances, the main propulsion machinery is to be capable of reversing the direction of thrust so as to bring the ship to rest from the maximum service speed. The main propulsion machinery is to be capable of maintaining in free route astern at least 70% of the ahead revolution.

1.1.5.2 For the main propulsion systems with reversing gears, controllable pitch propellers or electric propeller drive, running astern is not to lead to the overload of propulsion machinery.

1.1.5.3 Main propulsion systems are to undergo tests to demonstrate the astern response characteristics.

The tests are to be carried out at least over the manoeuvring range of the propulsion system and from all control positions. A test plan is to be provided by the yard and accepted by the surveyor. If specific operational characteristics have been defined by the manufacturer these are to be included in the test plan

1.1.5.4 The reversing characteristics of the propulsion plant, including the blade pitch control system of controllable pitch propellers, are to be demonstrated and recorded during trials

The new paragraph 1.1.9 is added as follows:

“1.1.9 Emissions treatment

1.1.9.1 Vessels installed with selective catalytic reduction systems for reduction of NOx emission from diesel engines are, in addition to the relevant provisions of this PART, to comply with the requirements of CCS 《*Guidelines for Approval and Survey of Selective Catalytic Reduction (SCR) systems*》 and 《*Guidelines for Application of Selective Catalytic Reduction (SCR) Systems Onboard Ships.*》

1.1.9.2 Vessels installed with exhaust gas cleaning systems for reduction of SOx emission from fuel oil combustion units are, in addition to the relevant provisions of this PART, to comply with the requirements of CCS 《*Guidelines for Testing and Inspection of Vessel Waste Gas Cleaning Systems*》 and《*Guidelines for Design and Installation of Exhaust Gas Cleaning Systems.*》”

The article numbers 1.1.9 and 1.1.10 are revised to 1.1.10 and 1.1.11.

CHAPTER 2 GENERAL REQUIREMENTS FOR PUMPS AND PIPING SYSTEMS

SECTION 1 GENERAL PROVISIONS

The paragraph 2.1.4.2 is revised as follow:

"2.1.4.2 Penetration pieces or steel pads are to be provided for pipes passing through watertight or gastight structures. If pipes are fixed on watertight bulkhead by bolts, bolt holes are not to pass through bulkhead. For pipes pass through deck or bulkhead with fire division, their arrangement is not to damage fire division of deck or bulkhead.

The new paragraph 2.1.4.6 is added as follows:

"2.1.4.6 For vessels required for damage stability, the arrangement is to ensure that the continuing flooding will not extend to the compartments other than those with assumption of flooding , provided the piping system is fitted in the assumed flooding compartments.

The new paragraph 2.1.9.3 is added as follows:

"2.1.9.3 In general, slip type expansion joints are only used for pipes in spaces accessible to operators for inspection during normal navigation. Slip type expansion joints are not to be used for pipes in spaces such as dry cargo tank and deep tank which are not easy to inspect. Slip type expansion joints may be used for pipes in tanks carrying the same liquid as that in the pipes.

Slip type expansion joints are not to be used in the systems listed below:

(1) class I Piping system;

(2) oil (such as fuel oil, lubricating oil, hydraulic oil, thermal oil) pipes of Class II piping system;

(3) steering gear hydraulic system;

(4) starting air and control air system;

(5) boiler feed water system;

(6) fixed gas fire extinguishing system;

(7) bilge pipelines located in cargo hold, deep tanks and double bottom tanks;

(8) oil pipes, such as fuel oil, lubricating oil, hydraulic oil and thermal oil, of Class III systems located in machinery spaces of category A, accommodation spaces or non-mechanically ventilated pipe duct keels;

(9) pipes passing through other tanks;

(10) exhaust system.

2.1.9.3 through 2.1.9.5 are revised to 2.1.9.4 through 2.1.9.6

Section 2 CARBON STEEL AND LOW-ALLOY STEEL

The new paragraph 2.2.1.2 is added as follows:

"2.2.1.2 In general, carbon and carbon-manganese steel pipes, valves and fittings are not to be used for medium temperatures above 400℃. Nevertheless, they may be used for higher temperatures if their metallurgical behavior and time dependent strength (UTS after 100,000 h) are in compliance with national or international codes or standards and if such values are guaranteed by the steel manufacturer.

Special alloy steel pipes, valve and fittings are to be employed according to the Chapter of this Rules.

The paragraph 2.2.2.1 is revised as follow:

"*b* ——allowance for bending, in mm, see 2.2.2.3 of this PART." to "*b*-allowance for bending, in mm. The value for this allowance is to be chosen in such a way that the calculated stress in the bend, due to the internal pressure only, does not exceed the permissible stress. When this allowance is not determined by a more accurate procedure, it is to be taken according to 2.2.2.3 of this Section;”

2.2.2.7 and 2.2.2.8 are deleted.

The article numbers 2.2.2.9 is revised to 2.2.2.7.

2.2.3 through 2.2.8 are deleted. The relevant contents are moved to Section 5 of this PART.

Section 3 COPPER AND COPPER ALLOYS

The new paragraph 2.3.1.2 is added as follows:

"2.3.1.2 Materials of copper and copper alloys for Class III piping systems are to be manufactured and tested in accordance with the approved standards."

The article numbers 2.3.1.2 is revised to 2.3.1.3.

In 2.3.2.1 “*b* ——allowance for bending, in mm, see 2.3.2.3 of this PART.” is revised to " *b* ——allowance for bending, in mm. The value for this allowance is to be chosen in such a way that the calculated stress in the bend, due to the internal pressure only, does not exceed the permissible stress. When this allowance is not determined by a more accurate procedure, it is to be taken according to 2.3.2.3 of this Section;”

Section 4 OTHER MATERIALS

The new paragraph 2.4.2.2 is added as follows:

"2.4.2.2 Ferritic nodular graphite iron pipes, valves and fittings may be accepted for bilge and ballast piping. "

The article numbers 2.4.2.2 and 2.2.2.3 are revised to 2.4.2.3 and 2.4.2.4.

The new paragraph 2.4.2.5 is added as follows:

"2.4.2.5 Where the elongation is less than the minimum required in 2.4.2.1 of this Section, the material is to be subject to the same limitations as grey cast iron. "

The paragraph 2.4.4 is revised as follow:

"2.4.4 Flexible hoses

2.4.4.1 Flexible hoses mean short length of metallic or non-metallic hoses normally with prefabricated end fittings ready for installation.

2.4.4.2 Flexible hoses may be used for a permanent connection between a fixed piping system and items of machinery, as well as temporary connection between portable equipment and pipes.

2.4.4.3 Flexible hoses are to be designed, manufactured, used and tested in accordance with the relevant requirements of CCS. Flexible hoses with end pieces made of fire-resistant materials shall withstand a high temperature fire test at 800℃ for 30 minutes. At this time, the water in the pipe is circulated at the maximum working pressure. The water temperature at the outlet is not to be lower than 80℃. There shall be no records of leakage during or after the test. Alternatively, the flexible hoses may be subjected to a fire test under a flowing water pressure condition of at least 0.5 MPa in the pipe, and a subsequent pressure test at twice the design pressure. ”

The new Section 5 is added as follows:

“Section 5 CONNECTION OF PIPE LENGTHS

2.5.1 Connection of pipe lengths

2.5.1.1 Direct connection of pipe lengths may be obtained by:

(1) welded butt-joints between pipes or between pipes and valve chests or other fittings, the welded butt-joints are to be of full penetration type with or without special provisions for the quality of root side[1]

[1]Special requirements for root quality mean that the butt welding is completed by double-sided welding, or the first welding process is completed by pad welding or single-sided welding filled with inert gas, or other similar methods accepted by CCS.

(2) slip-on sleeve welded joints, the slip-on sleeve welded joints are to have sleeves and relative welding of adequate dimensions conforming to the recognized standard;

(3) threaded sleeve joints of approved type;

(4) mechanical joints.

2.5.1.2 The application of the aforesaid types of connection is as follows:

(1) Welded butt-joints and slip-on sleeve welded joints are to comply with the requirements specified in Table 2.5.1.2(1).

Connection of pipe length Table 2.5.1.2 (1)

<table>
<tr><td>Type of connection</td><td>Allowed for classes</td><td>Allowed for outside diameter</td></tr>
<tr><td>Butt welded joints with special provision for a high quality of root side</td><td>I, II, III</td><td rowspan="3">No restriction</td></tr>
<tr><td>Butt welded joints without special provision for a high quality of root side</td><td>II, III</td></tr>
<tr><td rowspan="2">Slip-on sleeve welded joints</td><td>III</td></tr>
<tr><td>I, II, except for piping systems conveying toxic media where fatigue, severe erosion is expected to occur</td><td>$D \leq 88.9$ mm</td></tr>
</table>

(2) Slip-on threaded joints are to comply with requirements of a recognized standard. Slip-on threaded joints may be used for outside diameters as stated below except for piping systems conveying toxic or flammable media or services where fatigue, severe erosion or crevice is expected to occur. Threaded joints in CO_2 systems are to be allowed only inside protected spaces and in CO_2 cylinder rooms.

① Threaded joints for direct connectors of pipe lengths with tapered thread may be allowed for Class I, outside diameter not more than 33.7 mm as well as Class II and Class III, outside diameter not more than 60.3 mm.

② Threaded joints for parallel thread may be allowed for Class III, outside diameter not more than 60.3 mm.

③ In particular cases, sizes in excess of those mentioned above may be accepted if they satisfy the requirements of recognized international or national standards.

2.5.2 Flange connections

2.5.2.1 Typical flange connections are indicated in Figure 2.5.2.1.Slip-on joints, sleeve threaded joints and other types of direct connection of pipe lengths (e.g. bell and spigot joints) may be allowed in each particular case for small diameter and depending upon the service conditions.

2.5.2.2 The above-mentioned types of flange connections are to be selected in accordance with the requirements specified in Table 2.5.2.2.

Application of typical flange connections Table 2.5.2.2

<table>
<tr><td>Piping class</td><td>Toxic or corrosive media④, flammable media④, liquefied gas</td><td>Lubricating oil and fuel oil</td><td>Steam③ and hot oil</td><td>Other media①②③</td></tr>
<tr><td>I</td><td>A, B⑥</td><td>A, B</td><td>A, B⑥</td><td>A, B</td></tr>
<tr><td>II</td><td>A, B, C</td><td>A, B, C, E⑦</td><td colspan="2">A, B, C, D⑤, E⑤</td></tr>
<tr><td>III</td><td></td><td>A, B, C, E</td><td>A, B, C, D, E</td><td>A, B, C, D, E, F②</td></tr>
</table>

Notes: ①Include water, air, other gases and hydraulic oil;

②Type F is only applicable to water pipes and open pipes;

③When the design temperature exceeds 400℃, only type A is applicable;

④When the design pressure exceeds 1 MPa, only type A is applicable;

⑤When the design temperature exceeds 250℃, type D and type E are not applicable;

⑥Type B is only applicable to pipes with an outer diameter less than 150 mm;

⑦Type E is only applicable to oil pipes with design temperature less than 150 ℃ and design pressure less than 1.6 MPa.

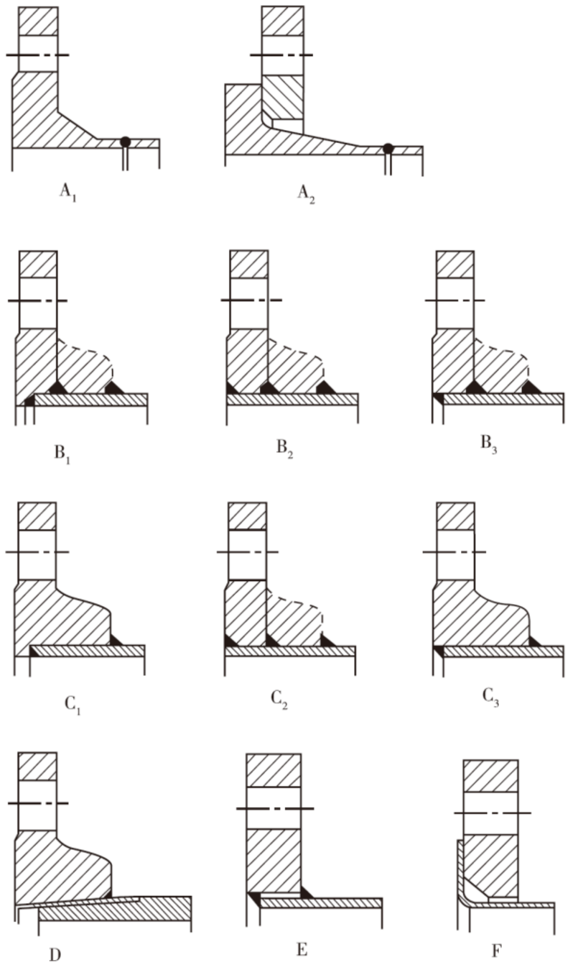


Figure 2.5.2.1 Typical flange connections

Notes: ① For type D, the pipe and flange are to be screwed with a tapered thread and the diameter of the screw portion of the pipe over the thread is not to be appreciably less than the outside diameter of the unthreaded pipe. After the flange has been screwed hard home, the pipe is to be expanded into the flange.

② The leg length of the fillet weld and the penetration of the flange edge, as shown in the Figure, are in general to be 1.5 times the wall thickness of the pipe, but not less than 5 mm.

2.5.2.3 The dimensions of flanges and relative bolts are to be chosen in accordance with the national standards or acceptable standards. For special application, the dimensions of flanges and relative bolts are to be subject to special consideration[1].

Gaskets are to be suitable for the media being conveyed under design pressure and temperature conditions and their dimensions and configuration are to be in accordance with national or acceptable standards.

Flange connections are to be in accordance with national or international standards that are applicable to the piping system and are to recognize the boundary fluids, design pressure and temperature conditions, external or cyclic loading and location.

2.5.3 Mechanical joints

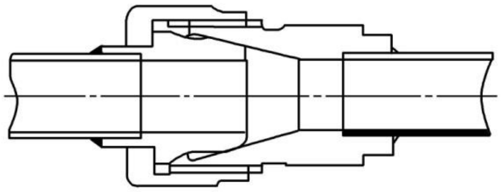
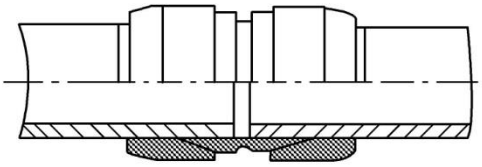
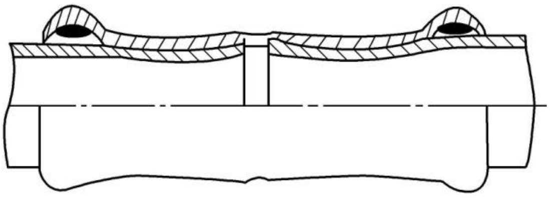
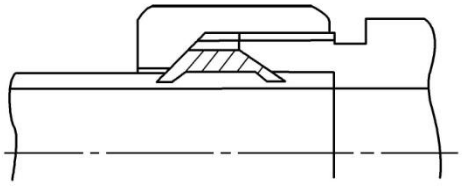
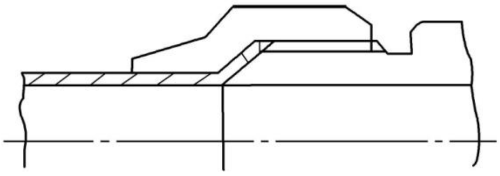
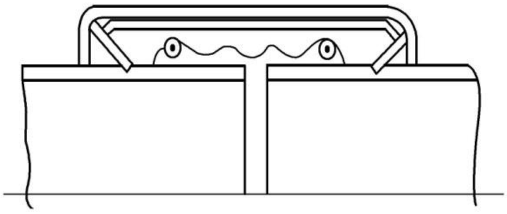
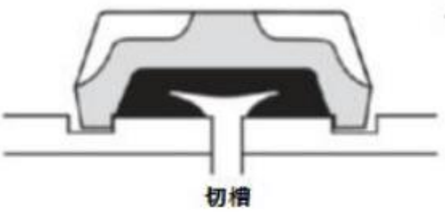
2.5.3.1 The different mechanical joints applicable to this paragraph are indicated in Table 2.5.3.1(1). The mechanical joints are to be subject to type approval based on different usage and location in accordance with the requirements of Appendix 3 of the CCS Rules for Classification of Sea-going Steel Ships.

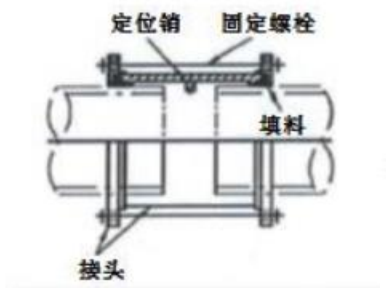
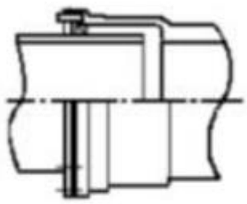
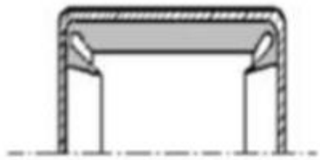
2.5.3.2 Where appropriate, mechanical joints are to be of fire resistant type as required by Table 2.5.3.1(2).

2.5.3.3 Material of mechanical joints is to be compatible with the piping material and internal and external media.

[1]For special applications where the fitting temperature, pressure and size of the flange exceed reliable limits, a complete calculation is to be carried out for bolts and flanges.

Examples of mechanical joints Table 2.5.3.1 (1)

Pipe unions	
Welded and brazed types	
Compression	
Swage type	
Press type	
Bite type	
Flared type	
Slip-on joints	
Grip type	
Machine grooved type	 Roll groove  Cut groove

Slip type	 STOP BOLD SETTING BOLT PACKING BODY  

Application of mechanical joints Table 2.5.3.1 (2)

Systems		Kind of connections		
		Pipe unions	Compression couplings	Slip-on joints
Flammable fluids (flash point ≤ 60℃)				
1	Vent lines[③]	×	×	×
Flammable fluids (flash point > 60℃)				
2	Fuel oil lines[③②]	×	×	×
3	Lubricating oil lines[②③]	×	×	×
4	Hydraulic oil [②③]	×	×	×
5	Thermal oil[②③]	×	×	×
Sea water				
6	Bilge lines[①]	×	×	×
7	Fire main (not permanently filled)[③]	×	×	×
8	Ballast system[①]	×	×	×
9	Cooling water system[①]	×	×	×
10	Tank cleaning services	×	×	×
11	Non-essential systems	×	×	×
Fresh water				
12	Cooling water system[①]	×	×	×

13	Condensate return ①	×	×	×
14	Non-essential systems	×	×	×
Sanitation/drains /scuppers				
15	Deck drains (inboard)⑥	×	×	×
16	Sanitary drains	×	×	×
17	Scuppers and discharge (overboard)	×	×	-
Sounding / vent				
18	Water tanks/dry spaces	×	×	×
19	Ooil tank②③	×	×	×
Miscellaneous				
20	Starting/control air①	×	×	-
21	Service air (non-essential)	×	×	×
22	Brine	×	×	×
23	CO_2 system①	×	×	-
24	Steam	×	×	×⑤

Notes:

×——Application is allowed.

-   ——Application is not allowed.

* Fire resistance capability:

If mechanical joints include any components which readily deteriorate in case of fire, they are to be of an approved fire resistant type under consideration of the following footnotes:

① Inside machinery spaces of category A – only approved fire resistant types.

②Sliding joints cannot be accepted in Class A machinery spaces or living spaces. If the joints are located in an easily visible and accessible location, they can be accepted in other machinery spaces.

③ Approved fire resistant types except in cases where such mechanical joints are installed on exposed open decks and not used for fuel oil lines.

④On open decks, approved fire resistance types are to be used.

* General:

⑤Slip type slip-on joints as shown in Table 2.5.3.1(1) may be used for pipes on deck with a design pressure of 10 bar or less. 1.02 MPa (10 bar).

⑥ Only above bulkhead deck

Application of mechanical joints depending upon the class of piping Table 2.5.3.1 (3)

Types of joints	Classes of piping system		
	Class I	Class II	Class III
Pipe unions			
Welded and brazed type	×($D\leq$ 60.3 mm)	×($D\leq$ 60.3 mm)	×
Compression couplings			
Swage type	×	×	×
Bite type Flared type	×($D\leq$ 60.3 mm) ×($D\leq$ 60.3 mm)	×($D\leq$ 60.3 mm) ×($D\leq$ 60.3 mm)	× ×
Press type	-	-	×

Slip-on joints			
Machine grooved type	×	×	×
Clip type	-	×	×
Slip type	-	×	×

Notes:

×——Application is allowed.

- ——Application is not allowed.

D_0—— outside diameter of the pipe.

2.5.3.4 Application of mechanical joints and their acceptable use for each service is indicated in Table 2.5.3.1(2); dependence upon the Class of piping and pipe dimensions is indicated in Table 2.5.3.1(3). In particular cases, sizes in excess of those mentioned above may be accepted if in compliance with a recognized national and/or international standard.

2.5.3.5 Where the application of mechanical joints results in reduction in pipe wall thickness due to the use of bite type rings or other structural elements, this is to be taken into account in determining the minimum wall thickness of the pipe to withstand the design pressure.

2.5.3.6 Mechanical joints, which in the event of damage could cause flooding or fire, are not to be used in piping sections directly connected to the ship's side below the bulkhead deck of passenger vessels (or freeboard deck of cargo vessels) or tanks containing flammable fluids. The number of mechanical joints in flammable fluid systems is to be kept to a minimum. In general, flanged joints conforming to recognized standards are to be used.

2.5.3.7 Mechanical joints in bilge systems of machinery space are to be of fire resistant type. For the required fire resistant mechanical joints, see Table 2.5.3.1(2).

2.5.3.8 Mechanical joints are to be tested where applicable, to a burst pressure of 4 times the design pressure.

2.5.3.9 Piping in which a mechanical joint is fitted is to be adequately adjusted, aligned and supported. Supports or hangers are not to be used to force alignment of piping at the point of connection.

2.5.3.10 Slip-on joints are not to be used in pipelines in cargo holds, tanks and other spaces which are not easily accessible. Application of these joints inside tanks may be permitted only for the same media that is in the tanks.

Usage of slip type slip-on joints as the main means of pipe connection is not permitted except for cases where compensation of axial pipe deformation is necessary.

2.5.3.11 Mechanical joints are not to be used in the following cases:

(1) bilge piping through ballast tanks and fuel tanks;

(2) sea water and ballast piping (including air and overflow pipes) through cargo holds and fuel tanks;

(3) fuel and oil piping (including air and overflow pipes) through machinery spaces, cargo holds and ballast tanks;

(4) non-water filled pressure water spraying systems (dry pipe systems).

2.5.3.12 The installation of mechanical joints is to be in accordance with the manufacturer's assembly instructions. Where special tools and gauges are required for installation of the joints, these are to be supplied by the manufacturer.

The new Section 6 is added sa follows:

"Section 6 PUMPS, VALVES AND FITTINGS

2.6.1 Pumps

2.6.1.1 Pumps are to be designed and manufactured according to accepted standards.

2.6.1.2 Hydraulic tests

All components of pumps subject to pressure are to be subject to hydraulic tests in workshop prior to assembly. The hydraulic test pressure is to be 1.5 times the design pressure, but need not exceed the design pressure plus 7 MPa.

For centrifugal pumps, the design pressure is to be taken as the maximum pressure head on the performance curve. For displacement pumps, the design pressure is to be taken as the relief valve setting pressure.

For steam driven pumps, the test pressure at the steam side is to be 1.5 times the steam working pressure.

2.6.1.3 Capacity tests

Pump capacities are to be checked with the pump operating at design conditions (rated speed and pressure head). For centrifugal pumps, the pump characteristic (head-capacity) design curve is to be verified to the satisfaction of the Surveyor. Capacity tests may be waived if previous satisfactory tests have been carried out on similar pumps.

2.6.1.4 Relief valve capacity test

For positive displacement pumps with an integrated relief valve, the valve's setting and full flow capacity corresponding to the pump maximum rating is to be verified. The operational test for relief valve capacity may be waived if previous satisfactory tests have been carried out on similar pumps.

2.6.2 Valves and fittings

2.6.2.1 Valves are to be designed and manufactured according to accepted standards. For other structurally new-type valves or non-standard valves, detailed drawings and information are to be submitted.

2.6.2.2 The strength of valves and fittings in piping system is to be appropriate to the strength required by the connected pipes and is to be able to work efficiently under the maximum working pressure. Valves are to be made of steel, cast iron, copper, copper alloy or other materials suitable for the intended service.

2.6.2.3 All valves are to be so constructed as to prevent the possibility of valve bonnets or glands being slackened back or loosened when the valves are operated. Screwed-on valve bonnets are not to be used for valves with nominal diameter exceeding 40 mm in Class I and Class II piping systems, sea valves, ship-side valves and valves in flammable liquid system.

2.6.2.4 Valves on board vessels are to be of such construction that the closing of which is obtained by clockwise rotation of the hand wheel, and the opening by counter-clockwise rotation.

2.6.2.5 Indicators are to be provided to show the open and closing condition of the valves, unless this can be observed in some other way.

2.6.2.6 Valves and cocks are to be fitted with nameplates to indicate their purposes. The casing of non-return valves is to be permanently marked with flow direction.

2.6.2.7 The welded necks on the valve bodies are to be long enough to ensure that the valves will not deform due to welding and subsequent heat treatment of the joints.

2.6.2.8 All valves are to be subject to hydraulic tests in workshop. The hydraulic test pressure is to be 1.5 times the design pressure.

Section 5 is revised to Section 7:

"Section 7 HYDRAULIC TEST AND TIGHTNESS TEST

2.7.1 Hydraulic tests for piping prior to installation on board

2.7.1.1 All Classes I and II pipes and their associated fittings and, all steam pipes, feed pipes, compressed air pipes and fuel oil pipes having a design pressure greater than 0.35 MPa together with their fittings are to be hydraulically tested after completion of manufacture and before insulating and coating. The test pressure P_s is not be less than 1.5 times the design pressure p.

2.7.1.2 For steel pipes and integral fittings for use in systems where the design temperature exceeds 300℃, test pressure P_s is to be determined by the following formula, but need not exceed $2p$.

$$P_S = 1.5 \frac{[\sigma]_{100}}{[\sigma]_t} p \quad \text{MPa}$$

Where: p——design pressure, in MPa

$[\sigma]_{100}$——permissible stress for 100℃, in N/mm^2;

$[\sigma]_t$——permissible stress for the design temperature, in N/mm^2.

The test pressure may be reduced to 1.5p where it is necessary to avoid excessive stress in way of bends and T-connections. In no case is the membrane stress to exceed 90% of the yield stress at the testing temperature.

2.7.1.3 When the hydraulic test of piping is carried out on board, it may be carried out concurrently with the tightness tests required after assembly on board.

2.7.1.4 For pipes with an internal diameter less than 15 mm, the hydraulic test may be waived.

2.7.1.5 When, for technical reasons, it is not possible to carry out complete hydraulic test for all sections piping, prior to assembly on board, applications are to be submitted to CCS for approval for testing the closing lengths of piping, particularly in respect to closing seams.

2.7.2 Hydraulic tests for valves and fittings prior to installation on board

2.7.2.1 Valves and fittings non-integral with the piping system, intended for Classes I and II, are to be hydraulically tested in accordance with recognized standards, but the test pressure is not to be less than 1.5 times the design pressure. Valves, cocks and distance pieces intended to be fitted on the ship side below the load waterline are to be tested by hydraulic pressure not less than 0.5 MPa.

2.7.3 Testing after assembly on board

2.7.3.1 All piping systems are to be checked for leakage under working conditions.

2.7.3.2 Fuel (oil or gas) piping, heating coils in tanks, bilge pipes in way of double bottom tanks or deep tanks and hydraulic piping are to be tested by hydraulic pressure in accordance with Table 2.7.3.2.

Hydraulic tests after assembly on board Table 2.7.3.2

Piping system	Test pressure
Fuel piping	1.5 times design pressure, but not less than 0.4 MPa
Heating coils in tanks	
Bilge pipes in way of double bottom tanks or deep tanks	Not less than test pressure of the tank
Hydraulic piping	1.25 times design pressure, but no need to exceed design pressure plus 7 MPa

2.7.3.3 Where Classes I and II pipes are butt welded together during assembly on board, they are to be tested by hydraulic pressure in accordance with the requirements of 2.7.1.1 to 2.7.1.3 after welding. During installation and before the hydraulic test is carried out, the pipe lengths may be insulated, except in way of the joints. The hydraulic test required in 2.7.3.3 of this Section may be omitted provided non-destructive tests by ultrasonic or radiographic methods are carried out on the entire circumference of all butt welds with satisfactory results.

CHAPTER 3 VESSEL'S PIPING AND VENTILATING SYSTEMS

SECTION 1 GENERAL PROVISIONS

The new paragraph 3.1.3.2 is added as follows:

"3.1.3.2 All valves or cocks on the overboard discharge pipes are to be installed directly on on the shell plating or sea chests. The wall thickness of the distance piece is to comply with the requirements in the following table, or may be same as that of the shell plating in way of its penetration into the distance piece. The distance piece is to be adequately strengthened as to ensure its rigidity.

Table 3.1.3.2

Nornimal diameter of pipe ①(in mm)	Pipe wall thickness (in mm)
50	6.3
100	8.6
125	9.5
150	11.0
200 and above	12.5

Notes: ①The wall thickness of pipes with nominal diameters between the columns can be calculated by insertion method.
"

Section 2 DRAINAGE OF COMPARTMENTS, OTHER THAN MACHINERY SPACES

The paragraph 3.2.2.4 is revised as follow:

"3.2.2.4 Fish tanks are to be provided with bilge water level measuring devices. If no measuring devices are provided, an effective water level alarm device is to be installed."

Section 5 BALLAST AND SCUPPER SYSTEMS

3.5.2 deleted.

Section 6 AIR, OVERFLOW AND SOUNDING PIPES

The paragraph 3.6.6.1 is revised as follow:

"3.6.6.1 The sectional area of overflow pipe(s) from each tank is not to be less than 1.25 times that of the filling pipe(s). When an overflow pipe serves several tanks, the sectional area of the overflow pipe is to be at least the combined area of the largest overflow pipes for two tanks."

Section 7 VENTILATION

3.7.2 deleted.

The article number 3.7.3 is revised to 3.7.2.

The new paragraphs 3.7.3 and 3.7.4 are added as follows:

"3.7.3 Sparkless fan

3.7.3.1 For fans that require a non-sparking fan, it means that the fan does not generate sparks under any circumstances, that is, it is considered to be non-sparking.

3.7.3.2 Design requirements:

(1) The gap between the impeller and the fan casing is not to be less than 0.1 times the shaft diameter at the impeller bearing, 2 mm as the minumum and 13 mm as the maximum;

(2) The ventilation inlet and outlet of the open deck are to be provided with a protective mesh with a square grid width of not more than 13 mm to prevent objects from entering the fan casing.

3.7.3.3 Materials:

(1) Both the impeller and its housing are to pass appropriate tests and be made of alloy materials believed as not producing produce sparks;

(2) Antistatic materials are to be used to prevent electrostatic charges on the rotating body and the casing. In addition, when installing ventilation equipment on board, make sure that the equipment itself is safely grounded;

(3) For the following combinations, the spark test is not required for fans:

① The impeller and / or housing are made of non-metallic materials, and the elimination of static electricity is to be taken into consideration;

② Impeller and housing are made of non-ferrous metal;

③ The impeller is made of aluminum alloy or magnesium alloy, and the housing is made of ferrous metal (including austenitic stainless steel).

A ring of non-ferrous metal material of appropriate thickness is to be applied on the housing;

④ The impellers and housings are made of any combination of ferrous metals (including austenitic stainless steel), but the design gap of the impeller end is not to be less than 13 mm.

(4) The following impellers and housings will generate sparks and should not use:

① The impellers are made of aluminum alloy or magnesium alloy, and the housings are made of ferrous metal, regardless of the end gap;

② The housings are made of aluminum alloy or magnesium alloy, and the impellers are made of ferrous metal, regardless of the end gap;

③ The impellers and housings are made of any ferrous metal combinations, but the design gap of the impeller end is less than 13mm.

(5) The type test after fan production is to meet the requirements of international standards or other standards accepted by CCS.

3.7.4 Ventilation of emergency generator rooms

3.7.4.1 Emergency generator rooms are to be provided with ventilation openings for the admission of combustion air to engines and the removal of heat. These openings are usually provided with louvers which can be closed from the outside of the emergency generator rooms (when fire breaks out in emergency generator rooms). The louvers may be hand-operated or power-operated. Alternatively, the louvers may be of fixed type with a closing door which may be hand-operated or automatic.

3.7.4.2 The following requirements apply to ventilation louvers for emergency generator rooms and to closing appliances where fitted to ventilators serving emergency generator rooms:

(1) Ventilation louvers and closing appliances may either be hand-operated or power-operated (hydraulic / pneumatic / electric) and are to be operable under a fire condition.

(2) Hand-operated ventilation louvers and closing appliances are to be kept open during normal operation of the vessel. Corresponding instruction plates are to be provided at the location where hand-operation is provided.

(3) Power-operated ventilation louvers and closing appliances are to be of a fail-to-open type. Closed ventilation louvers and closing appliances are acceptable during normal operation of the vessel. Power-operated ventilation louvers and closing appliances are to open automatically whenever the emergency generator is starting / in operation.

(4) It is to be possible to close ventilation openings by a manual operation from a clearly marked safe position outside the space where the closing operation can be easily confirmed. The louver status (open /closed) is to be indicated at this position. Such closing is not to be possible from any other remote position.

CHAPTER 4 MACHINERY PIPING SYSTEM

Section 2 OIL FUEL SYSTEMS

The paragraph 4.2.5.5 is revised as follow:

“4.2.5.5 Oil is not to be carried in a fore peak tank or other flammable liquids.

Section 6 LUBRICATING OIL SYSTEMS

The paragraph 4.6.3.5 is revised as follow:

"4.6.3.5 Each oil supply pipe of an oil storage tank and an oil circulation tank of a pressure lubrication system arranged above a double bottom is to be provided with a valve or cock on the tank wall. For oil tanks with a capacity of more than $0.5m^3$, in addition to the above-mentioned valves or cocks that can be closed on-site, generally, remote-control closing devices are also to be provided in safe spaces easily accessible outside of their locations. Under special circumstances, if the designers confirm that an unauthorized operation of the remotely controlled closing valves on the lubricating tanks will jeopardize safe running of the main or eventful auxiliary engines, the remotely controlled device may be omitted.

CHAPTER 5 DIESEL ENGINES

Section 1 GENERAL PROVISIONS

The new paragraph 5.1.11 is added as follows:

"5.1.11 Turbochargers

5.1.11.1 The turbochargers are to be designed to operate under conditions given in 1.1.2, Chapter 1 of this PART. The component lifetime and the alarm level for speed are to be based on 45℃ air inlet temperature.

5.1.11.2 Turbochargers are categorized in three groups depending on served power by cylinder groups(e.g. for a V-engine with one turbocharger for each bank, the categorization is based on half of the total engine rated power) with:

(1) Category A: ≤1,000 kW;

(2) Category B: > 1,000 kW and ≤2,500 kW;

(3) Category C: > 2,500 kW.

5.1.11.3 The requirements for turbochargers with regard to design, approval, type testing and certification escalate with the size of the turbochargers. For details, see Section 6 of this Chapter.

5.1.11.4 Turbochargers are to be type approved, either separately or as a part of an engine.

5.1.11.5The requirements relating to turbochargers in this Chapter are written for exhaust gas driven turbochargers, but apply in principle also for engine driven chargers."

The article number 5.1.11 is revised to 5.1.12.

Section 3 MAIN FITTINGS

The paragraph 5.3.4 is revised as follow:

"5.3.4 Crankcases and relief valves

5.3.4.1 Crankcases and their doors are to be of robust construction and the doors are to be securely fastened so that they will not be readily displaced by an explosion.

5.3.4.2 In diesel engines having cylinders not exceeding 200 mm bore or having a crankcase gross volume not exceeding 0.6 m^3, relief valves may be dispensed.

In engines having cylinders exceeding 200 mm but not exceeding 250 mm bore, at least one relief valve is to be fitted near respectively each end of crankcase and an additional relief valve is to be fitted near the middle of the engine, where crank throws exceed eight.

In engine having cylinders exceeding 250 mm but not exceeding 300 mm bore, at least one relief valve is to be fitted in way of each alternate crank throw with a minimum of two valves. Relief valves are to be arranged from each end, where the cranks are of odd number.

In engines having cylinders exceeding 300 mm bore, at least one relief valve is to be fitted in way of each main crank throw.

Additional relief valves are to be fitted for separate spaces on the crankcase, such as gear or chain cases for camshaft or similar drives, when the gross volume of such spaces exceeds 0.6 m^3.

The combined free area of the crankcase relief valves fitted on an engine is not to be less than 115 cm^2 per m3 of the volume of the crankcase. The free area of each relief valve is not to be less than 45 cm^2.

5.3.4.3 The structural design of crankcase relief valves are to comply with following requirements:

(1) Crankcase explosion relief valves are to be provided with lightweight spring-loaded valve discs or other quick-acting and self-closing devices to relieve a crankcase of pressure in the event of an internal explosion and to prevent the inrush of air thereafter;

(2) The valve discs in crankcase explosion relief valves are to be made of ductile material capable of withstanding the shock of contact with stoppers at the full open position;

(3) Crankcase explosion relief valves are to be designed and constructed to open quickly and be fully open at a pressure not greater than 0.02 MPa;

(4) Crankcase explosion relief valves are to be provided with a flame arrester that permits flow for crankcase pressure relief and prevents passage of flame following a crankcase explosion;

(5) Where crankcase relief valves are provided with arrangements for shielding emissions from the valve following an explosion, the valve is to be type tested to demonstrate that the shielding does not adversely affect the operational effectiveness of the valves;

(6) Crankcase explosion relief valves are to be provided with a copy of manufacturer's installation and maintenance manual that is pertinent to the size and type of valve being supplied for installation on a particular engine. The manual is to contain the following information:

① description of valve with details of function and design limits;

②copy of type test certification;

③ installation instructions;

④ maintenance in service instructions to include testing and renewal of any sealing arrangements;

⑤ actions required after a crankcase explosion.

(7) A copy of the installation and maintenance manual required by 5.3.4.3(6) of this Section is to be provided on board.

(8) Valves are to be provided with suitable markings that include the following information:

①name and address of manufacturer;

②designation and size;

③month/Year of manufacture;

④approved installation orientation.

(9) Crankcase explosion relief valves are to be type tested in a configuration that represents the installation arrangements that will be actually used on an engine.

5.3.4.4 The total volume of the stationary parts within the crankcase may be discounted in estimating the crankcase gross volume (rotating and reciprocating components are to be included in the gross volume).

5.3.4.5 Crankcase oil drain pipes of two or more diesel engines are not to be interconnected."

The new paragraph 5.3.6 is added as follows:

"5.3.6 Crankcase oil mist detection and alarm devices

5.3.6.1 In engine having cylinders with an output greater than or equal to 250 mm or cylinder bore exceeding 300 mm, approved crankcase oil mist detection and alarm devices (or diesel engine bearing temperature monitors or equivalent devices) are to be fitted.

For low-speed engines, an alarm is to be given and speed is to be reduced when high level of oil mist is detected.

For medium and high-speed diesel engines, an alarm is to be given and engines are to be automatically stopped when high level of oil mist is detected.

5.3.6.2 The oil mist detection/monitoring system and arrangements are to be installed in accordance with the engine designer's and oil mist manufacturer's instructions/recommendations. The following particulars are to be included in the instructions:

(1) Schematic layout of engine oil mist detection/monitoring and alarm system showing location of engine crankcase sample points and piping or electrical cable arrangements together with dimensions of pipes connected to detector/monitor;

(2) Evidence of study to justify the selected location of sample points and sample extraction rate (if applicable) in consideration of the crankcase arrangements and geometry and the predicted crankcase atmosphere where oil mist can accumulate;

(3) The manufacturer's maintenance and test manual;

(4) Information relating to type or in-service testing of the engine with engine protection system test arrangements having approved types of oil mist monitoring equipment.

5.3.6.3 A copy of the oil mist detection/monitoring equipment maintenance and test manual is to be provided on board.

5.3.6.4 Oil mist monitoring and alarm information is to be capable of being read from a safe location away from the engine.

5.3.6.5 Each engine is to be provided with its own independent oil mist detection arrangement and a dedicated alarm if multiple diesel engines need to be fitted with oil mist detection and alarm devices.

5.3.6.6 Oil mist detection/monitoring and alarm systems are to be subject to the simulated functional test on the test bench and on board at stop state and normal operating conditions of diesel engines in accordance with test procedures accepted by CCS.

5.3.6.7 The alarms and shutoff of oil mist detection devices are to comply with relevant requirements of Chapter 12 in this PART.

5.3.6.8 The oil mist detection/monitoring arrangements are to provide an alarm indication in the event of a foreseeable functional failure in the equipment and installation arrangements.

5.3.6.9 The oil mist detection/monitoring system is to provide an indication that any lenses fitted in the equipment and used in determination of the oil mist level have been partially obscured to a degree that will affect the reliability of the information and alarm indication.

5.3.6.10 Where oil mist detection/monitoring equipment includes the use of programmable electronic systems, the arrangements are to be in accordance with relevant requirements of Chapter 12 in this PART.

5.3.6.11 The equipment together with detectors/monitors is to be tested when installed on the test bench and on board to demonstrate that the detection/monitoring and alarm system functionally operates. The testing arrangements are to be submitted to CCS for approval.

5.3.6.12 Where sequential oil mist detection/monitoring arrangements are provided, the sampling frequency and time is to be as short as reasonably practicable.

5.3.6.13 Where alternative methods are provided for the prevention of the build-up of oil mist that may lead to a potentially explosive condition within the crankcase, the following information is to be included in the details to be submitted for approval:

(1) Engine particulars, including type, power, speed, stroke, bore and crankcase volume;

(2) Details of arrangements preventing the build-up of potentially explosive conditions within the crankcase, e.g. bearing temperature monitoring, oil splash temperature, crankcase pressure monitoring and recirculation arrangements;

(3) Evidence to demonstrate that the arrangements are effective in preventing the build-up of potentially explosive conditions together with details of in-service experience;

(4) Operating instructions and the maintenance and test instructions.

5.3.6.14 Where it is proposed to use the introduction of inert gas into the crankcase to minimize a potential crankcase explosion, details of the arrangements are to be submitted for approval.”

The clause numbers 5.3.6 are changed to 5.3.7.

Section 4 PIPING SYSTEMS

The new paragraph 5.4.1.4 is added as follows:

“5.4.1.4 Lubricating oil drain pipes from the engine sump to the drain tank are to be submerged at their outlet ends.”

The article number 5.4.1.4~5.4.1.9 are revised to 5.4.1.5~5.4.1.10.

Section 5 STARTING ARRANGEMENTS

The paragraph 5.5.1.2 is revised as follow:

“5.5.1.2 Where main engines are started by compressed air, at least two starting air receivers, available for operating separately, with equivalent capacity are to be fitted. The total capacity of air receivers is to be sufficient to provide, without their being replenished, not less than 12 consecutive starts of each main engine of the reversible type at the cold condition (the test is to be carried out alternating between ahead and astern); and not less than 6 starts of each main non-reversible type engine at the cold condition. Where main engines are at hot running state, starting times are to be added during the test. Where there are more than two main engines, the total capacity of air receivers is to be sufficient to provide 3 starts for each main engine and totally no less 12 starts but no more than 18 starts preferably. Its capacity is to be increased if the air receiver serves other functions in addition to starting.”

The paragraph 5.5.2.1 is revised as follow:

"5.5.2.1 At least two sets of air compressors are to be installed, including at least one set driven independently of the main engine and with the capacity no less than 50% of total required capacity, where main engines are arranged to be started by compressed air.

The total capacity of these air compressors is to be such that the atmospheric pressure will increase to the pressure required for consecutive start as specified in 5.5.1.2 of this PART, excluding emergency air compressors which may be fitted to comply with requirements of 5.5.2.2 in this Section. The total capacity is to be evenly distributed to each compressor in general."

The paragraph 5.5.5.1 is revised as follow:

"5.5.5.1 Where the main engine is arranged for electric starting, two separate batteries are to be fitted and are not to be connected in parallel. Each storage battery is to start main engines at cold condition and ready-to-start state. The combined capacity of the batteries is to be sufficient without recharging to provide starts of main engines required for air starting as specified in 5.5.1.2 of this Section."

The paragraph 5.5.5.2 is revised as follow:

"5.5.5.2 The electric starting device of auxiliary engine is to be fitted with two sets of independent storage battery, or the power may be also supplied by storage battery of main engine by means of independent circuit where the starting storage battery for main engine is fitted. Only 1 set of storage battery may be fitted in case of only single auxiliary engine. The combined capacity of the batteries is to be sufficient to provide no less 3 starts of each auxiliary engine."

The new paragraph 5.5.5.3 is added as follows:

"5.5.5.3 The starting batteries are to be used for starting and the engines own monitoring purposes only. Provisions are to be made to maintain continuously the stored energy at all times."

Section 6 SCAVENGING AND SUPERCHARGING ARRANGEMENTS

The paragraph 5. 6. 2 is revised as follow:

"**5.6.2 Alarm and monitoring**

5.6.2.1 For all turbochargers of Categories B and C, indications and alarms as listed in Table 5.6.2.1 are required.

Requirements for alarm and indication of turbochargers of categories B and C **Table 5.6.2.1**

SN	Monitored Parameters	Category of Turbochargers				Remark
		B		C		
		Alarm	Indication	Alarm	Indication	
1	Speed	High(4)	X (4)	High(4)	X (4)	
2	Temperature of exhaust gas at each turbocharger inlet	High(1)	X (1)	High	X	High temperature alarms for each cylinder at engine is acceptable (2)
3	Temperature of Lub. Oil at turbocharger outlet			High	X	If not forced system, oil temperature near bearings
4	Pressure of lub. Oil at turbocharger inlet	Low	X	Low	X	Only for forced lubrication systems (3)

Notes:

(1)For Category B turbochargers, the exhaust gas temperature may be alternatively monitored at the turbocharger outlet, provided that the alarm level is set to a safe level for the turbine and that correlation between inlet and outlet temperatures is substantiated.

(2)Alarm and indication of the exhaust gas temperature at turbocharger inlet may be waived if alarm and indication for individual exhaust gas temperature is provided for each cylinder and the alarm level is set to a value safe for the turbocharger.

(3)Separate sensors are to be provided if the lubrication oil system of the turbocharger is not integrated with the lubrication oil system of the diesel engine or if it is separated by a throttle or pressure reduction valve from the diesel engine lubrication oil system.

(4)On turbocharging systems where turbochargers are activated sequentially, speed monitoring is not required for the turbocharger(s) being activated last in the sequence, provided all turbochargers share the same intake air filter and they are not fitted with waste gates.

5.6.2.2 Monitoring parameters indicators may be fitted at the local control station or remote control position."

The new paragraph 5.6.6.2 is added as follows:

"5.6.6.2 For turbochargers of category C, in cases where the disc is connected to the shaft with interference fit, calculations is to substantiate safe torque transmission during all relevant operating conditions such as maximum speed, maximum torque and maximum temperature gradient combined with minimum shrinkage amount."

The new paragraph 5.6.9.2 is added as follows:

"5.6.9.2 Crosshead type engine scavenge spaces in open connection with cylinders are to be provided with independent fire extinguishing arrangements which are to be independent of the fire extinguishing system of the engine room."

The new paragraphs 5.6.10~5.6.12 are added as follows:

"**5.6.10 Containment of turbochargers**

5.6.10.1 Turbochargers are to fulfill containment in the event of a rotor burst. This means that at a rotor burst no part may penetrate the casing of the turbocharger or escape through the air intake. For documentation purposes (test/calculation),it is to be assumed that the discs disintegrate in the worst possible way.

5.6.10.2 For category B and C, containment is to be documented by testing. Fulfillment of this requirement can be awarded to a generic range of turbochargers based on testing of one specific unit. Testing of a large unit is preferred as this is considered conservative for all smaller units in the generic range. In any case, it must be documented (e.g. by calculation) that the selected test unit really is representative for the whole generic range.

5.6.10.3 The minimum test speeds, relative to the maximum permissible operating speed, are:

— for the compressor:120%;

— for the turbine:140% or the natural burst speed, whichever is lower.

5.6.10.4 Containment tests are to be performed at working temperature.

5.6.10.5 A numerical analysis (simulation) of sufficient containment integrity of the casing based on calculations by means of a simulation model may be accepted in lieu of the practical containment test, provided that:

(1) the numerical simulation model has been tested and its suitability/accuracy has been proven by direct comparison between calculation results and the practical containment test for a reference application (reference containment test). This test is to be performed at least once by the manufacturer for acceptance of the numerical simulation method in lieu of tests;

(2) the corresponding numerical simulation for the containment is performed for the same speeds as specified for the containment test;

(3) material properties for high-speed deformations are to be applied in the numeric simulation. The correlation between normal properties and the properties at the pertinent deformation speed are to be substantiated;

(4) the design of the turbocharger regarding geometry and kinematics is similar to the turbocharger that was used for the reference containment test. In general, totally new designs will call for a new reference containment test.

Note: Series means a set of turbocharger with dimensions scaled proportionally in the same design.

5.6.11 Type testing

5.6.11.1 Type testing is applicable to categories B and C. The type test for a generic range of turbochargers may be carried out either on an engine (for which the turbocharger is foreseen) or in a test rig.

5.6.11.2 Turbochargers are to be subjected to at least 500 load cycles at the limits of operation. This test may be waived if the turbocharger together with the engine is subjected to this kind of low cycle testing, see Appendix 4 of this Chapter.

5.6.11.3 The suitability of the turbocharger for such kind of operation is to be preliminarily stated by the manufacturer.

5.6.11.4 The rotor vibration characteristics are to be measured and recorded in order to identify possible sub-synchronous vibrations and resonances.

5.6.11.5 The type test is to be completed by a hot running test at maximum permissible speed combined with maximum permissible temperature for at least one hour. After this test, the turbocharger is to be opened for examination, with focus on possible rubbing and the bearing conditions.

5.6.11.6 The extent of the surveyor’s presence during the various parts of the type tests is left to the discretion of each Society.

5.6.12 Certification

5.6.12.1 The manufacturer is to adhere to a quality system designed to ensure that the designer’s specifications are met, and that manufacturing is in accordance with the approved drawings.

5.6.12.2 For category C, this is to be verified by means of periodic product audits of CCS Type approval A.

5.6.12.3 These audits are to focus on:

(1) chemical composition of material for the rotating parts;

(2) mechanical properties of the material of a representative specimen for the rotating parts and the casing;

(3) UT and crack detection of rotating parts;

(4) dimensional inspection of rotating parts;

(5) rotor balancing;

(6) hydraulic testing of cooling spaces to 4 bars or 1.5 times the maximum working pressure, whichever is higher;

(7) The overspeed test of all compressor wheels is to be carried out for a duration of 3 min. at least. The test may be carried out in one of the following conditions:

① 120% of alarm level speed at room temperature;

② 110% of alarm level speed at 45℃inlet temperature and corresponding pressure ratio.

The overspeed test may be waived for forged wheels that are individually controlled by an approved non-destructive method.

5.6.12.4The certification requirements for turbochargers are to be in compliance with relevant requirements of the Rules.

5.6.12.5 The requirements of 5.6.12.1 to 5.6.12.3 also apply to replacement of rotating parts and casing.

5.6.12.6Alternatively to the above periodic product audits, individual certification of a turbocharger and its parts may be made. However, such individual certification of category C turbocharger and its parts are to be based on test requirements specified in 5.6.12.4.”

Section 7 GOVERNORS AND OVERSPEED PROTECTIVE DEVICES

The new paragraph 5.7.1.2 is added as follows:

“5.7.1.2 Where electronic speed governors of main engines form part of a remote control system, they are to comply with the following conditions:

(1) If lack of power to the governor may cause major and sudden changes in the present speed and direction of thrust of the propeller, back-up power supply is to be provided.

(2)Local control of the engines is always to be possible even in the case of failure in any part of the automatic or remote control systems, and to this purpose, from the local control position it is to be possible to disconnect the remote signal. In addition, independent governors may be fitted to comply with the speed control requirements as specified in 5.7.1.1.

(3) Electronic governors and their actuators are to be subject to the type test in accordance with *CCS Guidelines for Type Approval Test of Electric and Electronic Products*.”

The new paragraph 5.7.2.1 is added as follows:

“5.7.2.1 In addition to speed governors as described in 5.7.1 of this PART, main engines, with rated output more than 220kW and capable of disconnecting transmission shafting or driving controllable-pitch propeller, are to be also fitted with overspeed protection devices, to prevent the speed of main engines from exceeding 120% of the nominal speed. Equivalent arrangements are also accepted provided that special considerations are given. Such overspeed protection devices, including their driving mechanisms, are to be separated from required governors.”

The new paragraph 5.7.3.1 is added as follows:

“5.7.3.1 Diesel engines intended for driving generating sets are to be provided with speed governors, which are to meet the following requirements:

They will prevent transient frequency variations in the electrical network in excess of 10% of the rated frequency with a recovery time to steady state conditions not exceeding 5 s, when the maximum electrical step load is switched on or off. When the rated load is suddenly taken off, a transient speed variation in excess of 10% of the rated speed may be acceptable, provided this does not cause the intervention of the overspeed device as required by 5.7.3.2 of this Section. The permanent speed variation is not to exceed 5% of the rated speed.

When 50% of the rated load is suddenly applied from no-load condition, followed by the remaining 50% load after an interval sufficient to restore the speed to steady state, the momentary variation in speed is not to exceed 10% of the rated speed, and permanent variation in speed is not to exceed 5% of the rated speed. The recovery time for the engine speed (i.e. the time for speed fluctuation ratio to return to ±1%) is not to exceed 5 s. When a four-stroke diesel engine with high supercharge is used as the prime mover for driving generator, application of electrical load in more than 2 load steps can be permitted in its governing characteristics tests (see Figure 5.7.3.1). Thus, the power necessary electrical installations being automatically switched on after block-out and the sequence in which it is connected are to be sufficiently considered in designing the load of vessel's electric power station. This also applies analogously for generators to be operated in parallel and where the power has to be transferred from one generator to another in the event of any one generator has to be switched off.

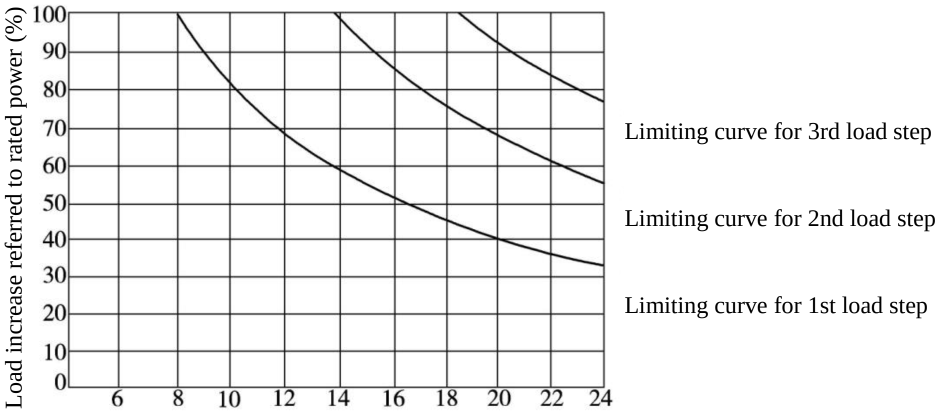


Figure 5.7.3.1

Emergency generator sets are to be subject to a sudden or stepped rated load application test and comply with the governor conditions aforesaid. Where the load is suddenly applied, the following requirements are to be complied with:

.1 emergency generator sets are to be started and supply power to the emergency power grid within 45 seconds since power failure on the main switchboard;

.2 the maximum step load is declared and demonstrated;

.3 the power distribution system is designed such that the declared maximum step loading is not exceeded;

.4 the compliance of time delays and loading sequence with the above is to be demonstrated at vessel's trials.

The new paragraph 5.7.3.4 is added as follows:

"5.7.3.4 Mechanical overspeed protective devices mentioned in 5.7.2 and 5.7.3.2 of this Section are to be independent of the governors."

Section 8 is added as follows:

"Section 8 ALARMS AND SAFEGUARDS FOR EMERGENCY DIESEL ENGINES

5.8.1 General requirements

5.8.1.1 Emergency diesel engines mainly include:

(1) a diesel engine generator used as the emergency source of electrical power;

(2) a diesel engine used to power the emergency fire pump (except for portable type);

(3) a diesel engine generator used as the independent source of power required for steering gear;

(4) other diesel engines used in an emergency.

5.8.1.2 This Section applies to diesel engines required to be immediately available in an emergency and capable of being controlled remotely or automatically operated.

5.8.2 Alarms and safeguards

5.8.2.1 The safety and alarm systems are to be designed to “fail safe” and satisfy the requirements of Chapter 12 in this PART.

5.8.2.2 Regardless of the engine output, shutdowns (if provided) other than the overspeed shutdown specified in Table 5.8.2.5 are to be automatically overridden when the engine is in automatic or remote control mode during navigation of fishing vessels.

5.8.2.3 The alarm system (including the indication) is to function in accordance with the relevant requirements of PART SEVEN of the Rules, with additional requirements that grouped alarms are to be arranged in the bridge.

5.8.2.4 In additional to the fuel oil control from outside the space, a local means of engine shutdown is to be provided.

5.8.2.5Emergency diesel engines are to be fitted with alarms and safeguards in accordance with the requirements of Table 5.8.2.5. Local indications of at least those parameters listed in Table 9.9.2.5 are to be provided within the same space as the diesel engines and are to remain operational in the event of failure of the alarm and safety systems.

Alarms and Safeguards for Emergency Diesel Engines **Table 5.8.2.5**

Parameter	≥220kW	＜220kW
Lubricating oil inlet pressure	Low	Low
Lubricating oil inlet temperature	High	
Temperature of cooling water or cooling air	High	High
Pressure or flow of cooling water	Low	
Overspeed activated	Alarm and shutdown for overspeed	
Fuel oil leakage from high pressure pipes	Oil leakage	Oil leakage
Oil mist concentration in crankcase①	High	

Note: ① only for engines having a power of not less than2250kW or a cylinder bore of more than 300mm.”

Section 8 is revised to Section 9.

CHAPTER 7 SHAFTING AND PROPELLERS

Section 1 GENERAL PROVISIONS

The new paragraph 7.1.2.2 is added as follows:

"7.1.2.2 Materials for shafting and propellers are to comply with the relevant requirements of PART 7.

The specified tensile strength of forgings for steel shafts is to be selected within the following general limits:

.1 for carbon and manganese steel, 400 to 600 N/mm^2;

.2 for alloy steel, not exceeding 800 N/mm^2;

.3 for austenitic stainless steel, 500 to 600 N/mm^2;

.4 for martensitic stainless steel, 850 to 1000 N/mm^2;

.5 for ferritic-austenitic (duplex alloy) stainless steel, 600 to 750 N/mm^2;

For hot-rolled round steels for manufacturing intermediate shafts, tube shafts and screwshafts, etc., the diameter is not to exceed 250 mm.

Shafts resistant to seawater corrosion may be made of forged copper alloy under exceptional circumstances upon approval by CCS.

For shaft couplings, nodular graphite cast iron may also be accepted.

Section 2 SHAFTING

The new paragraph 7.2.5.3 is added as follows:

"7.2.5.3 The length of the bearing in the stern bush next to and supporting the propellers is to be as follows:

.1 For water lubricated bearings which are lined with lignum vitae, synthetic materials (such as synthetic rubber or staves of approved plastic material), the length of the bearing is not to be less than 4 times the rule calculated diameter for the screwshaft. For water lubricated synthetic materials, if the bearing design and materials are proven as complying with the requirements of CCS, the length of the bearings may be appropriately reduced, but not less than 2 times the rule diameter of the shaft in way of the bearing. The synthetic materials of water lubricated bearings are to be subject to type approval;

.2 For bearings which are white-metal lined and oil lubricated, the length of the bearing is not to be less than twice the rule calculated diameter for the screwshaft. If the normal bearing pressure is less than 0.8 MPa as determined by static bearing reaction calculation taking into account shaft and propeller weight, the length of the bearings may be appropriately reduced. However, the minimum length is to be not less than 1.5 times the actual diameter;

.3 For bearings of synthetic rubber, reinforced resin or plastics materials which are approved for use as oil lubricated stern bush bearings, the length of the bearing is to be not less than twice the rule diameter of the shaft in way of the bearing. If the normal bearing pressure is less than 0.6 MPa as determined by static bearing reaction calculation taking into account shaft and propeller weight, the length of the bearings may be appropriately reduced. However, the minimum length is to be not less than 1.5 times the actual diameter.

Where the material has proven satisfactory testing and operating experience, consideration may be given to an increased bearing pressure."

Section 3 SHAFT TRANSMISSION UNITS

The new paragraph 7.3.2.1 is added as follows:

"7.3.2.1 The thickness of coupling flanges is not to be less than 20% of the intermediate shaft diameter required, nor is it to be less than the diameter of the fitting coupling bolts whose minimum tensile strength is equivalent to that of the shafts. The fillet radius at the base of the coupling flange is not to be less than 8% of the actual diameter of the shaft at the coupling. Fillets are to have a smooth finish and not to be recessed in way of nuts and bolt heads. The fillet may be formed of multi-radii in such a way that the stress concentration factor is not to be greater than that for a circular fillet with radius 0.08 times the actual shaft diameter."

Section 4 TORSIONAL VIBRATION

"The allowable torsional vibration stresses for main engine crankshafts, propeller shafts and front-end output shaft of main engine bearing the transverse transmission load" in 7.4.3.2 is revised to "The allowable torsional vibration stresses for main propulsion diesel engine crankshafts".

The new paragraph 7.4.3.3 is added as follows:

7.4.3.3 The allowable torsional vibration stresses for thrust, intermediate, stern tube shafts and screwshafts are not to exceed the values given by the following formulae:

Continuous running ($0 < r < 0.9$),

$$[\tau_c] = \pm C_W C_K C_D (3 - 2r^2) \qquad \text{N/mm}^2;$$

($0.9 \le r \le 1.05$):

$$[\tau_c] = \pm 1.38 C_W C_K C_D \qquad \text{N/mm}^2;$$

Transient running ($0 < r \le 0.8$),

$$[\tau_t] = 1.7[\tau_c] / \sqrt{C_K} \qquad \text{N/mm}^2;$$

Where: C_W ——material factor: $C_W = (\sigma_b + 160)/18$;

σ_b ——tensile strength of shaft, it is to be taken as 600N/mm^2 for R_m > 600N/mm^2;

C_K ——shape coefficient, see Table 7.4.3.3;

C_D ——size factor, $C_D = 0.35 + 0.9d^{-0.2}$.

Shape coefficient C_K **Table 7.4.3.3**

Intermediate shafts						Thrust shafts		Propeller shafts and tube shafts		
Integral coupling flange	Shrink fit coupling	Keyway (tapered connection)	Keyway (Cylindrical connection)	Radial hole	Longitudinal slot	On both sides of thrust collar	In way of axial bearings where roller bearing is used as thrust bearing	Flange mounted or keyless taper fitted propeller shafts	Key fitted propeller shafts	The portion of the screwshaft and tube shaft forward of the length of screwshaft required by 7.2.2.4 till it reaches the aft peak bulkhead
1.0①	1.0①	0.6	0.45	0.50	0.30②	0.85	0.85	0.55	0.55	0.8

Notes: ①For multiple-arc transition intermediate shaft, if C_K is greater than 1, the testing basis or service experience is to be provided and approved by CCS.

②C_K= 0.3 is a safe approximation within the limitations in note 4 of Table 7.2.2.1. More accurate estimate of the shape coefficient C_K may be determined by direct application of FE calculation or the following formula.

$$C_k = \frac{1.45}{scf}$$

where: *scf*— stress concentration factor, which is defined as the ratio between the maximum local principal stress and $\sqrt{3}$ times the nominal torsional stress (determined for the bored shaft without slots), to be calculated according to following formula:

$$scf = 2.3 + 0.8 \times \frac{(l - e)/d}{\sqrt{(1 - d_0/d) \times e/d}}$$

l— length of slot, in mm;
e— width of slot, in mm;
d— basic diameter of shaft, in mm;
d_0— actual bore of shaft, in mm."

The new paragraph 7.4.3.5 is added as follows:

"7.4.3.5 Where data from experience or detailed calculations are furnished by manufacturers, allowable torsional vibration stresses (or torques) as supplied by the manufacturers may be adopted."

Section 5 PROPELLERS

In Paragraph 7.5.4.1,

"S_F——factor of safety against friction slip at 35℃, not to be less than 2.8;

T——continuous thrust developed for free running fishing vessels, in N;

u——coefficient of friction between mating surfaces. For the oil injection method, the coefficient of friction is to be 0.13 for bosses made in bronze, copper or steel;

C——constant

C= 1 for turbines, geared diesel engines, electric controls and for direct diesel engines with a hydraulic or an electromagnetic or high elasticity coupling;

C= 1.2 for a direct diesel engine.

n_e——speed at rated output Ne, in r/min;

A——theoretical contact area of propeller boss and propeller shaft, in mm^2;

$$K_2 = \frac{d_2}{d_1};$$

d_1——mean diameter of the shaft within the fitted contact length, in mm;

d_2——mean outside diameter of the propeller boss, in mm;

u_1=0.30;

u_2——Poisson's ratio for propeller material. For copper propeller, in general, u_2= 0.34;

E_1——modulus of elasticity of propeller shaft material, E_1= 20.6 $\times 10^5$ N/ mm^2;

E_2——modulus of elasticity of propeller material. For copper propeller, in general, E_2=1.177$\times 10^5$ N/mm^2;

a_1——coefficient of linear expansion of propeller shaft material, a_1=11$\times 10^{-6}$ 1/℃;

a_2——coefficient of linear expansion of propeller material. For copper propeller, in general, a_2=18$\times 10^{-6}$ 1/℃;

R_{eH}——specified yield stress of propeller material, in N/mm^2."

are revised to:

"S_F——factor of safety against friction slip at 35℃. The factor of safety is not to be less than 2.8 at the rated torque (calculated according to the rated output and speed) plus the torque generated by torsion;

T——Rated thrust, N;

u——coefficient of friction between mating surfaces. For the oil injection method, the coefficient of friction is to be 0.13 for bosses made in copper alloy or steel;

C——constant

C= 1 for turbines, geared diesel engines, electric drive devices and for diesel engines directly driven by a hydraulic or an electromagnetic or high elasticity coupling;

C= 1.2 for a direct diesel engine.

C value is to be increased correspondingly in case of large pulsatory torque at the fitted position.

n_e——speed at rated output Ne, in r/min;

A——100% theoretical contact area of propeller boss and propeller shaft, in mm^2; referring to drawings, oil groove not deducted;

$$K_2 = \frac{d_2}{d_1};$$

d_1——mean diameter of the propeller shaft at the axial taper center point, in mm;

d_2——mean outside diameter of the propeller boss corresponding to the axial position of d_1 shaft, in mm;

u_1——Poisson's ratio of shaft material, refer to Table 7.5.4.1;

u_2——Poisson's ratio of propeller material, refer to Table 7.5.4.1;

E_1——modulus of elasticity of propeller shaft material, refer to Table 7.5.4.1;

E_2——modulus of elasticity of propeller material, refer to Table 7.5.4.1;

a_1——coefficient of linear expansion of propeller shaft material, refer to Table 7.5.4.1;

a_2——coefficient of linear expansion of propeller material, refer to Table 7.5.4.1;

R_{eH}——specified yield stress of propeller material or 0.2% of non-proportional elongation stress in N/mm^2.

Material coefficient **Table 7.5.4.1**

Material	Poisson's ratio	Modulus of elasticity E_1, E_2 (N/mm^2)	Coefficient of linear expansion a_1, a_2 (mm/mm/℃)
Cast and forged steel	0.29	2.1×10^4	12.0×10^{-6}
Cast steel	0.26	1.0×10^4	12.0×10^{-6}
Copper base alloy	0.33	Cu 1 and Cu 2: 1.1×10^4 Cu 3 and Cu 4: 1.2×10^4	17.5×10^{-6}

”

The new paragraph 7.5.4.2 is added as follows:

“Prior to the pull-up of propeller and propeller shaft, the actual contact area of the propeller boss and conical portion of the shaft is to be inspected and such contact area is not to be less than 70% of the theoretical contact area (100%). Non-contact bands extending circumferentially around the boss or over the full length of the boss are not acceptable. After final pull-up, the propeller is to be secured by a nut on the propeller shaft.”

The new paragraph 7.5.4.4 is added as follows:

“7.5.4.4 The formulae given in 7.5.4.1 are not applicable for propellers where a sleeve is introduced between shaft and boss.”

CHAPTER 8 BOILERS AND PRESSURE VESSELS

Section 3 BOILER MOUNTINGS AND FITTINGS

The new paragraph 8.3.11 is added as follows:

"8.3.11 Fittings of shell type exhaust gas heated economizer

8.3.11.1 All shell type exhaust gas heated economizers that may be isolated from the steam plant system in a flooded condition are to comply with the following requirements.

8.3.11.2 Where a shell type economizer is capable of being isolated from the steam plant system, it is to be provided with at least one safety valve, and when it has a total heating surface of 50 m^2 or more, it is to be provided with at least two safety valves.

8.3.11.3 To avoid the accumulation of condensate water on the outlet side of safety valves, the discharge pipes and/or safety valve housings are to be fitted with drainage arrangements from the lowest part, directed with continuous fall to a position clear of the economizer where it will not pose threats to either personnel or machinery. No valves or cocks are to be fitted in the drainage arrangements.

8.3.11.4 Every shell type economizer is to be provided with a means of indicating the internal pressure. A means of indicating the internal pressure is to be located so that the pressure can be easily read from any position from which the pressure may be controlled.

8.3.11.5 Every economizer is to be provided with arrangements for pre-heating and de-aeration, addition of water treatment or combination thereof to control the quality of feed water to within the manufacturer's recommendations.

8.3.11.6 Every shell type economizer is to be provided with removable lagging at the circumference of the tube end plates to enable ultrasonic examination of the tube plate to shell connection.

8.3.11.7 For design and construction of shell type economizers, particular attention is to be paid to the welding, heat treatment and inspection arrangements at the tube plate connection to the shell.

8.3.11.8 The manufacturer is to provide operating instructions for each economizer which is to include reference to:

(1) feed water treatment and sampling arrangements;

(2) operating temperatures –exhaust gas and feed water temperatures;

(3) operating pressure;

(4) inspection and cleaning procedures;

(5) records of maintenance and inspection;

(6) the need to maintain adequate water flow through the economizer under all operating conditions;

(7) periodical operational checks of the safety devices to be carried out by the operating personnel and to be documented accordingly;

(8) procedures for using the exhaust gas economizer in the dry condition;

(9) procedures for maintenance and overhaul of safety valves."

CHAPTER 9 STEERING GEAR AND WINDLASSES

Section 1 STEERING GEAR

Paragraphs .4 and .5 of 9.1.1.1 are to be revised as follow:

“.4 **Steering gear control system** is equipment by which orders are transmitted from the navigating bridge to the steering gear power units. Steering gear control systems comprise transmitters, receivers, hydraulic control pumps and their associated motors, motor controllers, piping and cables.

.5 **Maximum ahead service speed** is the greatest speed which the vessel is designed to maintain in service at sea at her deepest seagoing draught at maximum propeller RPM and corresponding engine MCR.”

Paragraphs 7, 8 and 9 are added in 9.1.1.1 as follow:

“.7 **Rudder actuator** is the component which converts directly hydraulic pressure into mechanical action to move the rudder.

.8 **Maximum working pressure** is the maximum expected pressure in the system when steering gear is operated to comply with 9.1.3.1.1 of this Section.

.9 **Declared steering angle limits** are the operational limits in terms of maximum steering angle of propulsion and steering systems other than traditional arrangements for a ship’s directional control (e.g. azimuth propulsion arrangements or water jet propulsion systems, but not limited to them), or equivalent, according to the manufacturer’s guidelines for safe operation, also taking into account the ship’s speed or propeller torque/speed or other limitation; the declared steering angle limits are to be declared by the directional control system manufacturer for each vessel specific non-traditional steering means. ”

The new paragraph 9.1.2.2 is added as follows:

“9.1.2.2 For the main steering gear composed of two sets of steering gear power units, the auxiliary steering gear may be dispensed, provided that:

.1 the main steering gear is capable of operating the rudder as required in 9.1.3.2 of this Section while any one of the steering gears is out of operation;

.2 the main steering gear is so arranged that after a single failure in its piping system or in one of the power units the defect can be isolated so that steering capability can be maintained or speedily regained.”

The new paragraph 9.1.3.1 is added as follows:

“9.1.3.1 The main steering gear and rudder stock is to be:

.1 of adequate strength and capable of putting the rudder over from 35° on one side to 35° the other side with the ship at its deepest seagoing draught and running ahead at maximum ahead service speed and under the same conditions, from 35° either side to 30° the other side in not more than 28 s. For the propulsion and steering systems other than traditional arrangements for a ship’s directional control, the main steering arrangements (equivalent to the main steering gear) are to be capable of changing direction of the ship’s directional control system from one side to the other at declared steering angle limits at an average rotational speed of not less than 2.3°/s with the ship running ahead at the maximum ahead service speed;

.2 operated by power where necessary to meet the requirements of (1) above and in any case when, excluding strengthening for navigation in ice, a rudder stock is over 120 mm diameter in way of the tiller. For the propulsion and steering systems other than traditional arrangements for a vessel’s directional control, the main steering arrangements are to be operated by power;

.3 so designed that they will not be damaged at maximum astern speed; however, this design requirement need not be proved by trials at maximum astern speed and maximum rudder angle.”

The new paragraph 9.1.3.2 is added as follows:

“9.1.3.2 The auxiliary steering gear is to be:

.1 of adequate strength and capable of steering the ship at navigable speed and of being brought speedily into action in an emergency;

.2 capable of putting the rudder over from 15° one side to 15° the other side in not more than 60 s with the ship at its deepest seagoing draught and running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater. For the propulsion and steering systems other than traditional arrangements for a ship's directional control, the auxiliary steering arrangements (equivalent to the auxiliary steering gear) are to be capable of changing direction of the ship's directional control system from one side to the other at declared steering angle limits at an average rotational speed of not less than 0.5°/s; with the ship running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater;

.3 operated by power where necessary to meet the requirements above and in any case when, excluding strengthening for navigation in ice, a rudder stock is over 230 mm diameter in way of the tiller. For the propulsion and steering systems other than traditional arrangements for a vessel's directional control, where the propulsion power exceeds 2,500 kW per thruster unit, the auxiliary steering arrangements are to be operated by power. "

Paragraphs 9.1.3.3 to 9.1.3.8 are deleted.

The new paragraph 9.1.3.3 is added as follows:

"9.1.3.3 Main and auxiliary steering gear power units are to be:

.1 arranged to re-start automatically when power is restored after a power failure;

.2 capable of being brought into operation from a position in the navigation bridge;

.3 in the event of a power failure to any one of the steering gear power units, an audible and visual alarm is to be given in the navigation bridge."

The new paragraph 9.1.4.1 is added as follows:

"9.1.4.1 The alarm and monitoring requirements for the steering gear are to be in accordance with Table 9.1.4.1 and comply with the relevant requirements of Chapter 12 in this PART. The failures likely to cause uncontrolled movements of rudder as indicated in the Table below are to be clearly identified. In the event of detection of such failure, the rudder is to stop in the current position.

Alarm and Monitoring Requirements **Table 9.1.4.1**

No.	Item	Alarm and monitoring	Location	Note
1	Steering gear power unit	Power supply failure	Navigation bridge	-
2	Steering gear circuit and motor	Broken connections and overload	Navigation bridge and main control position in engine room	-
3	Steering gear motor	Indication of running		
4	Steering gear control system	Power supply failure	Navigation bridge	-
5		Earth fault on AC and DC circuits		If applicable (e.g. the control system is connected to main power supply through transformer)
6		Loop failures in closed loop systems(short circuit, broken connections and earth faults)		-
7		Data communication errors		If programmable electronic system is used
8		Computer hardware and software failures		
9		Deviation alarm		Deviation alarm is to be initiated if the rudder's actual position does not reach the set point within acceptable time limits for the closed loop control systems (e.g. follow-up control and autopilot). Deviation

				alarm may be caused by mechanical, hydraulic or electrical failures.
10	Hydraulic oil tank of steering gear	Low level	Navigation bridge and machinery space	Each oil tank is to be monitored; dispensed if the vessel length is less than 45 m
11	Angular position of rudder	Rudder angle indication	Navigation bridge and steering gear compartment	See 9.1.2.4 of this PART
12	Automatic rudder arrangement	Failure	Navigation bridge	-
13		Indication of operation		
14	Hydraulic oil	High temperature	Navigation bridge	If fitted with oil cooler
15	Hydraulic oil filter	High pressure difference	Navigation bridge	If oil filter is fitted
16	Steering gear (power or control) hydraulic system	Hydraulic locking	Navigation bridge	See 9.1.4.6

”

The new paragraph 9.1.4.2 is added as follows:

“9.1.4.2 Short circuit protection and an overload alarm are to be provided for the circuits and motors referred to in Paragraph .2 in 9.1.8.5 of this PART. Protection against excess current, including starting current, if provided, is to be not less than twice the full load current of the motor or circuit so protected, and is to be arranged to permit the passage of the appropriate starting currents. The overcurrent protection may be dispensed where the power is supplied by the electronic inverter with restrictions at the circuit carrying full-load current of steering gear motor (e.g., speed control). However, the setting value of overload alarm is not to exceed the normal load current of the electronic inverter. Where a three-phase supply is used, an alarm is to be provided that will indicate failure of any one of the supply phases. The alarms required in this Article are to be both audible and visual and are to be situated in a conspicuous position in the main machinery space or control room from which the main machinery is normally controlled. Audible and visual alarms are also required to be provided in the navigation bridge.”

9.1.4.4 deleted.

The new paragraph 9.1.4.4 is added as follows:

“9.1.4.4 Where the power driving auxiliary steering gears as required in 9.1.3.2.3 of this Section is from motors for other purposes, the requirements of 9.1.4.2 in this Section may be waived for fishing vessels with total capacity less than 1600 tons, provided that CCS considers the requirements for auxiliary steering gears in 9.1.3.3 and 9.1.8.1.3 as well as requirements for protective devices are complied with”.

The new paragraph 9.1.4.6 is added as follows:

“9.1.4.6 Where hydraulic locking, caused by a single failure, may lead to loss of steering, an audible and visual alarm, which identifies the failed system, is to be provided in the navigation bridge.

The alarm is to be activated whenever:

(1) position of the variable displacement pump control system does not correspond with given order; or

(2) incorrect position of 3-way full flow valve in constant delivery pump system is detected. ”

The following provisions are added after Paragraph 9.1.5.1: “Graphitic cast iron may be also accepted for low-stress parts fitted for double sets, provided that reliable use evidence and relevant background materials can be provided.”

The new paragraphs 9.1.5.2~9.1.5.4 are added as follows:

“9.1.5.2 Approved flexible hose assemblies may be installed between two points where flexibility is required and there will be no tortuosity during normal operation. The length of hoses are to ensure flexibility and normal mechanical operation.

9.1.5.3 Flexible hose assemblies are to be high-pressure hydraulic hoses manufactured according to the requirements of Chapter 2 in this PART and suitable to all fluids, pressures, temperatures and related ambient conditions.

9.1.5.4 The bursting pressure of flexible hoses is not to be lower than 4 times designed pressure.”

Paragraph 9.1.5.2 is revised to Paragraphs 9.1.5.3, 9.1.5.4 and 9.1.5.5:

"9.1.5.3 Factory Test

(1) The pipes, valves and other parts in hydraulic piping system of hydraulic power steering gear are to comply with the related requirements for class I piping in Chapter 2 of this PART.

(2) The pressure parts designed in accordance with 13.1.6.1 of this Section are to be tested in accordance with the related requirements for class I pressure vessels in Chapter 6 of this PART.

(3) A hydraulic power unit pump is to be subject to a type test. The type test is to be carried out at workshop for a duration of not less than 100 h according to the following:

① the test arrangements are to be such that the pump may run in idling conditions, and at maximum delivery capacity at maximum working pressure;

② during the test, idling periods are to be alternated with periods at maximum delivery capacity at maximum working pressure. The passage from one condition to another is to occur at least as quickly as on board;

③ during the whole test, no abnormal heating, excessive vibration or other irregularities are permitted;

④ after the test, the pump is to be disassembled and inspected;

Type test may be waived for a power unit which has been proven to be reliable in marine service.

(4)For a diesel engine of a hydraulic power unit, see Chapter 9 of this PART.

(5)For an electric motor of a hydraulic power unit, see Chapter 3, PART 4 of the Rules.

(6)After testing of each part and completion of general installation, the steering gear is to be subject to the final inspection and operation test.

9.1.5.4 Testing on board

After installation on board the vessel, the steering gear is to be subject to a hydraulic tightness test under 1.25 times the design pressure and a running test in mooring condition.

9.1.5.5 Sea trials

The steering gear is to be tried out on sea trial in order to demonstrate satisfaction that the requirements of this Section have been met. The trial is to include the operation of the following:

(1) the steering gear, including demonstration of the performances required in 9.1.3.1.1 and 9.1.3.2.2 of this Section.

If the vessel cannot be tested at the deepest seagoing draught, steering gear trials are to be conducted at a displacement as close as reasonably possible to full-load displacement on either of the following conditions:

① where the rudder is fully submerged (zero speed waterline) and the vessel is in an acceptable trim condition; or

② where the rudder load and torque at the specified trial loading condition have been predicted and extrapolated to the full load condition.

In any case for the main steering gear trial, the speed of ship corresponding to the number of maximum continuous revolution of main engine could apply; for controllable pitch propellers, the propeller pitch is to be at the maximum design pitch approved for the maximum continuous ahead R.P.M. at the main steering gear trial.

(2) the steering gear power units, including transfer between steering gear power units.

(3) the isolation of one power actuating system, checking the time for regaining steering capability.

(4)the hydraulic fluid recharging system.

(5)the emergency power supply required in 9.1.8.6 of this Section;

(6) the steering gear controls, including transfer of control and local control;

(7)the means of communication between the wheelhouse, engine room and the steering gear compartment;

(8)the alarms and indicators required in this Chapter;

(9) where steering gear is designed to avoid hydraulic locking this feature is to be demonstrated.

The trials in (2), (3), (4), (7), (8) and (9) above may be carried out during mooring trial."

The new paragraph 9.1.6 is added as follows:

"9.1.6 Construction and design

9.1.6.1 The steering gear components, subject to internal pressure, are to be designed in accordance with the relevant requirements of Chapter 8 of this PART for Class I pressure vessels, in addition to the permissible stress specified in this Section. Accumulators, if fitted, are to comply with the relevant requirements of Chapter 8 of this PART.

9.1.6.2Where the components subject to pressure are designed in accordance with the requirements of 9.1.6.1

of this Section, the permissible primary general membrane stress is not to exceed the lower of the following values:

$$\frac{R_m}{A} \text{ or } \frac{R_{eH}}{B}$$

Whichever is less.

Where: R_m——specified tensile strength of material at ambient temperature, in N/mm^2;

R_{eH}——specified yield stress or proof stress of the material at ambient temperature, in N/mm^2;

A or B—safety coefficient given by Table 9.1.6.2.

Safety coefficient A or B **Table 9.1.6.2**

Safety coefficient	Forged steel	Cast steel	Nodular graphite cast iron
A	3.5	4	5
B	1.7	2	3

9.1.6.3 All welded joints within the pressure boundary of steering gear or connecting parts transmitting mechanical loads are to be full penetration type or of equivalent strength. The welding details and welding procedures are to be subject to approval of CCS.

9.1.6.4 The construction of steering gear components is to be such as to minimize local concentrations of stress.

9.1.6.5 When determining the dimensions of piping and other steering gear components subjected to internal hydraulic pressure, the design pressure is to be at least equal to the greater of the following:

.1 1.25 times the maximum working pressure;

.2 the relief valve setting.

9.1.6.6 All the steering gear components and the rudder stock are to be of sound and reliable construction. Any essential component which is not duplicated, where appropriate, is to use anti-friction bearings such as ball bearings, roller bearings or sleeve bearings which are to be permanently lubricated or provided with lubrication fittings.

9.1.6.7 All steering gear components transmitting mechanical forces to the rudder stock, which are not protected against overload by structural rudder stops or mechanical buffers, are to have a strength at least equivalent to that of the rudder stock in way of the tiller.

9.1.6.8 Oil seals between non-moving parts forming part of the external pressure boundary are to be of the metal upon metal type or of an equivalent type.

Oil seals between moving parts forming part of the external pressure boundary are to be duplicated, so that the failure of one seal does not render the actuator inoperative. Alternative arrangements providing equivalent protection against leakage may be accepted.

9.1.6.9 Pipes, joints, valves, flanges and other fittings are to comply with the requirements for Class I piping in Chapter 2 of this PART. The design pressure is to be in accordance with 9.1.6.5.

9.1.6.10 For relevant requirements to rudder, rudder stock, tiller and quadrant, refer to PART TWO of the Rules.”

The new paragraph 9.1.7 is added as follows:

“**9.1.7 Hydraulic system**

9.1.7.1 Pipes, joints, valves, flanges and other fittings in hydraulic piping of hydraulic power steering gear are to comply with the requirements for Class I piping in Chapter 2 of this PART. The design pressure is to be in accordance with 9.1.6.5.

9.1.7.2 Relief valves

.1 Relief valves are to be fitted to any part of the hydraulic system which can be isolated and in which pressure can be generated from the power source or from external forces. The setting of the relief valves is not to exceed the design pressure. The valves are to be of adequate nominal diameter and so arranged as to avoid an undue rise in pressure above the design pressure.

.2 Relief valves fitted as required in 9.1.7.2.1 are to comply with the following:

① the setting pressure is not to be less than 1.25 times the maximum working pressure;

②the minimum discharge capacity of the relief valve(s) is not to be less than 110% of the total capacity of the pumps which can deliver through it (them).

Under such conditions, the rise in pressure is not to exceed 10% of the setting pressure. In this regard, due consideration is to be given to extreme foreseen ambient conditions in respect of oil viscosity.

9.1.7.3 Isolating valves

For rudder actuators with non-duplicated units, isolating valves are to be fitted at the connection of pipes to the hydraulic cylinders, and are to be directly fitted on the hydraulic cylinders.

9.1.7.4 Filters

Arrangements to maintain the cleanliness of the hydraulic fluid are to be provided taking into account the type and design of the hydraulic system.

9.1.7.5 Level alarm

A low level alarm is to be provided for the circulating oil tank of each hydraulic system to give the earliest practicable indication of hydraulic fluid leakage. Audible and visual alarms are to be given in the navigation bridge and in the machinery space where they can be readily observed.

Arrangements for bleeding air from the hydraulic system are to be provided, where necessary.

9.1.7.6 Discharge device

The hydraulic system of the steering device, if necessary, shall be provided with a deflating device.

9.1.7.7 Hydraulic locking

Where the steering gear is so arranged that more than one system (either power or control) can be simultaneously operated, the risk of hydraulic locking caused by single failure is to be considered.

9.1.7.8 Storage tank

A fixed storage tank having sufficient capacity to recharge at least one power actuating system including the circulating oil tank is to be provided, where the main steering gear is required to be power operated. The storage tank is to be permanently connected by piping in such a manner that the hydraulic systems can be readily recharged from a position within the steering gear compartment and provided with a content gauge.

9.1.7.9 Arrangement

.1 The power piping for hydraulic steering gears is to be so arranged that transfer between units can be readily effected.

.2 The hydraulic piping of steering gear is to be apart from the hull and is not to pass through fish hold. Where it has to pass through fish hold in arrangement, it is to be approved by CCS beforehand and provided with necessary actions.

.3The hydraulic piping is not to be connected with other hydraulic systems."

The new paragraph 9.1.8 is added as follow:

"**9.1.8 Power supply and control systems**

9.1.8.1 Steering gear control is to be provided:

.1 for the main steering gear, both in the navigation bridge and in the steering gear compartment;

.2 where the main steering gear is arranged according to 9.1.2.2 of this Section, by two independent control systems, both operable from the navigating bridge. This does not require duplication of the steering wheel or steering lever. Where the control system consists of a hydraulic telemotor, a second independent system need not to be fitted;

.3 for the auxiliary steering gear, in the steering gear compartment and,if power operated, it is also to be operable from the navigating bridge and is to be independent of the control system for the main steering gear.

9.1.8.2 Main and auxiliary steering gear control systems operable from the navigating bridge are to comply with the following:

.1 Means are to be provided in the steering gear compartment for disconnecting any control system operable from the navigating bridge from the steering gear it serves.

.2 The system is to be capable of being brought into operation from a position in the navigation bridge.

9.1.8.3 The angular position of the rudder is to be:

.1 if the main steering gear is power operated, indicated in the navigation bridge. The rudder angle indication is to be independent of the steering gear control system;

.2 recognizable in the steering gear compartment.

9.1.8.4 Where applicable, following standard signboard is to be fitted at a suitable place on steering control position in the bridge or incorporated into operating instruction mentioned in 9.1.9.3 of this Section.

Caution:

In Some Circumstances When Two Power Units Are Running Simultaneously the Rudder May Not Respond to Helm. If This Happens Stop Each Pump in Turn Until Control Is Regained."

The above signboard is related to steering gears provided with two identical power units intended for simultaneous operation, and normally provided with either their own control systems or two separate (partly or mutually) control systems which are/may be operated simultaneously.

9.1.8.5 Source of electrical power and cable installation

.1 Means for indicating that motors of electric and electrohydraulic steering gear are running is to be installed in the navigation bridge and at a suitable main machinery control position.

.2 Each electrical or electrohydraulic steering gear comprising one or more power units is to be served by at least two exclusive circuits fed directly from the main switchboard, however, one of the circuits may be supplied through the emergency switchboard. Each power unit of electrical or electrohydraulic main steering gear complying with the requirements of this Section is to be served by one exclusive circuit fed directly from the main switchboard, and one of the aforesaid circuits may be fed from the emergency switchboard. An auxiliary electric or electrohydraulic steering gear associated with a main electrical or electrohydraulic steering gear may be connected to one of the circuits supplying this main steering gear. The circuits supplying an electrical or electrohydraulic steering gear are to have adequate rating for supplying all motors which can be simultaneously connected to them and may be required to operate simultaneously.

.3 When in a vessel of less than 1,600 gross tonnage an auxiliary steering gear which is required in 9.1.3.2.3 of this Section to be operated by power is not electrically powered or is powered by an electrical motor primarily intended for other services, the main steering gear may be fed by one circuit from the main switchboard.

.4 Each main and auxiliary steering gear electric control system, if operable from the navigating bridge, is to be served by its own separate circuit supplied from a steering gear power circuit from a point within the steering gear compartment. Or alternatively, this control system may be supplied by a separate circuit directly from the same section of main or emergency switchboard bus-bars at a point on the switchboard adjacent to that supplying the said steering gear power circuit. For above-mentioned main and auxiliary steering gear, short circuit protection is only to be provided for power circuits of control system.

.5 The electrical power circuits and the steering gear control systems with their associated components, cables and pipes required in this Section are to be separated as far as practicable throughout their length. The requirements may be relaxed for vessels less than 45 m in length.

9.1.8.6 Where the rudder stock is required to be over 230 mm diameter in way of the tiller (excluding strengthening for navigation in ice), or where the propulsion power exceeds 2,500 kW per thruster unit (applying to propulsion and steering systems other than traditional arrangements for a fishing vessel's directional control), an alternative power supply, sufficient at least to supply the steering gear power unit or the steering arrangements which complies with the requirements of 9.1.3.2.2 of this Section and also its associated control system and the rudder angle indicator, is to be provided automatically, within 45 s, either from the emergency source of electrical power or from an independent source of power located in the steering gear compartment. This independent source of power is to be used only for this purpose and have a capacity to maintain continuous operation for at least 10 min.

9.1.8.7 Where the alternative power source for steering gear is an independent engine driven hydraulic pump located in the steering gear compartment, automatic starting arrangements for the engine are to comply with the relevant requirements relating to the automatic starting arrangements of emergency generators."

The new paragraph 9.1.9 is added as follow:

"**9.1.9 Arrangement**

9.1.9.1 In general, the steering gear is to be reliably secured to the seating with sufficient rigidity by fitting bolts or bolts and thrust plates.

9.1.9.2 The steering gear compartment is to be:

(1) readily accessible and, as far as practicable, separated from machinery spaces;

(2) provided with suitable arrangements to ensure working access to steering gear machinery and controls. These arrangements are to include handrails and gratings or other non-slip surfaces to ensure suitable working conditions in the event of hydraulic fluid leakage.

9.1.9.3 Suitable operating instructions with a block diagram showing the change-over procedures for actuating systems and control systems of steering gear are to be permanently displayed in the navigation bridge and in the steering gear compartments.

9.1.9.4 A means of communication is to be provided between the navigation bridge and the steering gear compartment."

CHAPTER 10　FISHING MACHINERY

Section 2　WINCH

The new paragraph 10.2.5.1 is added as follows:

"10.2.5.1 Clutches easy to operate are to be fitted between double-reels and winches with auxiliary reel and friction drum and their driving shafts."

CHAPTER 12 AUTOMATION OF MACHINERY INSTALLATIONS

Section 3 SAFETY SYSTEMS

In 12.3.1.1, “.3 Class III: Corresponding actions of class I or class II are not required. Generally, the equipment will stop running and the standby equipment will be started and operated.” is revised to “.3 Class III: The standby equipment will be started and operated to recover to the normal running state.”

Section 4 ALARM SYSTEMS (INCLUDING DISPLAYS)

The new paragraph 12.4.1.4 is added as follows:

“12.4.1.4 Alarms are to be fitted with devices for eliminating or silencing the audible alarm signal. When the silencing button of such device is pressed after the alarm signal is triggered, the visual signal is not to be eliminated but the visual signal (e.g., from flickering to steady light) may be changed during silencing. Such visual signal is to be still clear and identifiable. The partial elimination of visual alarm signal in the navigation bridge and accommodation spaces is not to stop the audible alarm at the machinery spaces. However, the silencing button for the audible alarms in machinery spaces is permitted to be arranged only in the machinery space or at the engine room centralized control station and the visual alarm signals are to be retained until the fault has been rectified. When the fault has been rectified, the alarm system is to be automatically reset to its normal operating condition.”

Section 5 REQUIREMENTS FOR AUTOMATION OF CENTRALIZED CONTROL STATION REMOTE CONTROL OF BRIDGE AND MACHINERY SPACES, ATTENDED CENTRALIZED CONTROL STATION OF MACHINERY SPACES

The new paragraphs 12.5.2.1 to 12.5.2.8 are added as follow:

“12.5.2.1 For remote control of main propulsion machinery at the navigation bridge, each separate propeller is to be controlled with single control device. All relevant devices are to be automatically operated, including devices preventing overload of propulsion machinery and long-term running in the restricted vibration speed ranges. Where multiple propellers are to be designed to operate simultaneously, they may be controlled by a control device.

12.5.2.2 The control system of navigation bridge is to be independent of the transmitting system for other purposes, but two systems may be controlled by a control rod.

12.5.2.3 For various operation instructions transmitted from the control device of the bridge, including change from maximum forward running speed to full-speed astern running, the automatic sequence control is to be completed in the allowable time interval of main engine.

12.5.2.4 When the propulsion machinery is remotely started at the navigation bridge and propulsion machinery state may cause dangers such as turning gear meshing and lubricating oil pressure drop, the remote control start is to be automatically prevented.

12.5.2.5 The control system of the navigation bridge is to be so designed to give an alarm signal in the event of a fault. In this case, the speed and rotation direction of propeller shaft are to be maintained till the local control unless deemed as non-feasible. Particularly, the propulsion power or propulsion rotation is not to be changed significantly and suddenly in case of power sources (electric, pneumatic and hydraulic powers) disconnection or control switchover of monitoring system.

12.5.2.6 The mechanical and electrical equipment which can be controlled by more than two control stations (rooms) is to be only controlled by a control station (room) anytime. Controllers of main propulsion machinery may be interlocked in each control station (room).

12.5.2.7 Control stations (rooms) are to be capable of switching over control in case of normal operation or failure of mechanical and electrical equipment jointly controlled by them, without resulting in severe changes of mechanical and electrical equipment running state.

12.5.2.8 All control stations (rooms) are to indicate the controlling control station (station). Instructions for main propulsion machinery from the navigation bridge are to be indicated at all control positions of such machinery.”

Paragraph No. 12.5.2.1~12.5.2.11 is revised to 12.5.2.9~12.5.2.19.

Section 6 PERIODICALLY UNATTENDED MACHINERY SPACES

The new paragraphs 12.6.2.2~12.6.2.4 are added as follows:

“12.6.2.2 When fishing vessels are sailing on sea (including maneuvering), propulsion directions, speeds and propeller pitch (if provided) are to be fully controlled from the navigation bridge.

12.6.2.3 The control station of the navigation bridge is to be provided with an emergency stopper for main propulsion machinery independently of the control system of the navigation bridge, but the actuator may not be independent and its arrangement is to prevent false operation.

12.6.2.4 The local control function of local control station for the main propulsion machinery is not to be affected in the event of a fault or failure of any part in the automatic or remote control system of other control stations or propulsion machinery.”

The new paragraph 12.6.5.2 is added as follows:

“12.6.5.2 The engine compartment is to be provided with bilge high water level alarm. The bilge water alarm level is to be such that the bilge water will not rise to the top plate of double-layer bilge. Water level sensors are to be so arranged to prevent false alarm during normal inclination and swing.”

Paragraphs 12.6.5.3 and 12.6.5.4 are added as follows:

“12.6.5.3 The bilge well is to be capable of holding the normal water discharge in the unattended cycle. Where the bilge pump is capable of being automatically started, a smaller bilge well is to be provided to hold the normal water discharge for a long period appropriately, but greater bilge water inflow than the discharge capacity of pump, too long pump operation time or too frequent starting is to be alarmed, and its discharge is to also comply with relevant requirements on pollution prevention. Refer to Table 12.7.1.1 of this Chapter for relevant monitoring items.

12.6.5.4 Alarms as required in 12.6.5.2 and 12.6.5.3 above are to be fitted in the centralized control station of engine compartment, control station of navigation bridge and accommodation space of marine engineers.”

Paragraphs No.12.6.5.3~12.6.5.5 are revised to 12.6.5.5~12.6.5.7.

The new paragraph 12.6.10 is added as follows:

“12.6.10 **Additional requirements of alarm systems**

12.6.10.1 Alarm displays are to be so arranged to identify the specific conditions and positions of faults in the machinery spaces.

12.6.10.2 Where the watch officer of the navigation bridge is the only person on duty, the alarm system is to enable the watch officer to be aware of the following when the equipment fault is monitored at the local control station:

(1) A fault has occurred;

(2) The occurred fault has been noticed (e.g., response and silencing);

(3) The fault has been eliminated. Such function can be achieved by other communication means between the control station of the navigation bridge, accommodation space of marine engine and machinery spaces (centralized control station of engine compartment or local control station).

12.6.10.3 Occurred faults are to be displayed in the navigation bridge in form of combined alarm. However, fault alarms of propulsion machinery deceleration or automatic stop are to be distinguished.

12.6.10.4 Alarm systems are to be tested during the normal operation of monitored mechanical and electrical equipment. If feasible, means are to be provided to test sensors at the accessible position without affecting the operation of mechanical and electrical equipment.

12.6.10.5 An alarm is to be given for separate fault when any power source of alarm system fails. Where the alarm system may be adversely affected due to the disconnection of power source, the standby power source may be switched to supply power continuously.

12.6.10.6 If the alarm has been acknowledged, and the second fault has occurred before the elimination of the first fault, the visual and audible alarm signal is to be transmitted again. The alarm given for the transient fault is to be maintained before being acknowledged.

12.6.10.7 The alarm system is to be so designed that its function is independent of the safety system and control system. In the event of fault or malfunction of other systems, the normal operation of the alarm system is not to be affected.”

The new paragraph 12.6.11 is added as follows:

“**12.6.11 Additional requirements of safety system**

12.6.11.1 The safety system is to given an alarm during operation.

12.6.11.2 To avoid unnecessary stop of mechanical and electrical equipment, the safety system is to act in the following methods after the alarm system acts, to minimize the harm:

(1) Starting and launching the standby equipment;

(2) Reducing load or stopping operation.

12.6.11.3 Safety systems of mechanical and electrical equipment in different units are to be independent of each other. In the event of a fault in one safety system, the normal operation of the other safety system is not to be affected.

12.6.11.4 Visual and audible alarms are to be given at the control station after the action of the safety system to indicate the reasons of the safety system action.”

Section 7　AUTOMATIC CONTROL AND MONITORING ITEMS

The new paragraph 12.7.1 is added as follows:

“**12.7.1 Table of automatic control and monitoring items**

12.7.1.1 For fishing vessels with periodically unattended machinery, automatic control and monitoring items (if any) are to comply with the requirements of Table 12.7.1.1.

12.7.1.2 Designations used in Table 12.7.1.1 of this Section and their meanings are as follows:

I: Not required to be provided;

*: Such item is only applicable to the trunk piston type diesel engine;

Ⅰ: Class I protective action such as emergency stop, furnace shutdown and power switching off;

Ⅱ: Class II protective action such as operation at reduced speed or power;

Ⅲ: Class III protective action such as starting and launching standby pump and standby equipment;

S: Single item alarm;

G_{I}: Combined alarm during class I protective action;

G_{II}: Combined alarm during class II protective action;

R: Combined alarm in case of major fault;

Y: Combined alarm in case of general fault.

12.7.1.3 Where “per cylinder” appears in the column “Remark” of Table 12.7.1.1 of this Section, it applies only to crosshead diesel engines, and for trunk piston diesel engines, “fitted on manifold outlet” may be used to replace the “per cylinder”.

12.7.1.4 For the equipment marked with “▲” in Table 12.7.1.1 of this Section, if all of the single alarms and display items provided locally or in the vicinity of the engine are confirmed by CCS, the engine room central control station and the BCS may be exempted from the single alarms and display items as required in Table 3.10.1.1. Only one group alarm for general faults and one fault display are to be provided in this case.

Automatic Control and Monitoring Items　of Fishing Vessels with Periodically Unattended Machinery Space　　Table 12.7.1.1

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6
1 Main diesel engine **1.1 Fuel oil system**					
Fuel oil inlet pressure	Pressure	Low	III	*R*	Fitted after filter
Fuel oil temperature or viscosity (before injection pump)	Temperature or viscosity	Low and high	—	*Y*	Only for heavy oil
Leakage of high-pressure fuel pipe	—	Leakage	—	*Y*	
Level of fuel oil in daily service tanks	—	Low	—	*Y*	High-level alarm also required, if no suitable overflow arrangement provided
Common rail fuel oil pressure	—	Low	—	*Y*	
1.2 Lubricating oil system					
Lub-oil inlet pressure to main bearing & thrust bearing	Pressure	Low	III	*R*	
			II	G_{II}	Necessary for crosshead diesel engines
		Excessively low	I	G_{I}	
Lub-oil inlet pressure to crosshead bearing	Pressure	Low	III	*R*	Required if separate lub-oil system installed for crosshead diesel engines
			II	G_{II}	
		Excessively low	I	G_{I}	
Lub-oil inlet pressure to camshaft	Pressure	Low	III	*R*	
		Excessively low	I	G_{I}	
Lub-oil inlet temperature to camshaft	Temperature	High	—	*Y*	
*Lub-oil filter differential pressure	Pressure	High	—	*Y*	
Lub-oil inlet temperature	Temperature	High	—	*Y*	
Thrust pad bearing temperature or bearing lubricating oil outlet temperature	Temperature	High	II	G_{II}	Necessary for crosshead diesel engines
		Excessively high	I	G_{I}	
Main, crank, crosshead bearing oil outlet temperature or oil mist concentration in crankcase	—	High	II	G_{II}	Applicable to low-speed diesel engines
*Oil mist concentration in crankcase	—	High	I	G_{I}	Applicable to medium and high speed diesel; one oil mist detector for each engine having two independent outputs for initiating the alarm and shutdown would satisfy the requirement for independence between alarm and shutdown systems

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6
Flow rate of cylinder lubricator (each apparatus)	—	Small	II	G_{II}	Required for trunk piston diesel engines if necessary for safe operation of the engines
Oil level in lub-oil circulating tank	—	Low	—	*Y*	Necessary for crosshead diesel engines; individual level alarms required for the tanks if separate lub-oil systems installed (e.g. camshaft, rocker arms, etc.) for crosshead diesel engines
Common rail servo oil pressure	—	Low	—	*Y*	
1.3 Turbocharger system					
Turbocharger lub-oil inlet pressure	Pressure	Low	—	*Y*	Unless provided with a self-contained lubricating oil system integrated with the turbocharger
Turbocharger lub-oil outlet temp each bearing	Temperature	High	—	*Y*	Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design, alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.
Speed of turbocharger	Speed	High	—	—	Applicable to class B and class C turbochargers
1.4 Piston cooling system (Necessary for crosshead diesel engines)					
Piston coolant inlet pressure	Pressure	Low	III	*Y*	The slowdown is not required if the coolant oil taken from the main cooling system of the engine
		Excessively low	II	G_{II}	
Piston coolant outlet flow	—	Low	II	G_{II}	Per cylinder; where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted
Piston coolant outlet temperature	Temperature	High	II	G_{II}	Per cylinder
Level of piston coolant in expansion tank	—	Low	—	*Y*	
1.5 Seawater cooling system					
Pressure of cooling seawater	Pressure	Low	III	*Y*	
1.6 Cylinder fresh cooling water system					
Cylinder water inlet pressure or flow	Pressure or flow	Low	III	*Y*	Only cylinder coolant inlet pressure required for crosshead diesel engines
		Excessively	II	G_{II}	

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6
		low			
Cylinder water outlet temperature (from each cylinder) or Cylinder water outlet temperature (general)	Temperature	High	II	G_{II}	Required for crosshead diesel engines where one common cooling space without individual stop valves is employed for all cylinder jackets. For trunk piston diesel engines, alarm and slowdown only for cylinder water outlet temperature (general) and two separate sensors required
Oily contamination of main engine cooling water system	—	Contaminated	—	—	Necessary for crosshead diesel engines; required where main engine cooling water is used in fuel and lubricating oil heat exchangers
Level of cylinder cooling water in expansion tank	—	Low	—	*Y*	
1.7 Starting and control air systems					
Starting air pressure before main shut-off valve	Pressure	Low	—	*S*	
Control air pressure	Pressure	Low	—	*S*	
Safety air pressure	Pressure	Low	—	*S*	Necessary for crosshead diesel engines
1.8 Scavenging system					
Scavenge air receiver pressure	Pressure	—	—	—	Necessary for crosshead diesel engines
Scavenge air box temperature (fire)	Temperature	High	II	G_{II}	
Scavenge air receiver water level	—	High	—	*Y*	
*Scavenge air receiver temperature	Temperature	High	—	*Y*	
1.9 Exhaust gas system					
Exhaust gas temp. after each cylinder	Temperature	High	II	G_{II}	For trunk piston diesel engines having a power of more than 500 kW per cylinder only
Exhaust gas temperature after each cylinder. Deviation from average	—	Large	—	*R*	
Exhaust gas temperature before each turbocharger	Temperature	High	—	*R*	Necessary for crosshead diesel engines
Exhaust gas temperature after each turbocharger	Temperature	High	—	*R*	
1.10 Fuel valve coolant					

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6
Pressure of fuel valve coolant	Pressure	Low	III	*R*	The requirement is to be complied with if the crosshead diesel engine is fitted with a separate fuel valve cooling system
Temperature of fuel valve coolant	Temperature	High	—	*Y*	
Level of fuel valve coolant in expansion tank	—	Low	—	*Y*	
1.11 Engine speed/direction of rotation					
Speed	Speed	Overspeed	I	G_{I}	
Direction of rotation	Direction of rotation	Wrong way	—	*S*	Necessary for crosshead diesel engines
1.12 Power supply for control-safety-alarm systems (electrical, pneumatic and hydraulic pressure)	Voltage, pneumatic and hydraulic pressure	Voltage loss	—	*Y*	Indication of voltage may be replaced by indicating lamp
2 Diesel engines driving generators▲					
Lub-oil inlet pressure	Pressure	Low	—	*Y*	
		Excessively low	I		
Fuel oil temperature or viscosity (before injection pumps)	Temperature or viscosity	Low and high	—	*Y*	Only for heavy oil
Exhaust gas temperature after each cylinder	Temperature	High	—	*Y*	For engine power > 500 kW per cylinder only
Lub-oil inlet temperature	—	High	—	*Y*	
Temperature of cooling water or cooling air outlet	Temperature	High	—	*Y*	
Pressure or flow of cooling water	—	Low	—	*Y*	
Speed	—	Overspeed	I	*Y*	
Starting air pressure	Pressure	Low	—	*Y*	
High-pressure fuel pipe	—	Leakage	—	*Y*	
Oil mist concentration in crankcase	—	High	I	*Y*	Applicable to diesel engines specified in 5.3.6.1 of PART 3; one oil mist detector for each engine having two independent outputs for initiating the alarm and shutdown would satisfy the requirement for independence between alarm and shutdown systems
Level in fuel oil daily service tank	—	Low	—	*Y*	

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6
Level in cooling water expansion tank	—	Low	—	*Y*	Fitted if such system is provided with the expansion box and is not connected to the main engine system
Common rail fuel oil pressure	—	Low	—	*Y*	
Common rail servo oil pressure	—	Low	—	*Y*	
Speed of turbocharger	Speed	High	—	—	Applicable to class B and class C turbochargers
Power supply for control-safety-alarm systems (electrical, pneumatic and hydraulic pressure)	Electrical, pneumatic and hydraulic pressure	Voltage loss	—	*Y*	Indication of voltage may be replaced by indicating lamp
3 Gearbox					
Lubricating oil temperature		High	III		No less than 1500kW
Lubricating oil inlet pressure		Low	I		
4 Shafting (applicable to the propulsion machinery with power no less than 750kW)					
Rear bearing temperature of tail pipe		High	III		The sensor can be fitted near the rear bearing
Shafting bearing temperature		High	I		In case of no less than 1500kW
Thrust bearing lubricating oil or thrust block temperature		High	III		
5 Controllable pitch propeller systems					
Hydraulic oil pressure		Low		*S*	Jointly displayed with “remote control system fault” in the navigation bridge
Hydraulic oil level of gravity tank or backpressure of oil pump		Low	III		Applicable to the propulsion machinery with the power no less than 750 kW
6 Clutches					
Control power of clutch		Low		*S*	Applicable to the propulsion machinery with the power no less than 750 kW; if caused by the operation failure
7 Oil purifier (Applicable to the propulsion machinery with the power no less than 750 kW)					
Oil temperature		High or low	III	*S*	In case of local independent indication, the combined alarm device can be fitted at the central alarm control panel.
Accidental discharge of rotor drum/ water seal failure/water contained in the output oil similar conditions			III	*S*	
8 Steering gear					
Failure of steering gear		Failure		*S*	
Steering gear overload		Overload		*S*	

Item	Centralized control station (room) of engine compartment		Safety system action category	Alarm method of bridge control station	Remark
	Display	Limit alarm			
1	2	3	4	5	6
Phase fault		Fault		*S*	Applicable to the propulsion machinery with power no less than 750kW
Control system failure		Failure		*S*	Applicable to the propulsion machinery with power no less than 750kW
9 Tank liquid level					
Daily fuel tank		Low	III	*S*	High level alarm is to be increased for the tank controlled automatically or remotely
Expansion tank		Low	III	*S*	
Sump oil, oil discharge tank or fuel overflow tank		High	III	*S*	Only applicable to the oil discharge tank for the propulsion machinery with power less than 750kW
Gravity oil tank of tail pipe		Low	III	*S*	High level alarm is to be increased for the tank controlled automatically or remotely
Lubricating oil collection chassis /tank of main engine		Low	III	*S*	
Hydraulic oil tank of steering gear		Low	III	*S*	
10 Fire detection system					
Fire alarm		Accident fire		*S*	Only applicable to the accident fire of machinery space for the propulsion machinery with power less than 750kW
Fault		Fault	III		Applicable to the propulsion machinery with power no less than 750kW
11 Miscellaneous					
Failure of remote control system		Failure		*S*	
Failure of alarm system		Failure	III		Not applicable to the propulsion machinery with power less than 750 kW
Failure of safety system		Failure	III		
Tripping of safety system		Failure	III		
Auxiliary automatic switchover		Failure	III		
Bilge water level/Sewage well position at machinery spaces		High	III		
12 Auxiliary steam boilers (applicable to the propulsion machinery with power no less than 750kW)					
Release of safety system		Release	III		
Steam pressure		Low or high	III		
Water level		Low or high	III		
Failure of circulating water pump		High	III		
Condensate water salinity		High	III		
Condensate water oil stain		High	III		

”

Section 8 is added as follows:

Section 8 COMPUTER BASED SYSTEMS

12.8.1 General requirements

12.8.1.1 This Section applies to on-board computer based systems which provide control, alarm, monitoring, safety or internal communication functions of engine compartment or whole vessel, including programmable electronic system. This Section does not apply to loading instruments and radio communication and navigation equipment with detailed performance standard by IMO.

12.8.1.2 Computer based systems are to perform various per-determined functions in various operation conditions (including emergency), based on the following factors:

(1) No danger is to be caused to personnel;

(2) No fishing vessels and their equipment are to be damaged;

(3) The operation of non-computer equipment and systems is not to be affected (e.g., main engines and auxiliary engines);

(4) The environment is not to be damaged;

(5) The availability of system is not to be affected;

(6) Repair and maintenance are to be facilitated.

12.8.1.3 Where the design or arrangement not consistent with the requirements of this Section, the engineering analysis in accordance with relevant international or Chinese national standards is to be submitted to and approved by CCS. The failure of class III system may result in serious consequence, so non-conventional techniques (e.g., radio communication technology) are allowed to be applied only upon approval by CCS when sufficient evidences are provided to prove the acceptability and reliability of systems.

12.8.1.4 Class II and class III computer systems are to be provided with protective means to prevent the unintentional or unauthorized modification of programs by operators. Any modifications after performance tests witnessed by the Surveyor of CCS are to be recorded and traceable. Major modifications[1] (if any) are to be submitted to CCS for approval.

12.8.1.5 The modifications of parameters such as characteristic value and setting value of class III computer based systems are to be approved by CCS.

12.8.2 System categories

12.8.2.1 Computer systems may be classified into three categories: class I, class II and class III as shown in Table 12.8.2.1 according to the extent of damage which may be caused by single fault. Such damage is caused by an incident rather than being caused directly. Redundancy is not taken into account during system classification.

Computer Based System Categories **Table 12.8.2.1**

Category	Effect	System function	Example
I	Failure of those systems will not lead to dangerous situations for human safety, safety of the fishing vessel and/or threat to the environment	——Monitoring function and daily management function	——Maintenance supporting systems ——Daily information processing
II	Failure of those systems could eventually lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment	——Monitoring and alarm functions ——Control functions which are necessary to maintain the vessel in its normal operational and habitable conditions	——Monitoring and alarm devices ——Liquid tank capacity measuring equipment ——Auxiliary engine control systems ——Remote control system of main propulsion machinery ——Fire detection and extinguishing systems ——Bilge water systems ——Governors
III	Failure of those systems could immediately lead to dangerous situations for human safety, safety of the vessel and/or threat to the environment	——Control functions for maintaining the fishing vessel's propulsion and steering ——Vessel safety function	——Mechanical protection systems or equipment ——Combustor control systems ——Electronic oil injectors of internal combustion engines ——Propulsion and steering control systems ——Generator synchronization unit

12.8.2.2 The classification of computer based systems may be varied somewhat deepening on different types and dimensions of fishing vessels, working duration and frequency of personnel at the hazardous area, system complexity and possibility to prevent damage.

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[1] Major modifications refer to those modifications affecting system functions and safety.

12.8.2.3 Where provided with independent and effective standby systems or other means to avoid risks, class III systems may be reduced to class II systems.

12.8.3 System design

12.8.3.1 In various operation circumstances (including emergency), computer based systems are to ensure the following:

(1) Execution of necessary automatic operation;

(2) Acceptance of user's instructions;

(3) Providing correct information for users.

12.8.3.2 The system is to be so designed to provide sufficient response time for completing all functions in various processing conditions, taking into account the maximum load and required maximum working capacity as well as network communication speed.

12.8.3.3 Computer based systems are to be so designed that they can be easily and safely operated by personnel without professional computer knowledge. Otherwise, relevant training is to be provided to operators.

12.8.3.4 Faults and restart of computer based systems are not to result in non-defined or dangerous state. When the power supply is recovered after failure, computer based systems are to be re-started and operated in a short time according to the pre-determined sequence, with functions recovered rapidly.

12.8.3.5 The system is to be so designed that the fault of other parts of the system or the whole system will not be caused by single fault in the system; such fault is to be limited in the faulted module. The redundancy design (e.g., standby equipment) is to be adopted when necessary, and such equipment is to recover its function.

12.8.3.6 To facilitate maintenance and replacement, the hardware is to be composed by replaceable modules, and is to be standardized and modularized as far as practicable. To reduce the number of spare parts, types of modules are to be minimized. The construction of each replaceable component is to be so designed to facilitate safe operation. Plug-in modules and connectors (including electrical connections) are to be provided with marks for identifications and are to be so designed to ensure correct connection.

12.8.3.7 Systems undertaking important functions are to be saved by permanent-storage components, to avoid loss or errors of applied programs, characteristic curves and limit values.

12.8.3.8 Software of Class II and class III computer based systems is to be so designed to comply with the following requirements:

(1) The software is to be confidential and encapsulated;

(2) The program of the operating system is to adapt to the development, installation and subsequent modifications in all stages of the service period;

(3) The software is to be subject to system test which is to be documented. These tests are to include all software functions, important functional combinations, operation characteristics, relevance and using requirements in all operation modes (including operations in case of emergency and fault). Where the software is modified somewhat, the tests are to be also changed correspondingly;

(4) The software is to be so designed to prevent the operator from modifying the programs and fixed data related to fishing vessels.

12.8.3.9 Computer based systems are to be provided with self-inspection function. Visual and audible alarm signals are to be given for all faults leading to loss of important functions.

12.8.3.10 Faults, which affect essential internal functions and cannot be displayed by computer based systems, are to be displayed by equipment independently of computer.

12.8.3.11 External power sources of computer based systems is to be provided with fault monitoring, and visual and audible alarm signals are to be given in the event of a fault. Where the redundant system is used, each system is to supplied by the independent final sub-circuit.

12.8.3.12 Computer based systems are to achieve the pre-determined automatic monitoring functions, and their control systems, alarm systems and safety systems are to be designed in accordance with the independence requirements of 12.4.1 and 12.5.2 in this Chapter.

12.8.3.13 When the computer system is used for essential functions related to propulsion, steering and fishing vessels safety, standby systems or emergency measures, independently of computer based systems preferably, are to be provided.

12.8.4 Data communication

12.8.4.1 The reliability extent of data communication is to be determined based on different computer systems and specific using conditions, and class II and class III systems are to comply with requirements of 12.8.4.2 and 12.8.4.9 in this chapter.

12.8.4.2 Data communication lines are to automatically check the continuity of lines and network connections. An alarm is to be given in the event of abnormalities.

12.8.4.3 The system is to automatically switch to the least dangerous state in the event of a fault of data communication.

12.8.4.4 Where the same data communication line serves as two or more essential functions, such line is to be in redundancy design.

12.8.4.5 The changeover switch of the redundancy line is not to interfere with the continuous operation of data communication or functions

12.8.4.6 To ensure the normal switching between systems, standard ports are to be adopted as far as practicable.

12.8.4.7 Where the data communication is lost due to the fault of single component, means are to be provided for automatic recovery of data communication.

12.8.4.8 The loss of data communication is not to affect the capacity to operate essential equipment by alternative means.

12.8.4.9 Means are to be provided to ensure the data integrity and timely recover damaged or invalid information.

12.8.4.10 The data communication line is to be capable of transmitting necessary information in sufficient time to avoid blockage.

12.8.5 Additional requirements of wireless data communication

12.8.5.1 In addition to the requirements of 12.8.4 in this Chapter, the wireless data communication of class II system is to also comply with requirements of 12.8.5.2 to 12.8.5.4 in this Chapter. The wireless data communication of class III system is to also comply with requirements of 12.8.1.3.

12.8.5.2 Where functions required for continuous operation of essential services depend on wireless data communication, alternative control measures are to be provided and to be put into use in the acceptable time.

12.8.5.3 Approved international radio communication system protocols are to be adopted for wireless data communication and are to comply with the following requirements:

(1) Information integrity: Faults are to be prevented, inspection, diagnosed and corrected, so that the received information (compared with transmitted information) is not damaged or changed;

(2) Configuration and equipment verification: The protocols are to be only connected with the equipment contained in the system design;

(3) Information encryption: Confidential and/or essential data contents are to be protected;

(4) Security management: Network assets are to be protected to prevent illegal access to network assets.

12.8.5.4 The wireless system is to comply with requirements of International Telecommunication Union and flag country authority for radio frequency and power level[1].

12.8.6 Input and output devices

12.8.6.1 Input and output devices of computer based systems are to be so designed to facilitate the user's operation, and to be designed and laid out based on the principle of ergonomics.

12.8.6.2 Operation keyboards of computer are to comply with the following requirements:

(1) Where the operation or functions of devices may be changed by means of keyboard, appropriate means (e.g., setting a password) are to be provided to limit unauthorized personnel against such operation;

(2) Where the operation of a key may lead to hazardous operation, means are to be provided to prevent against faults caused by single-key action, e.g., special lock key, or two or more keys.

12.8.6.3 The computer display is to comply with the following requirements:

(1) Dimensions, color and resolution rate of texts and charts shown on the display are to be easily read from the operator's normal position in case of various operation lighting. The brightness and contrast are to be adjusted according to the surrounding ambient conditions;

(2) The displayed information is to have logic priority;

(3) Where the alarm information is shown on the color display, the alarm state is to be clear even during the original color fault.

12.8.6.4 Where the display replaces the general indicator alarm display in class II and class III computer systems, the following requirements are to be complied with:

(1) The display is to be clear at bright ambient conditions, and the data and information shown on the display are to be easily read by operators at the normal operation position;

(2) The display is to clearly show all alarms;

(3) The display is to appropriately show the difference before and after the fault alarm is acknowledged, but such difference is not to be shown only by different colors;

(4) Store devices and output ports are to be provided, in order to record and output the fault content and fault occurring time;

(5) The centralized monitoring and alarm system of engine compartment is to be provided with 1 standby

[1] Ports and prohibition of radio communication according to local laws are to be taken into account

display or lamp panel at least, or 1 printer for recording the fault contents and fault occurring time;

(6) The display is to still operate normally during normal power supply or failure;

(7) Where the parameters and alarm are shown on the same display, the display is not to affect the alarm signal.

12.8.7 Graphic user interface

12.8.7.1 The shown information is to be clear and easy to understand based on the importance and relevance of functions. The contents on the screen are to be reasonably arranged, and their expression is to be only limited to the data related to users.

12.8.7.2 When general graphic user interface is used, only necessary functions in relevant processes can be applied.

12.8.7.3 In each operation mode of graphic user interface system, the alarm is to be superior to the visual and audible alarm of other information, and to be distinguished from other information.

12.8.8 Tests and verification

12.8.8.1 Computer based systems are to be tested and verified in accordance with requirements of Table 12.8.8.1. Refer to the Annex 1 of this chapter for the definitions and explanations in Table 12.8.8.1.

Tests and Verification of Computer Based Systems **Table 12.8.8.1**

SN	Tests and verification	System categories		
		I	II	III
1.	Quality system certification document			
	Software quality plan		**M**	**M**
	Inspection of parts (only for hardware) supplied by distributors		**M**	**M**
	Quality control in production		**M**	**M**
	Completion test report	**M**	**M**	**S**
	Traceability of software	**M**	**M**	**S**
2.	Instructions for hardware and software			
	Instructions for software		**M**	**S**
	Instructions for hardware		**M**	**S**
	Fault analysis on relevant safety functions			**S**
3.	Software test documents			
	Documents of software test based on the quality plan		**M**	**S**
	Analysis on effectiveness of programmable program for related safety functions			**S**
4.	Hardware test			
	Tests in accordance with CCS *CCS Guidelines for Type Approval Test of Electric and Electronic Products (2006)*.		**W**	**W**
5.	Software test			
	Module test		**M**	**S**
	Sub-system test		**M**	**S**
	System test		**M**	**S**
6.	Performance test			
	Integrated test		**M**	**W**
	Fault simulation		**W**	**W**
	Factory acceptance test	**M**	**W**	**W**
7.	On-board test			
	Complete system test	**M**	**W**	**W**
	Integration test		**W**	**W**
	Evidence to prove the capacity of electromagnetic compatibility by the radio function operation		**W**	**W**
8.	Modification	**M**	**W**	**W**
	Test after modification	**M**	**S/W**	**S/W**

Notes: M - Documents retained and submitted by manufacturers as required

S - Documents to be inspected by CCS

W - To be witnessed by CCS

Chapter 13 is added as follows:

CHAPTER 13 SUPPLEMENTARY PROVISIONS FOR FISHING VESSELS NO LESS THAN 90 M IN LENGTH

Section 1 General Provisions

13.1.1 Applicable scope

13.1.1.1 This Section applies to fishing vessels no less than 90 m in length in non-restricted waters.

13.1.2 Bilge suction arrangement

13.1.2.1 At least two bilge suctions are to be provided within each fish hold, normally in way of the fore and aft central longitudinal plane. In all cases, water is to be capable of being drained continuously from the compartments to the bilge suctions. Bilge wells are to be provided where necessary. Where the length of a fish hold is less than 9 m, only one bilge suction is to be provided at the aft end of the hold.

13.1.2.2 A water level alarm is to be fitted for the water at the bottom of fish hold.

13.1.2.3 A grating cover is to be fitted on the fish hold sewage well, with the passage area no less than 5 times cross-sectional area in the suction pipe, and the sewage well volume can be reduced to $0.1m^3$.

13.1.3 Size of tank air pipes

13.1.3.1 In the case of all tanks which can be pumped up, either by the ship's pumps or by shore pumps through a filling main, the inner diameter of tank air pipe can be reduced to 38 mm if the volume is no more than $0.5m^3$.

13.1.3.2 Where the tank is fitted with overflow pipes complying with requirements, the inner diameter of air pipe is not to be less than 38 mm.

13.1.4 Steam pipes

13.1.4.1 Steam pipes are to be maintained in a spacing of no less than 150 mm when arranged along the fuel oil tank wall. Appropriate protective means are to be provided when steam pipes are arranged adjacent to cables.

13.1.5 Windlass

13.1.5.1 For fishing vessels with the anchor mass less than 450 kg, windlasses may be driven by non-independent prime movers or motors.

13.1.5.2 Where a wire windlass is used in a fishing vessel, a clutchable ratchet gear is to be fitted, and a wire stopper or fixed thimble is to be fitted in the bow area excluding the windlass. The wire stopper is to be capable of withstanding the proof test load of chain cables, and the stress is not to be more than 90% of specified minimum yield stress of the material.

13.1.5.3 For fishing vessels usually operating at sea areas of more than 100 m in depth, deep-sea anchor gears are normally to be provided, for which steel wires may be used instead of chain cables.

13.1.5.4 A buffer is generally to be fitted before the wire stopper for deep-sea anchor gears, and means for blowing and oiling chain cables are to be provided as far as possible

13.1.5.5 For fishing vessels, when carrying out the trial of hoisting anchors by the windlass, a mean speed of hoisting one anchor from a depth of 55 m to a depth of 27.5 m is not to be less than 9 m/min. The anchor hoisting speed of the deep-sea windlass is generally not to be less than 30 m/min. after anchors have come aweigh.

13.1.5.6 The bow sheaves of deep-sea anchor gears are to have an adequate diameter, which is generally not to be less than 13 times that of anchor wires. The construction of bow sheaves is to be such that the anchor wires will not be impaired.

13.1.5.7 The hoisting drum of deep-sea windlasses is to be provided with a spooling gear and fitted, as far as possible, with a means for keeping the wires in an even tension. Where the construction of hoisting drums enables the wires to be ranged in order, the spooling gear may be waived.

13.1.6 Period of supply of emergency sources

13.1.6.1 The period of supply of emergency sources is not to be less than 3 h.

13.1.7 Periodically unattended machinery spaces

13.1.7.1 The manoeuvring position of seawater inlet valve is to be arranged considering that an operator needs to spend at least 10 min to reach to and close the valve when the water enters the space; such manoeuvring position is to be arranged above the immersion water level of such machinery space possibly due to pipeline damage during full load of the fishing vessel.”

CHINA CLASSIFICATION SOCIETY

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDMENTS

PART 4 ELECTRICAL INSTALLATIONS

Effective from July 1, 2019

CHAPTER 1 GENERAL

Section 2 Environmental and Working Conditions

The paragraph 1.2.2.1 is revised as follow:

“1.2.2.1 AC electrical equipment is to operate satisfactorily with a supply voltage containing a total harmonic content of the voltage waveform not exceeding 8%. Where the power is supplied by semiconductor convertors, the equipment is to operate satisfactorily in case of high harmonic content.”

CHAPTER 2 ELECTRICAL SYSTEMS AND INSTALLATIONS

Section 3 SYSTEM PROTECTION

The paragraph 2.3.1.3.3 is revised as follow:
"2.3.1.3.3 earthed systems: each non-earthed pole (or phase)."

Section 5 EMERGENCY SOURCES OF ELECTRICAL POWER

The paragraph 2.5.4.1.1 is revised as follow:
"2.5.4.1.1 Devices as described in Paragraphs (1), (2) and (3) in 2.5.2.1.4 of this PART may be dispensed if independent storage batteries for emergency service and capable of supplying power in the specified time are installed at the appropriate positions."

Section 6 ELECTRIC CONTROL OF MACHENIRY AND EQUIPMENT

The paragraph 2.6.2.2 is revised as follow:
"2.6.6.2 Emergency stopping devices are to be provided outside machinery spaces where forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps, lubricating oil service pumps, thermal oil circulating pumps oil separator (oil purifier)."

Section 7 LIGHTING

The paragraph 2.7.1.3 is revised as follow:
2.7.1.3 "Lighting switches of fish holds, fish processing spaces, freezer rooms, refrigerated fish holds, food tanks and other similar compartments are not to be installed indoors. Lighting switches of moist spaces and explosion-hazard spaces are to switch off all insulating poles."

Section 8 NAVIGATION LIGHTS AND OTHER SIGNAL LAMPS

The paragraph 2.8.1.4 is revised as follow:
"2.8.1.4 Each navigation light is to be provided with an automatic indicator giving an audible and visual indication of failure of the light. If a visual signal is used and connected in series with the navigation light, means are to be provided to prevent extinction of the navigation light due to failure of the signal, and the audible and visual alarms for failure of the power source of the control box are to be provided. Fishing vessels with the total weight of no less than 500 tons may not comply with the requirements aforesaid."

Section 9 NAVIGATION LIGHTS AND OTHER SIGNAL LIGHTS

The paragraph 2.9.1.3 is revised as follow:
"2.9.1.3 Each consumer is to be supplied by an independent final sub-circuit from its distribution switchboard."

Section 10 INTERNAL COMMUNICATION AND SIGNAL EQUIPMENT

The paragraph 2.10.4.8 is revised as follow:
"2.10.4.8 Each electrically operated bell or other equivalent warning system is to be separately protected against short circuit. "

Section 13 CABLES

The paragraph 2.13.3.3 is revised as follow:

"2.13.3.3 Where cables for services, required to be operable under fire conditions, including their supply cables, pass through high fire risk areas[1], they are to be so arranged that a fire in any of these areas or zones does not affect the operation of the service in any other area or zone. This may be achieved by either of the following:

(1) Cables being of a fire resistant type are installed and run continuously to keep the fire integrity within the high fire risk area, as shown in Figure 2.13.3.3 (1);

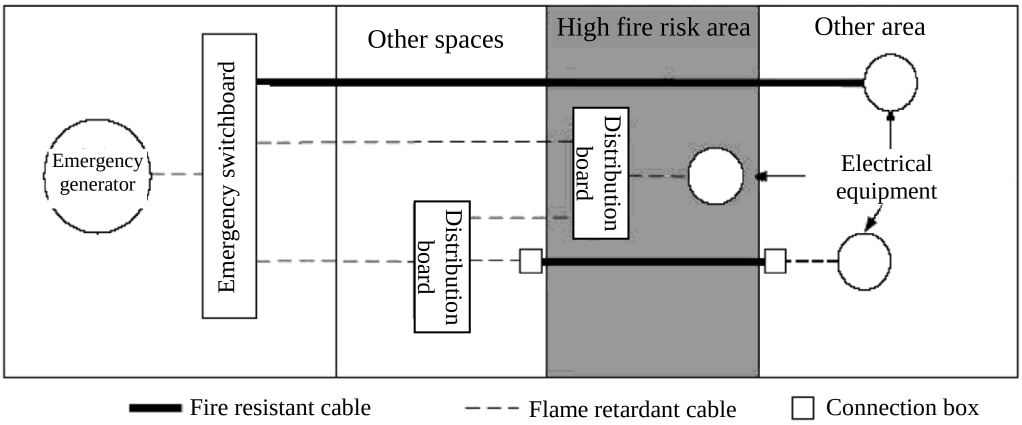

Figure 2.12.3.3 (1) Cables for Services under Fire Conditions

(2) At least two-loops/radial distributions run as widely apart as is practicable and so arranged that in the event of damage by fire at least one of the loops/radial distributions remains operational."

Section 16 ADDITIONAL REQUIREMENTS FOR ELECTRICAL PROPULSION INSTALLATIONS

The paragraph 2.16.1.20 is revised as follow:

"2.16.1.20 The electric installations are to be so designed as to prevent the harmful effects of electromagnetic interference generated by semiconductor converters. AC electrical devices supplied by daily power grid are to operate normally when the total voltage harmonic component of power source is no more than 8%."

[1] The "high fire risk areas" are defined as follows:
(1) class A machinery spaces and other machinery spaces where propulsion machinery, boilers, fuel oil devices, internal combustion engines, generator sets and refrigerators (using flammable liquid) are fitted;
(2) spaces containing fuel treatment equipment or other highly flammable substances;
(3) galley and pantries containing cooking appliances;

CHAPTER 3 CONSTRUCTION AND TESTING OF ELECTRICAL EQUIPMENT

Section 10 INTERNAL COMMUNICATION AND SIGNAL EQUIPMENT

The paragraph 3.10.2.2 is revised as follow:

“3.10.2.2 The main engine telegraph is to be generally provided with the main engine wrong direction alarm near the console of main engine (applicable to reversible main engines).”

Section 13 is added as follows:

“Section 13 UNINTERRUPTIBLE POWER SYSTEM

3.13.1 Applicable scope

3.13.1.1 The UPS [1] units, to which this Section applies, may provide an alternative power supply or transitional power supply, in lieu of independent accumulator batteries, to services as defined in 2.5.2 and 2.5.4 of Chapter 2 of this PART.

3.13.2 Plans and documents

3.13.2.1 The following plans and documents are to be submitted for approval:

(1) General plan;

(2) Electrical schematic diagram;

(3) Technical specifications of the products.

3.13.3 Design and construction

3.13.3.1 UPS units are to be constructed in accordance with IEC 62040, or an acceptable a standard.

3.13.3.2 The operation of the UPS is not to depend upon external services.

3.13.3.3 The type of UPS unit employed is to be appropriate to the power supply requirements of the connected load equipment.

3.13.3.4 An external bypass is to be provided.

3.13.3.5 The UPS unit is to be monitored and audible and visual alarm is to be given in a normally attended location for:

(1) power supply failure (voltage and frequency) to the connected load;

(2) UPS earth fault;

(3) operation of battery protective device;

(4) when the battery is being discharged; and

(5) when the bypass is in operation for on-line UPS units.

3.13.4 Performance

3.13.4.1 The output power is to be maintained for the duration required for the connected equipment as stated in 2.5.2 and 2.5.4 of Chapter 2 of this PART.

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[1] Refer to IEC620400

3.13.4.2 No additional circuits are to be connected to the UPS unit without verification that the UPS unit has adequate capacity. The UPS battery capacity is, at all times, to be capable of supplying the designated loads for the time specified in Chapter 2 of this PART.

3.13.4.3On restoration of the input power, the rating of the charge unit is to be sufficient to recharge the batteries while maintaining the output supply to the load equipment.

3.13.5 Testing and survey

3.13.5.1 UPS units of 50 kVA and over are to be surveyed by CCS Surveyors during manufacturing and testing.

3.13.5.2 Appropriate testing is to be carried out to demonstrate that the UPS unit is suitable for its intended environment. This is expected to include as a minimum the following tests:

(1) Functionality, including operation of alarms;

(2) Temperature rise;

(3) Ventilation rate;

(4) Battery capacity.

3.13.5.3 Where the supply is to be maintained without a break following a power input failure, this is to be verified after installation by practical test.”

CHINA CLASSIFICATION SOCIETY

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDTENTS

PART 5 REFRIGERATING AND QUICK-FREEZING INSTALLATIONS

Effective from 1 July 2019

CHAPTER 2 REFRIGERATING PLANT

Section 3 PRESSURIZED CONTAINERS, PIPELINES AND ACCESSORIES

2.3.2.8 deleted.

The article number 2.3.2.9~2.3.2.11 is revised to 2.3.2.8~2.3.2.10.

The paragraph 2.3.13.6.4 is revised as follow:

“.4 Detection devices are to be fitted in refrigerating machinery space. If ammonia refrigerant in refrigerating machinery space leaks, the compressor will stop automatically when the concentration of leaking gas exceeds 300 ppm. However, detection device may not be fitted if refrigerating machinery space is attended;”

CHINA CLASSIFICATION SOCIETY

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDMENTS

PART 6 LIFTING APPLIANCES

Effective from 1 July 2019

CHAPTER 2 DERRICK SYSTEM

Section 4 MASTS AND DERRICK POSTS

The paragraph 2.4.3.7 is revised as follow:

"2.4.3.7 The requirements for gantry are the same as those for mast and derrick post. The uprights on the two sides of derrick post for portal frame or A frame gin pole are to be supported by at least two decks and effectively connected to the main hull structure, and the hull structures at the joints are to be strenghthened by doubling the plate and brackets. The plate thicknesses of door mast and bipod mast are to be no less than 7mm."

CHINA CLASSIFICATION SOCIETY

RULES FOR CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDTENTS

PART 7 MATERIALS

Effective from 1 July 2019

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

The paragraph 1.1.1.1 is revised as follows:

"1.1.1.1 The chemical composition, mechanical properties and heat treatment procedures of hulls, machinery, boilers, pressure vessels and other parts of fishing vessels are to comply with the relevant provisions of this PART. They are to be also deemed as complying with the requirements of this PART if complying with corresponding provisions of CCS *RULES FOR MATERIALS AND WELDING*."

Section 2 TESTING AND SURVEY

The new paragraph 1.2.1.3 is added as follows:

"1.2.1.3 In the event of any material to be found and proved unsatisfactory during subsequent working, machining, fabrication or testing, such material is to be rejected, notwithstanding any previous certification."

Section 3 HEAT TREATMENT

The paragraph 1.3.1.2 is revised as follows:

"1.3.1.2 Heat treatment is to be carried out in properly constructed furnaces operating satisfactorily and having adequate means for the control and recording of temperature. The furnace dimensions are to be such as to allow the whole item to be uniformly heated to a specified temperature. In the case of very large components which require heat treatment, suitable alternative methods may be adopted. However, such methods are to be proved feasible. Sufficient thermocouples are to be connected to the furnace charge to measure and record the furnace temperature and verify the temperature uniformity of the furnace in addition that the inspection of the temperature uniformity of the furnace is carried out at regular intervals."

CHAPTER 2 MECHANICAL TESTS AND TECHNOLOGICAL TESTS

Section 1 GENERAL PROVISIONS

The paragraph 2.1.4 is revised as follows:

"**2.1.4 Testing machines**

2.1.4.1 All tests are to be carried out by competent personnel in accordance with specified procedures.

2.1.4.2 Testing machines are to be maintained in a satisfactory and accurate condition and are to be recalibrated at least once a year by a nationally recognized metrology authority. Testing machines are to be calibrated in accordance with the specified standards. The metric measures of the testing machines being calibrated are to be traced to national standards.

2.1.4.3 Tension testing machines are to be calibrated in accordance with ISO 7500-1 or equivalent national standards. The accuracy of testing machines is to be within ±1%.

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

The Section 2 is revised as follows

"Section 2 TENSILE TESTS

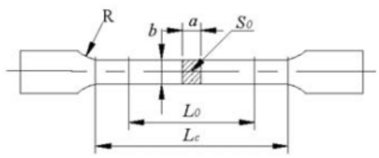
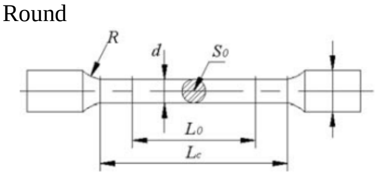
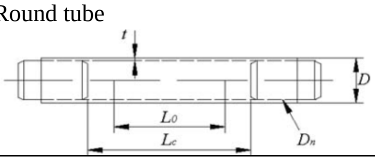
2.2.1 General requirements

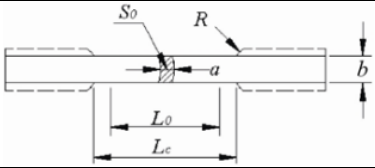
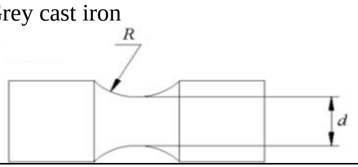
2.2.1.1 The mechanical properties of marine metallic materials such as tensile strength, yield strength, elongation and reduction in area are to be determined by a tensile test.

2.2.2 Specimens

2.2.2.1 Tensile specimens are to be of the type and dimensions as given in Table 2.2.2.1. Both ends of the test specimen may be machined to suit the grips of the testing machine used.

Type and Dimensions of Tensile Specimens **Table 2.2.2.1**

<table>
<tr><th>Item</th><th>Type of specimen</th><th>Dimensions of specimen (mm) [note 1]</th><th>Applicable materials</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Flat
</td><td>Proportional test specimen: $a=t$, $b=25$, $R=25$
$L_0=5.65\sqrt{S_0}$
$L_c=L_0+2\sqrt{S_0}$</td><td rowspan="2">Steel plates, strips and sections [note 2]</td></tr>
<tr><td>Non-proportional test specimen 1: $a=t$, $b=25$, $R=25$
$L_0=200$, $L_C\geq212.5$</td></tr>
<tr><td>2: $a=t$, $b=12.5$,
$R=25$, $L_0=50$, $L_C\geq55$</td><td>Aluminium alloy plates and sections of $t\leq12.5$ mm</td></tr>
<tr><td>2</td><td>Round
</td><td>Proportional test specimen: $d=10\sim20$, (preferably 14)
$L_0=5d$,
$L_C\geq L_0+0.5d$
$R=10$</td><td>Thick steel plates and sections;
Aluminium alloy plates and sections of $t>12.5$ mm;
Metallic forgings;
Wires [note 3], bars [note 4];
Castings (excluding grey cast iron)</td></tr>
<tr><td>3</td><td>Round tube
</td><td>Proportional test specimen: $L_0=5.65\sqrt{S_0}$
$L_C\geq L_0+0.5D$ [注 5]</td><td>Tubes of thin wall and small diameter</td></tr>
<tr><td>4</td><td>Tube longitudinally cut</td><td>Proportional test specimen: $a=t$, $b\geq12$, $R\geq10$
$L_0=5.65\sqrt{S_0}$
$L_C\geq L_0+2b$</td><td>Tubes of large diameter [note 6]</td></tr>
</table>

			
5	Grey cast iron 	Non-proportional test specimen: d=20, R=25	Grey cast iron

Note 1: a, b and d respectively means thickness, width and diameter, D means external tube diameter, L'_0 means original gauge length, L_c means parallel length, R means transition radius, S_0 means original cross-sectional area and t means plate thickness.

Note 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.

Note 3: Thin wires may be directly taken as test specimens, with L_0 being 200 mm and L_c between grips being 250 mm.

Note 4: For small-size forging and casting bars or similar products, the test specimens may consist of a suitable length of bar or other product tested in the full cross-section.

Note 5: L_c is not to be greater than the distance between the grips or the plugs, whichever is the smallest.

Note 6: 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.

2.2.2.2 Proportional test specimens with a gauge length $5.65\sqrt{S_0}$ or 5d are preferably to be used, and L_0 is preferably to be not less than 20 mm. When the cross-section of a test specimen is too small, a proportional test specimen with a gauge length 11.3 $\sqrt{S_0}$ or 10d or a non-proportional test specimen may be used. The actual gauge length may be rounded off to the nearest 5 mm provided that the difference between this length and L_0 is less than ±10% of L_0.

2.2.2.3 After machining of tensile specimens, dimensional tolerances of tensile specimens are to comply with the requirements of the accepted standards.

2.2.3 Yield strength and elongation of materials

2.2.3.1 The yield phenomenon is not exhibited by all the metallic materials detailed in this PART. For metallic materials showing a yield phenomenon, the upper yield strength R_{eH} is to be determined. For metallic materials showing no yield phenomenon, the proof strength R_p under test force is to be taken as yield strength.

2.2.3.2 The yield strength for different types of metallic materials is defined as follows:

(1) For carbon, carbon-manganese and alloy steel products and welding consumables, either the upper yield strength R_{eH}, or strength $R_{p0.2}$ at the non-proportional elongation being 0.2% of the original gauge length is to be determined;

(2) For austenitic and duplex stainless steel products and welding consumables, strength $R_{p0.2}$ or strength $R_{p1.0}$ at the non-proportional elongation respectively being 0.2% or 1.0% of the original gauge length is to be determined;

(3) For aluminium alloy and copper alloy products and welding consumables, strength $R_{p0.2}$ at the non-proportional elongation being 0.2% of the original gauge length is to be determined.

2.2.3.3 The elongation A is usually determined on the proportional test specimens as specified in Table 2.2.2.1. Except thin aluminium alloy plates detailed in Chapter 8 of this PART, the elongation specified in other Chapters means elongation A_5 determined on a proportional gauge length $5.65\sqrt{S_0}$ or 5d.

2.2.3.4 When a non-proportional test specimen which is made of ferritic steel of low or medium strength and not cold worked is used, in order to check whether the elongation of the material complies with the Rules, the required minimum elongation may be converted to the minimum equivalent elongation A_0 from the following formula:

$$A_0 = 2A_5\left(\frac{\sqrt{S_0}}{L_0}\right)^{0.40}$$

Where: A_5——the minimum elongation value as specified in relevant Chapters of this PART when L_0 is $5.65\sqrt{S_0}$ or 5d, in %;

S_0——original cross-sectional area in parallel length of test specimen, in mm^2;

L_0—— gauge length of test specimen, in mm.

During testing, the elongation actually measured is not to be less than the specified minimum equivalent elongation.

2.2.3.5 The above conversion is applicable only to carbon, carbon-manganese and low alloy steels with a tensile strength not exceeding 700 N/mm^2 in the hot rolled, annealed, normalized, or normalized and tempered conditions. For carbon, carbon-manganese and low alloy steels with a tensile strength exceeding 700 N/mm^2 in other delivery conditions as well as for other materials, the minimum equivalent elongation is to be additionally calculated in accordance with recognized methods.”

2.2.4 Testing

2.2.4.1 The tensile test at room temperature is to comply with the following requirements:

(1) During plastic deformation at yield, the stress rate is to be within the limits specified in Table 2.2.4.1(1) for the determination of the yield strength or the proof strength of metallic materials.

Rate of Stressing under Load during Tensile Test **Table 2.2.4.1(1)**

Modulus of elasticity of the material E N/mm^2	Stress rate (N/mm^2/s)	
	Min.	Max.
<150 000	2	20
≥150 000	6	60

(2) After reaching the yield or proof load, in order to measure the tensile strength of materials, for ductile material, the strain rate is not to exceed 0.008/s. For brittle materials, such as cast iron, the elastic stress rate is not to exceed 10 N/mm^2 per second.

(3) For steel, the upper yield strength is to be calculated from the following measured load values:

① the load immediately prior to a distinct fallback in the movement of the pointer of the testing machine or the load at a marked hesitation of this pointer;

②the value of load measured either at the commencement of plastic deformation at yield or at the first peak obtained during yielding even when that peak is equal to or less than any subsequent peaks observed during plastic deformation at yield, as shown in a load/extension diagram.

(4) The non-proportional elongation is to be determined from an accurate load/extension diagram by drawing a line parallel to the straight elastic portion and distant from it an amount representing 0.2% or 1.0% of the extensometer gauge length. The point of intersection of this line with the plastic portion of the diagram represents the load for calculation of the proof strength ($R_{p0.2}$ or $R_{p1.0}$).

2.2.4.2Testing at elevated temperatures (≥ 50℃) is to comply with the following requirements:

(1) The test specimens used for determination of lower yield strength or the 0.2% non-proportional elongation strength at elevated temperatures are to have an gauge length L_0 of not less than 50 mm and a cross-sectional area S_0 of not less than 65 mm^2. Where this is precluded by the dimensions of the product or by the capacity of the test equipment available, the test specimen is to be of the largest practicable dimensions;

(2) The heating apparatus is to be such that the temperature of the specimen during testing does not deviate from that specified by more than ±5℃;

(3) The straining rate when approaching the yield strength or non-proportional elongation strength is to be controlled within the range of 0.1% to 0.3% of the original gauge length per minute.

(4) The time intervals used for estimation of straining rate from measurements of strain are not to exceed 6s.

Section 3 BEND TESTS

The paragraph 2.3.2.1 is revised as follows:

“2.3.2.1 Bend test specimens are to be of the dimensions given in Table 2.3.2.1 in accordance with the type of materials.

Dimensions of Bending Specimens **Table 2.3.2.1**

SN	Dimensions of test specimen (mm)				Applicable materials
	Thickness a	Width b	Length L	Edge rounded	
1	$a=t$①	b=30mm②	11a~9a+D	Both sides of tension surface of specimen are allowed to be chamfered by 1~2mm.	Plates and profiles
2	a=20mm	b=25mm	11a~9a+D		Cast, forged pieces and semi-finished products
3	$a=d$③		11a~9a+D		Rods or wires

Notes: ①t means thickness and may be reduced according to paragraph 2.4.2.2.

② When t *is* less than 6mm, b=5a.

③ d means diameter of round materials, and D means the diameter of the mandrel. ”

Section 4 IMPACT TESTS

The paragraph 2.4.1.3 is revised as follows:

“2.4.1.3 For materials with a thickness of less than 10mm, a standard auxiliary specimen is to be made as large as possible, and the notch direction is to be perpendicular to the rolled surface. The width of the standard subsidiary test specimen and the conversion with the impact energy of the standard specimen is given in Table 2.4.1.3. For specimens smaller than 5 mm in size, the impact test is generally not required.”

CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS

Section 1 GENERAL PROVISIONS

The paragraph 3.1.2 is revised as follows:

"3.1.2 Manufacture

3.1.2.1 The steels are to be manufactured at works which have been approved by CCS in accordance with the approved procedures, types and grades of steels. During works approval, testing for cold or hot workability and welding property may be required at the discretion of CCS.

3.1.2.2 Steel is to be manufactured by open hearth, electric, basic oxygen processes or by other processes specially approved by CCS. The deoxidation method used for each grade is to comply with the relevant requirements of subsequent Sections of this Chapter.

3.1.2.3The steels are to be cast in metal ingot moulds or made by a continuous casting process approved by CCS, and to comply with the following:

(1) The size of the ingot, or of the continuous cast billet or slab, is to be of sufficient proportion to the dimensions of the final product, in order that the amount of mechanical work will be adequate to ensure a satisfactory property in the finished product;

(2) Where mould cast is employed, sufficient discard is to be taken from the top and bottom ends of each ingot to ensure that the finished product is free from internal defects. When necessary, the Surveyor may require the steel works to carry out periodical sulphur prints or other suitable proving tests to demonstrate that the steel has a sound quality;

(3) Where continuous casting is employed, a specified program of tests is to be carried out under the supervision of the Surveyor.

3.1.2.4 Rolling practice and heat treatment method applied for steel is to comply with the appropriate conditions of supply as specified in relevant sections in this Chapter. The definitions of applicable rolling and heat treatment procedures are given as follows.

(1) As Rolled (AR): This procedure involves steel being cooled as it is rolled with no further heat treatment. The rolling and finishing temperatures are typically in the austenite recrystallization region and above the normalizing temperature. The strength and toughness properties of steel produced by this process are generally less than steel heat treated after rolling or than steel produced by advanced processes.

(2) Normalizing (N): Normalising involves heating rolled steel above the critical temperature, Ac3, and in the lower end of the austenite recrystallization region for a specific period of time, followed by air cooling. The process improves the mechanical properties of as rolled steel by refining the grain size and homogenising the microstructure.

(3) Controlled rolling (CR, normalizing rolling (NR)): A rolling procedure in which the final deformation is carried out in the normalizing temperature range, allowed to cool in air, resulting in a material condition generally equivalent to that obtained by normalising.

(4) Quenching and tempering (QT): Quenching involves a heat treatment process in which steel is heated to an appropriate temperature above the Ac3, held for a specific period of time, and then cooled with an appropriate coolant for the purpose of hardening the microstructure. Tempering subsequent to quenching is a process in which the steel is reheated to an appropriate temperature not higher than the Ac1, maintained at that temperature for a specific period of time to restore toughness properties by improving the microstructure and reduce the residual stress caused by the quenching process.

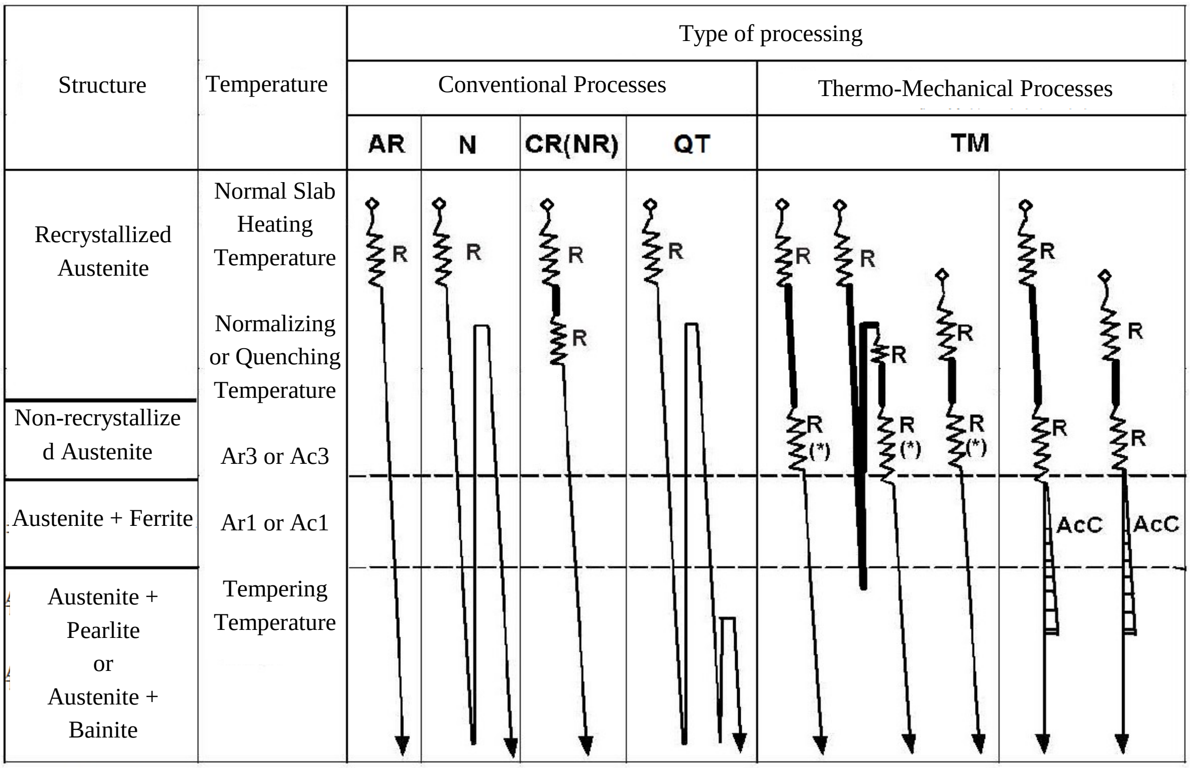
(5) Thermo-mechanical control processing, TM (Thermo-Mechanical Controlled Processing, TMCP):

This is a procedure which involves the strict control of both the steel temperature and the rolling reduction. Generally a high proportion of the rolling reduction is carried out close to the Ar3 temperature and may involve the rolling in the dual phase temperature region. Unlike controlled rolled (normalised rolling) the properties conferred by TM (TMCP) cannot be reproduced by subsequent normalising or other heat treatment.

The use of accelerated cooling on completion of TM-rolling may also be accepted subject to the special approval of CCS. The same applies for the use of tempering after completion of the TM-rolling.

(5)Accelerated cooling (AcC): Accelerated cooling is a process, which aims to improve mechanical properties by controlled cooling with rates higher than air cooling immediately after the final TM-rolling operation. Direct quenching is excluded from accelerated cooling.

The material properties conferred by TM(TMCP) and AcC cannot be reproduced by subsequent normalising or other heat treatment



◇ Start rolling temperature

▬ Delays to allow cooling before finishing rolling process

Note: AR—As-rolled; N—Normalizing; CR(NR)— Controlled rolling (normalizing rolling); QT—Quenching and tempering; TM—Thermo-mechanical controlled process; R—rolling;

(*) means the rolling at two-phase area of austenite and ferrite sometimes; AcC—accelerated cooling.

Figure 3.1.2.4 Schematic Diagram of Steel Rolling Processes

3.1.2.5 It is the manufacturer's responsibility to ensure that proper process and effective production controls in operation are adhered to within the approved manufacturing specifications. To this effect, the actual rolling records are to be reviewed by the manufacturer and occasionally by the Surveyor.

3.1.2.6 When deviation from the programmed rolling schedules or normalizing or quenching and tempering procedures occurs, or where control imperfection inducing possible inferior quality of product occurs, the manufacturer is to:

(1) find the reasons and take measures to prevent it from reoccurrence. Meanwhile, a report is to be submitted to the Surveyor for information.

(2) Where the affected steel is required to be used, the manufacturer is to carry out the test for each affected piece and the results are to comply with the requirements of the Rules.

(3) The frequency of testing subsequent products offered may be increased to gain confidence in the quality at the discretion of CCS.

3.1.2.7 The specified tests on mechanical properties are to be carried out in the presence of the Surveyor or his authorized deputy."

Paragraph 3.1.3 is revised to:

"**3.1.3 Dimensional tolerance**

3.1.3.1 The responsibility for verification and maintenance of the production within the required tolerances rests with the manufacturer. The Surveyor may require to witness some measurements.

The length, width and flatness of steel plates are to meet recognized national or international standards.

3.1.3.2 The responsibility for proper transport and storage of the delivered products without significant corrosion or other damages rests with the parties concerned. The products are to be maintained with an acceptable level of surface conditions before they are used in fabrication.

3.1.3.3 The nominal thickness is to be mutually agreed in the contract. The tolerances on thickness of a given product are defined as follows:

(1) minus tolerance is the lower limit of the acceptable range below the nominal thickness;

(2) plus tolerance is the upper limit of the acceptable range above the nominal thickness.

3.1.3.4Unless otherwise agreed mutually in the contract, the thickness of steel plates, wide flats equal to or over 600 mm in width and sections mentioned in this Chapter is to comply with the following requirements:

(1) For steel plates with nominal thickness less than 5 mm (not including 5mm), the thickness deviation is to be inspected according to the accepted standards and the negative deviation of the thickness is not to exceed 0.3 mm;

(2) For steel plates and wide flats intended for hull structures as detailed in Sections 2, 3 and 4 of this Chapter, except those intended for pressure vessels for the transportation of chemicals or liquefied gases in bulk as well as independent tank structures, thickness measurements are to be carried out for the mother plates produced (i.e. steel plates rolled directly from one slab or steel ingot and not cut) according to the provisions of 3.1.3.5, and the arithmetic mean of the measurements is not to be less than the nominal thickness, and the minus tolerance of individual measuring points is not to exceed 0.3 mm. If steel plates are rolled by such technological means that the thickness of any measuring point is not less than the nominal thickness, the arithmetic mean need not be calculated, but the steel mill is to demonstrate to the satisfaction of CCS that the number of measurements and measurement distribution is appropriate to establish that the mother plates produced are at or above the specified nominal thickness.

(3) For steels for boilers and pressure vessels as detailed in Section 5 of this Chapter as well as steels for independent tanks for the transportation of chemicals or liquefied gases in bulk, the minus tolerance on thickness of products is not to exceed 0.3 mm unless mutually agreed;

(4) For steel plates and wide flats intended for machinery as detailed in Section 6 of this Chapter, the under thickness tolerances are to comply with Table 3.1.3.4(4);

Under Thickness Tolerance of Steel Plates and Wide Flats for Machinery Table 3.1.3.4 (4)

Nominal thickness t(mm)	Minus tolerance (mm)
$3 \le t < 5$	<0.3
$5 \le t < 8$	<0.4
$8 \le t < 15$	<0.5
$15 \le t < 25$	<0.6
$25 \le t < 40$	<0.8
$40 \le t < 80$	<0.9
$80 \le t < 150$	<1.1
$150 \le t < 250$	<1.2
$t \ge 250$	<1.3

(5) For steel plates and wide flats detailed in Section 7 of this Chapter and where in the order specifications it is not specified that the nominal thickness is to be taken as the minimum thickness, the under thickness tolerance is not to exceed 0.3 mm for plate thickness not exceeding 10 mm, and 0.5 mm for plate thickness exceeding 10 mm.

(6) For steels as detailed in Section 8 of this Chapter, the thickness tolerance is to comply with the requirements for parent steel.

(7) The plus tolerances on nominal thickness of all steels may be accepted in accordance with a recognized national or international standard.

(8) The requirements of thickness tolerance in this chapter are not applicable to manufacturing of products for lifting equipment.

3.1.3.5 Except that the thickness of steel plates for hull structure is to comply with the following requirements, the measurement for other steel plates may be in accordance with national or international standards:

(1) Automated method or manual method is applied to the thickness measurements;

(2) Measuring locations of steel plates are to comply with the following requirements:

a. at least two lines among Line 1, Line 2 or Line 3 as shown in Figure 3.1.3.5(2), are to be selected for the thickness measurements and at least three points on each selected line as shown in Figure 3.1.3.5(2) are to be selected for thickness measurement. If more than three points are taken on each line, the number of points is to be equal on each line;

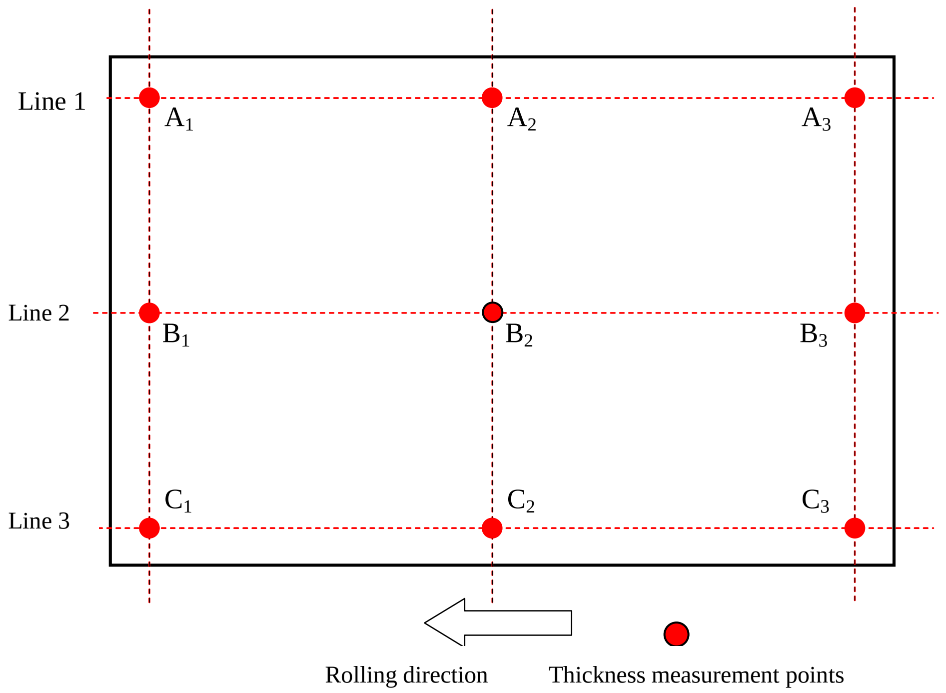


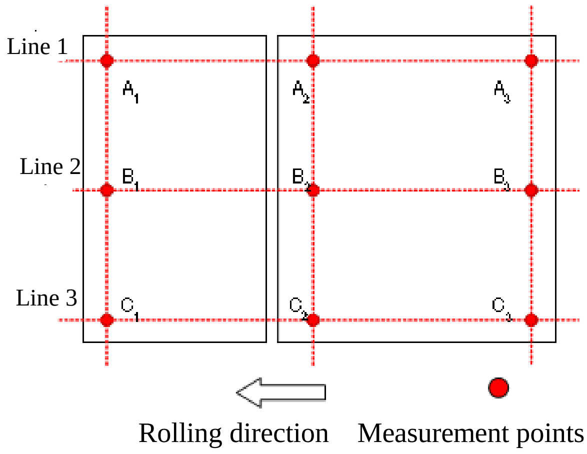
Figure 3.1.3.5(2) Locations of Thickness Measuring Points for the Original Steel Plates

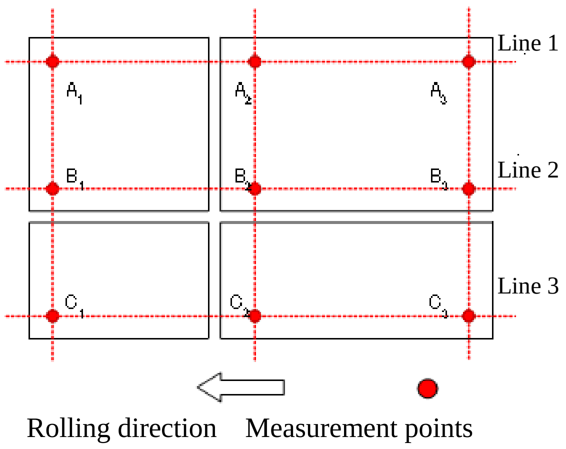
b. for automated methods, the measuring points at sides are to be located not less than 10 mm but not greater than 300 mm from the transverse or longitudinal edges of the product;

c. for manual methods, the measuring points at sides are to be located not less than 10 mm but not greater than 100 mm from the transverse or longitudinal edges of the product.

The procedure and the records of measurements are to be maintained by the manufacturer, available to the Surveyor and copies provided on request.

(3) The measurement locations apply to a product rolled directly from one slab or steel ingot even if the product is to be later cut by the manufacturer. Examples of the original measurements relative to later cut products are shown in Figure 3.1.3.5(3).





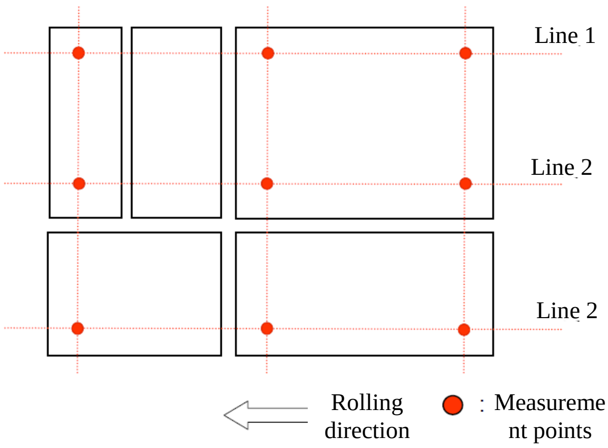


Figure 3.1.3.5(3) Locations of Thickness Measuring Points for the Cut Steel Products"

The paragraph 3.1.5 is revised as follows:

"**3.1.5 Surface inspection and non-destructive testing**

3.1.5.1 Visual inspection and verification of dimensions on all steels for meeting relevant quality requirements are the responsibility of the steel maker, who is to take the necessary manufacturing precautions and is to inspect the products prior to delivery. At that stage, however, rolling or heat treatment scale may conceal surface discontinuities and defects. If the material is found to be defective during the subsequent descaling or working operations, CCS may require materials to be repaired or rejected (refused/removed).

3.1.5.2 The surface quality inspection method is to be in accordance with recognized national or international standards agreed between purchaser and manufacturer, accepted by CCS. The finished material is to have a surface quality in accordance with a recognized standard such as EN 10163, or an equivalent standard accepted by the CCS, unless otherwise specified in this Chapter.

3.1.5.3 For steel plates and wide flats, imperfections of a harmless nature, for example pitting, rolled-in scale, indentations, roll marks, scratches and grooves, regarded as being inherent of the manufacturing process, are permissible irrespective of their number, provided that all of the following conditions are met:

(1) The maximum permissible limits of Class A of EN 10163-2 or limits specified in a recognized equivalent standard accepted by CCS, are not exceeded;

(2) The remaining plate or wide flat thickness remains within the average allowable minus thickness tolerance specified in 3.1.3.4 of this Section;

(3) Total affected area with imperfection not exceeding the specified limits in (1) are not to exceed 15% of the total surface in question.

The surface quality and conditions of supply for sections and bars may be accepted according to a recognized standard.

3.1.5.4 Affected areas with imperfections with a depth exceeding the limits specified in 3.1.5.3(1) are to be repaired irrespective of their number.

Cracks, injurious surface flaws, shells (over lapping material with non-metallic inclusion), sand patches, laminations and sharp edged seams (elongated defects) visually evident on surface and/or edge of plate are considered defects, which would impair the end use of the product and which require rejection or repair, irrespective of their size and number.

3.1.5.5 Unless otherwise specified in relevant Sections of this Chapter, the non-destructive testing of materials is not required for acceptance purposes. However, steelmakers are expected to employ suitable methods for the general maintenance of quality standards. The acceptance by CCS of material does not absolve the steelmaker of the responsibility of ensuring the internal quality of the material. If plates and wide flats are ordered with ultrasonic inspection, this is to be made in accordance with a recognized standard."

The paragraph 3.1.6.1 is revised as follows:

"3.1.6.1 For plates or wide flats intended for structural purposes as detailed in Sections 2, 3, 4 and 6 of this Chapter, surface defects may be removed by grinding provided all the conditions below are adhered to:

(1) Each single ground area does not exceed 0.25 m^2. (Ground areas lying in a distance less than their average breadth to each other are to be regarded as one single area.) All ground areas do not exceed 2% of the total surface in question;

(2) The nominal product thickness will not be reduced by more than 7% or 3 mm, whichever is the less;

(3) Ground areas lying opposite each other on both surfaces are not to decrease the product thickness by values exceeding the limits as stated under (2);

(4) Defects or unacceptable imperfections are to be completely removed by grinding and the remaining plate or wide flat thickness is to remain within the average allowable minus thickness tolerance specified in 3.1.3.4 of this Section;

(5) The ground areas are to be a smooth transition to the surrounding surface of the product;

(6) Complete elimination of the defect is to be verified by magnetic particle or by liquid penetrant testing."

The paragraph 3.1.6.2 is revised as follows:

"3.1.6.2 Surface defects which cannot be dealt with as in 3.1.6.1 above may be repaired by chipping or grinding followed by welding, subject to agreement of CCS, provided that:

(1) any one single welded area is not to exceed 0.125 m^2 and the total welded area is not to exceed 2% of the total area of the surface in question;

(2) two repair welded areas are considered as one defect where the distance between them is less than their average width;

(3) after removal of the defect and before welding, the thickness of the material is not to be less than 80% of the nominal thickness. For occasional defects with depths exceeding the limit, special consideration at the Surveyor's discretion will be necessary;

(4) the repair is to be carried out by qualified welders using an approved method and procedure for the appropriate steel grade. The electrodes are to be of low hydrogen type and be dried in accordance with the manufacturer's requirements and protected against rehumidification before and during welding;

(5) after welding, the repaired area is to be ground smooth and subjected to magnetic particle or liquid penetrant testing for proving good welding quality. If weld repair depth exceeds 3 mm, UT may be requested by CCS. If required, UT is to be carried out in accordance with an approved procedure;

(6) if required by the Surveyor, the item is normalized or otherwise suitably heat-treated after welding and grinding."

The paragraph 3.1.7 is revised as follows:

"

3.1.7 Identification and certification of materials

3.1.7.1 Every finished item (small items may be fastened in bundles) is to be clearly marked, at least at one position, by the manufacturer with the CCS stamp and the following particulars:

(1) the manufacturer's name or trade mark;

(2) the grade of steel;

(3) cast number and identification number or initials which will enable the full history of the item to be traced;

(4) delivery condition of steels for structures (e.g. N, NR, TM, TM+AcC, TM+DQ or Q&T);

(5) if required by the purchaser, his order number or other identification mark.

The above stamps and marks are to be encircled with paint for easy recognition.

3.1.7.2 In the event of any material bearing CCS stamp failing to comply with the test requirements in subsequent mechanical tests, the CCS stamp is to be unmistakably defaced.

3.1.7.3 The steelmaker is to provide certificates for all accepted materials in duplicate to the Surveyor. In addition to the name of the steelmaker, the certificate of conformity for steels is to include the following particulars:

(1) purchaser's name and order number, and if known, the ship's name or machinery number for which the material is intended;

(2) cast/piece number and chemical composition of ladle samples;

(3) technical specification/grade and size;

(4) number and weight of the cargo;

(5) carbon equivalent (Ceq, C_{ET} or P_{cm} value) (where applicable);

(6) mechanical test results, including traceable test identification;

(7) condition of supply when other than as rolled (for high strength steels supplied in a heat treated condition in Section 4, the heat treatment temperature is to be attached);

(8) surface quality and inspection results;

(9) UT result, where applicable.

3.1.7.4 Before the certificates are signed by the Surveyor, the steelmaker is required to provide a written declaration stating that the material has been made by an approved process, and that it has been subjected to and has withstood satisfactorily the required tests in the presence of the Surveyor, or an authorized deputy.

The declaration will be accepted if stamped or printed on each certificate with the name of the steelworks and signed by an authorized representative of the manufacturer.

3.1.7.5 When steel ingots or billets are not produced at works where they are rolled, a certificate of conformity is to be supplied by the steelmaker stating the process of manufacture, the cast number and the chemical composition of ladle samples. The works where the steel was produced is to be approved by CCS."

Section 2 NORMAL STRENGTH HULL STRUCTURAL STEELS

The Table 3.2.3.1 is revised as follows:

"Condition of Supply for Normal Strength Hull Structural Steel Table 3.2.3.1

<table>
<tr><th rowspan="3">Grade</th><th rowspan="3">Deoxidation</th><th rowspan="3">Products</th><th colspan="5">Condition of supply note[1、2]</th></tr>
<tr><th colspan="5">Thickness t (mm)</th></tr>
<tr><th>$t\le 12.5$</th><th>$12.5<t\le 25$</th><th>$25<t\le 35$</th><th>$35<t\le 50$</th><th>$50<t\le 100$</th></tr>
<tr><td rowspan="3">A</td><td>Rimmed steel</td><td>Sections</td><td>A(I)</td><td colspan="4">NA</td></tr>
<tr><td rowspan="2">For $t\le 50$mm, any method except rimmed steel; for $t>50$mm, killed</td><td>Plates</td><td colspan="4">A(I)</td><td>N(—), TM(—)[注3], CR(50), AR*(50)</td></tr>
<tr><td>Sections</td><td colspan="4">A(I)</td><td>NA</td></tr>
<tr><td rowspan="2">B</td><td rowspan="2">For $t\le 50$mm, any method except rimmed steel; for $t>50$mm, killed</td><td>Plates</td><td colspan="2">A(I)</td><td colspan="2">A(50)</td><td>N(50), TM(50), CR(25), AR*(25)</td></tr>
<tr><td>Sections</td><td colspan="2">A(I)</td><td colspan="2">A(50)</td><td>NA</td></tr>
<tr><td rowspan="3">D</td><td>Killed</td><td>Plates and sections</td><td colspan="2">A(50)</td><td colspan="3">NA</td></tr>
<tr><td rowspan="2">Killed and fine grain treated</td><td>Plates</td><td colspan="3">A(50)</td><td>N(50), CR(50), TM(50)</td><td>N(50), TM(50), CR(25)</td></tr>
<tr><td>Sections</td><td colspan="3">A(50)</td><td>N(50), CR(50), TM(50), AR*(25)</td><td>NA</td></tr>
<tr><td rowspan="2">E</td><td rowspan="2">Killed and fine grain treated</td><td>Plates</td><td colspan="5">N(each piece), TM(each piece)</td></tr>
<tr><td>Sections</td><td colspan="4">N(50), TM(25), AR*(15), CR*(15)</td><td>NA</td></tr>
</table>

Note 1:

Condition of supply:
A: any;
N: normalized;
CR: controlled rolling;
TM (TMCP): thermo-mechanical controlled process;
AR*: as-rolled condition subject to special approval of CCS; CR*: controlled rolled condition subject to special approval of CCS.

Note 2: The number in parentheses denotes the batch weight for impact test (in t), (-) means impact tests are not required. One set of three Charpy V-notch impact test specimens is to be taken from each batch weight."

The Section 4 is revised as follows:

"Section 4 HIGH STRENGTH QUENCHED AND TEMPERED STEEL FOR WELDED CONSTRUCTION

3.4.1 Application

3.4.1.1 These requirements apply to hot-rolled, fine-grain, weldable high strength structural steels. These requirements do not apply to steels intended for hull structures as specified in sections 2 and 3 of this Chapter.

The requirements of this Section may apply to products other than steel plates, such as sections or seamless tubulars, etc.

3.4.1.2 Steels covered by this section are specified in eight yield strength levels of 420, 460, 500, 550, 620, 690, 890 and 960 N/mm^2 based on the minimum required yield strength. For each yield strength level grades A, D, E and F are specified, based on the impact test temperature, except for yield strength level of 890 and 960 N/mm^2 for which grade F is not applicable.

The full list of grades is:

Table 3.4.1.2

AH420	DH420	EH420	FH420
AH460	DH460	EH460	FH460
AH500	DH500	EH500	FH500
AH550	DH550	EH550	FH550
AH620	DH620	EH620	FH620
AH690	DH690	EH690	FH690
AH890 AH960	DH890 DH960	EH890 EH960	

3.4.1.3 The requirements of this section apply to steel plates and flats with thickness not greater than 250 mm, the sections with thickness not greater than 50 mm and bars with diameter/thickness not exceeding 250 mm. Steels with a thickness beyond the maximum thickness as given above are to be subject to the special consideration of CCS.

3.4.1.4 Steels covered by this Section may be delivered in Normalized (N)/Normalized rolled (NR); Thermo-mechanical controlled rolled (TM) or Quenched and Tempered (QT) condition. TM delivery conditions may include Thermo-mechanical controlled rolled (TM), Thermo-mechanical controlled rolled with Accelerated cooling (TM+AcC) and Thermo-mechanical controlled rolled with direct quenching followed by tempering (TM+DQ).

3.4.1.5 Steels which have been specially approved by CCS and which differ from the requirements of the Rules are to have the letter “S” after the identification mark (e.g. EH620S).

3.4.2 Method of manufacture

3.4.2.1 The high strength steel specified by this Section is to be manufactured, by the basic oxygen, basic electric arc furnace or by processes specially approved by CCS.

3.4.2.2 Vacuum degassing is to be used for any of the following:

(1) All steels with enhanced through-thickness properties (“Z” quality);

(2) All steels of strength levels 690, 890 and 960 N/mm^2.

3.4.3 Deoxidation and chemical composition

3.4.3.1 The high strength steel as specified in this Section is to be fully killed, and is to be fine grain treated in accordance with an approved manufacturing process. A fine grain structure is to have an equivalent index≥ 6 determined by micrographic examination in accordance with ISO 643 or alternative test method.

3.4.3.2 The aim analysis for chemical composition is to be carried out in accordance with the approved manufacturing specification. All elements listed in table 3.4.3.2 are to be reported. Steels of different delivery conditions are to meet the corresponding composition requirements.

Chemical Composition of High Strength Steels for Welded Construction **Table 3.4.3.2**

Delivery condition ①	N/NR		TM		QT	
Steel grade / Chemical composition ②	AH420 DH420 AH460 DH460	EH420 EH460	AH420 DH420 AH460 DH460 AH500 DH500 AH550 DH550 AH620 DH620 AH690 DH690 AH890	EH420 FH420 EH460 FH460 EH500 FH500 EH550 FH550 EH620 FH620 EH690 FH690 DH890 EH890	AH420 DH420 AH460 DH460 AH500 DH500 AH550 DH550 AH620 DH620 AH690 DH690 AH890 AH960	EH420 FH420 EH460 FH460 EH500 FH500 EH550 FH550 EH620 FH620 EH690 FH690 DH890 EH890 DH960 EH960
C (%)	≤0.20	≤0.18	≤0.16	≤0.14	≤0.18	
Mn (%)	1.0~1.70		1.0~1.70		≤1.70	
Si (%)	≤0.60		≤0.60		≤0.80	
P③ (%)	≤0.030	≤0.025	≤0.025	≤0.020	≤0.025	≤0.020
S③ (%)	≤0.025	≤0.020	≤0.015	≤0.010	≤0.015	≤0.010
Al(total content)④ (%)	≥0.02		≥0.02		≥0.018	
Nb⑤ (%)	≤0.05		≤0.05		≤0.06	

V⑤ (%)	≤0.20	≤0.12		≤0.12	
Ti⑤ (%)	≤0.05	≤0.05		≤0.05	
Ni⑥ (%)	≤0.80	≤2.00⑥		≤2.00⑥	
Cu (%)	≤0.55	≤0.55		≤0.50	
Cr⑤ (%)	≤0.30	≤0.50		≤1.50	
Mo⑤ (%)	≤0.10	≤0.50		≤0.70	
N (%)	≤0.025	≤0.025		≤0.015	
O⑦ (ppm)	NA	NA	≤50	NA	≤30

Notes: ① See 3.4.4.1 for definition of delivery conditions.

② The chemical composition is to be determined by ladle analysis and is to meet the approved manufacturing specification.

③ For sections the P and S content can be 0.005% higher than the value specified in the table.

④ The total aluminium to nitrogen ratio is to be a minimum of 2:1. When other nitrogen binding elements are used, The minimum Al value and Al/N ratio do not apply.

⑤ Total Nb+V+Ti ≤ 0.26% and Mo+Cr ≤ 0.65%, not applicable for QT steels.

⑥ Higher Ni content may be approved at the discretion of CCS.

⑦ The requirement on maximum Oxygen content is only applicable to DH890, EH890, DH960 and EH960.

3.4.3.3 Elements used for alloying, nitrogen binding, and fine grain treatment, and as well as the residual elements are to be as detailed in the manufacturing specification, e.g. when boron is deliberately added for enhancement of hardenability of the steels, the maximum content of the boron content is not to be higher than 0.005%, and the analysis result is to be reported.

3.4.3.4 The carbon equivalent value C_{eq} is to be calculated from the ladle analysis. Maximum values are specified in Table 3.4.3.4.

(1) For all steel grades the following formula of IIW may be used:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad (\%)$$

(2) For steel grades H460 and higher, *CET* may be used instead of C_{eq} at the discretion of the manufacturer, and is to be calculated according to the following formula:

$$CET = C + \frac{(Mn + Mo)}{10} + \frac{(Cr + Cu)}{20} + \frac{Ni}{40} \quad (\%)$$

(3) For TM and QT steels with carbon content not more than 0.12%, the cold cracking susceptibility P_{cm} for evaluating weldability may be used instead of carbon equivalent of C_{eq} or *CET* at manufacturer's discretion and is to be calculated using the following formula:

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B \quad (\%)$$

Requirements for Carbon Equivalent of High Strength Steel (%) Table 3.4.3.4

Carbon equivalent(%)	C_{eq}						*CET*	P_{cm}
Product form	Plate			Sections	Bars	Tubulars	All	All
Thickness / Steel grade/Delivery condition	t≤50 (mm)	50<t≤100 (mm)	100<t≤250 (mm)	t≤50 (mm)	T(or d) ≤250 (mm)	t≤65 (mm)	All	All
H420N/NR	0.46	0.48	0.52	0.47	0.53	0.47	-	
H420TM	0.43	0.45	0.47	0.44	-	-		
H420QT	0.45	0.47	0.49	-	-	0.46		
H460N/NR	0.50	0.52	0.54	0.51	0.55	0.51	0.25	
H460TM	0.45	0.47	0.48	0.46	-	-	0.30	0.23
H460QT	0.47	0.48	0.50	-	-	0.48	0.32	0.24
H500TM	0.46	0.48	0.50	-		-	0.32	0.24
H500QT	0.48	0.50	0.54			0.50	0.34	0.25
H550TM	0.48	0.50	0.54			-	0.34	0.25
H550QT	0.56	0.60	0.64			0.56	0.36	0.28
H620TM	0.50	0.52	-			-	0.34	0.26

H620QT	0.56	0.60	0.64		0.58	0.38	0.30
H690TM	0.56	-			-	0.36	0.30
H690QT	0.64	0.66	0.70		0.68	0.40	0.33
H890TM	0.60	-			-	0.38	0.28
H890QT	0.68	0.75	-		-	0.40	-
H960QT	0.75	-			-	0.40	-

Note: “-”= Not applicable.

3.4.4 Delivery condition

3.4.4.1 High strength steel specified in this Section is to be delivered in accordance with the following condition:

(1) Normalized (N)/Normalized rolled (NR);

(2) Thermo-mechanical controlled rolled (TM), including TM+AcC and TM+DQ;

(3) Quenched and Tempered condition (QT) (including direct quenching after hot-rolling followed by tempering).

3.4.5 Rolling reduction ratio

3.4.5.1 The rolling reduction ratio of slab, billet, bloom or ingot is not to be less than 3:1 unless agreed at the time of approval.

3.4.6 Thickness limits

3.4.6.1 The maximum thickness of slab, billet or bloom from the continuous casting process is to be at the manufacturer’s discretion.

3.4.6.2 Maximum thickness of plates, sections, bars and tubulars over which a specific delivery condition is applicable are shown in Table 3.4.6.2.

Maximum thickness limits for Different Forms of Products Table 3.4.6.2

Delivery condition	Maximum thickness /diameter(mm)			
	Plates	Sections	Bars	Tubulars
N	250[②]	50	250	65
NR	150	①		
TM	150	50	NA	NA
QT	150[②]	50	NA	50

Notes: ① The maximum thickness limits of sections, bars and tubulars produced by NR process route are generally less than those manufactured by N route, and is to be at the discretion of CCS.

② Approval for N steels with thickness larger than 250 mm and QT steels with thickness larger than 150 mm is subject to the special consideration of CCS.

3.4.7 Mechanical properties

3.4.7.1 Test frequency for mechanical properties is to meet the following requirements:

(1) Tensile test sample is to be randomly selected from each batch, that is to be less than or equal to 25 tonnes, and to be from the same cast, in the same delivery condition and of the same thickness.

(2) Charpy V-notch impact test specimens are to be taken in accordance with following requirements:

a. For steel plates or flats in N, NR or TM condition test sample is to be taken from each piece.

b. For steel plates or flats in QT condition test sample is to be taken from each individually heat treated part thereof.

c. For sections, bars and tubulars, test sample is to be taken from each batch of 25 tonnes or fraction thereof.

(3) For continuous heat treated product special consideration may be given to the number and location of impact test specimens required by the manufacturer to be agreed by CCS.

3.4.7.2 In addition to the following requirements, the position and direction of the specimens taken for mechanical property tests are to be in accordance with the relevant requirements of 3.1.4 of this chapter.

(1) Where round cross-sectional tensile specimens are used for the steel with thickness above 100 mm, the specimens are to be located at a position lying at a distance of t/4 from the surface and additionally at t/2.

(2) The Charpy V-notch impact test specimens for plates and wide flats over 600 mm in width are to be taken with their axes transverse to the final rolling direction; for other product forms, the impact tests are to be in the longitudinal direction.

(3) Sub-surface impact test specimens will be taken in such a way that one side is not further away than 2 mm from a rolled surface, however, for material with a thickness in excess of 50 mm, impact test specimens shall be taken at the quarter thickness (t/4) location and mid-thickness (t/2).

(4) Impact test for a nominal thickness less than 6 mm is normally not required.

3.4.7.3 Test specimens and test procedures for mechanical properties are to be in accordance with the provisions of Chapter 2 of the Rules.

3.4.7.4 The results of the tests are to comply with the appropriate requirements of Table 3.4.7.4. In the case of product forms other than plates and wide flats where longitudinal tests are agreed, the elongation values are to comply with the longitudinal requirements as listed in Table 3.4.7.4.

Mechanical Properties of High Strength Steel for Welded Structures Table 3.4.7.4

Mechanical properties / Steel grade & delivery condition		Minimum yield strength R_{eH} (N/mm^2)			Ultimate tensile strength R_m (N/mm^2)		Minimum percentage elongation after fracture A_5 (%) $L_0=5.65\sqrt{S_0}$		Charpy V-notch impact test		
		Nominal thickness (mm)			Nominal thickness (mm)				Test temperature (℃)	Minimum impact energy (J)	
		≥3 ≤50	>50 ≤ 100	>100 ≤250①	≥3 ≤100	>100 ≤250①	transverse T	Longitudinal L		transverse T	Longitudinal L
H420N/NR H420TM H420QT	A D E F	420	390	365	520~680	470~650	19	21	0 -20 -40 -60	28	42
H460N/NR H460TM H460QT	A D E F	460	430	390	540~720	500~710	17	19	0 -20 -40 -60	31	46
H500TM H500QT	A D E F	500	480	440	590~770	540~720	17	19	0 -20 -40 -60	33	50
H550TM H550QT	A D E F	550	530	490	640~820	590~770	16	18	0 -20 -40 -60	37	55
H620TM H620QT	A D E F	620	580	560	700~890	650~830	15	17	0 -20 -40 -60	41	62
H690TM H690QT	A D E F	690	650	630	770~940	710~900	14	16	0 -20 -40 -60	46	69
H890TM H890QT	A D E	890	830	NA	940~1100	NA	11	13	0 -20 -40	46	69
H960QT	A D E	960	NA	NA	980~1150	NA	10	12	0 -20 -40	46	69

Note: ① For plates and sections for applications, such as racks in offshore platforms etc., where the design requires that tensile properties are maintained through the thickness, a decrease in the minimum specified tensile properties is not permitted with an increase in the thickness.

3.4.7.5 For full thickness flat test specimens with a width of 25 mm and a gauge length of 200 mm the elongation is to comply with the minimum values shown in Table 3.4.7.5.

Elongation Minimum Values for Full Thickness Flat Test Specimens① Table 3.4.7.5

Strength	Thickness (mm)						
	≤10	>10 ≤15	>15 ≤20	>20 ≤25	>25 ≤40	>40 ≤50	>50 ≤70
H420	11	13	14	15	16	17	18
H460	11	12	13	14	15	16	17
H500	10	11	12	13	14	15	16
H550	10	11	12	13	14	15	16
H620	9	11	12	12	13	14	15
H690	9②	10②	11②	11	12	13	14

Notes: ① The tabulated elongation minimum values are the requirements for testing specimen in transverse direction.

②For H690 plates with thickness ≤ 20 mm, round specimen in accordance with Section 2, Chapter 2 of this PART may be used instead of the flat tensile specimen. The minimum elongation for testing specimen in transverse direction is 14%.

③H890 and 960 specimens and specimens which are not included in this table are to be proportional specimens with a gauge length of $L_0=5.65\sqrt{S_0}$.

3.4.8 Stress relieving heat treatment and other heat treatments

3.4.8.1 Steels approved with respect to heat treatment are suitable for stress relieving heat treatment such as post-weld heat treatment and stress relieving heat treatment after cold forming for the purpose of reducing the risk of brittle fracture, increasing the fatigue lifetime and dimensional stability for machining.”.

The new Section 8 is added as follows:

“Section 8 STEELS INTENDED FOR WELDING WITH HIGH HEAT INPUT

3.8.1 General requirements

3.8.1.1 The steels specified in this Section as intended for welding with high heat input are hull structural steels intended for welding with high heat input over 50 kJ/cm.

3.8.1.2 The steels intended for welding with high heat input are steels being slightly adjusted in their chemical composition on the basis of certain grades of structural steel (parent steel). Hence, in addition to the requirements detailed in this Section, all the requirements for the parent steel are to be complied with (see Sections 2 and 3 of this Chapter).

3.8.2 Grade marks

3.8.2.1 The grade mark of the steels intended for welding with high heat input is expressed by a symbol of the grade mark of the parent steel suffixed with the grade mark of being intended for a high heat input. This suffixed mark consists of W and the value of the high heat input. For example, AH32-W60 means AH32 high-strength hull structural steel intended for high heat input up to 60 kJ/cm.

3.8.3 Welding properties

3.8.3.1 Steel manufacturers are to propose, according to their product development, the maximum heat input with which hull structural steels are intended to be welded. Such maximum heat input is to be confirmed through welding tests.

3.8.3.2 Welding tests with high heat input are generally carried out only during approval of steel products. The Surveyor may require such tests of samples according to the results of impact tests during routine surveys.

3.8.3.3 Welding procedure approval tests for butt weld joints of plates as required in Section 2, Chapter 2 of PART 8 of the Rules are applicable to welding tests with high heat input.

3.8.3.4 The welding is to be performed in the downhand position with the maximum heat input proposed by the manufacturer.

3.8.3.5 In addition to the requirements in 2.2.4 of Chapter 2, PART 8 of the Rules, impact tests are to be carried out at the HAZ (heat affected zone) 5 mm and 10 mm from the fusion line respectively.

3.8.3.6 All the test results are to comply with the relevant requirements for parent steels.

CHAPTER 4 STEEL FORGINGS

Section 1 GENERAL PROVISIONS

The new paragraphs 4.1.1.3 and 4.1.1.4 are added as follows :

"4.1.1.3 The requirements of this Chapter only apply to steel forgings only for design and acceptance tests related to mechanical properties at the ambient temperature. For other applications, where steel forgings are used for low temperature or high temperature, necessary additional tests may be required.

4.1.1.4 Forgings are to be made at works which have been approved by CCS. The steel used is to be manufactured at steel works approved by CCS."

The paragraph 4.1.2.1 is revised as follows:

"4.1.2.1 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 of ladle samples is to comply with the requirements detailed in subsequent sections of this Chapter. The chemical composition selected is to be appropriate for the type of steel, dimensions and required mechanical properties of the forgings being manufactured."

The new paragraph 4.1.2.3 is added as follows:

"4.1.2.3Elements designated as residual elements in the individual specifications are not to be intentionally added to the steel. The content of such elements is to be reported."

The new paragraph 4.1.3.8 is added as follows:

"4.1.3.8 Where two or more forgings are joined by welding to form a composite component, or the forgings are joined with other steel members by welding to form a composite component, the welding procedure specification is to be submitted to CCS for approval. If necessary, welding procedure approval tests may be required."

The new paragraph 4.1.4.6 is added as follows:

"4.1.4.6The forge is to maintain records of heat treatment identifying the furnace used, furnace charge, date, temperature and time at temperature. The records are to be presented to the Surveyor on request"

The new paragraph 4.1.6.7 is added as follows :

"4.1.6.7 Before acceptance, all forgings are to be presented to the Surveyor for visual examination. Where applicable, this is to include the examination of internal surfaces and bores. Unless otherwise agreed, the manufacturer is to be responsible for checking the accuracy of dimensions of forgings."

Paragraph 4.1.7.3 is added as follows The new paragraph 4.1.7.3 is added as follows:

"4.1.7.3The forging manufacturer is to maintain records of repairs and subsequent inspections traceable to each forging repaired. The records are to be presented to the Surveyor on request."

Paragraph The new paragraph 4.1.8 is added as follows:

"**4.1.8 Identification**

4.1.8.1 The manufacturer is to adopt a system of identification which will enable all finished forgings to be traced to the original cast and the Surveyor is to be given full facilities for so tracing the forgings when required.4.1.8.2 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 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.

4.1.8.3 Where small forgings are manufactured in large numbers, modified arrangements for identification may be submitted by the manufacturer to CCS for information."

The new paragraph 4.1.9 is added as follows:

"**4.1.9 Certification**

4.1.9.1The 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 testing (where applicable)."

Section 2 FORGINGS FOR HULL STRUCTURES

The paragraph 4.2.1.1 is revised as follows:

"4.2.1.1The requirements of this Section apply to carbon, carbon manganese or alloy steel forgings intended for use in hull structures such as rudder axles, rudder posts, rudder stocks, rudder pintles, stems and stern frames."

The paragraph 4.2.3 is revised as follows:

"**4.2.3 Heat Treatment**

4.2.3.1 Forgings are to be supplied in one of the following conditions:

.1 fully annealed; or

.2 normalized; or

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

.4 quenched and tempered (tempered at a temperature not less than 550℃).

4.2.3.2 Unless otherwise provided, alloy steels are to be supplied in the quenched and tempered condition (tempered at a temperature not less than 550℃)."

The paragraph 4.2.4.2 is revised as follows:

"4.2.4.2 The results of all tensile tests of steel forgings are to comply with the requirements given in Table 4.2.4.2. For large forgings, where tensile tests are taken from each end, the variation in tensile strength is not to exceed 70 N/ mm^2.

Mechanical Properties for Hull Steel Forgings **Table 4.2.4.2**

Steel type	Tensile strength①② R_m min. (N/mm^2)	Yield strength R_{eH} min. (N/mm^2)	Elongation A_5 min.(%)		Cross-section reduction rate Z min.(%)	
			Longitudinal	Tangential	Longitudinal	Tangential
Carbon and carbon-manganese	400	200	26	19	50	35
	440	220	24	18	50	35
	480	240	22	16	45	30
	520	260	21	15	45	30
	560	280	20	14	40	27
	600	300	18	13	40	27

Steel type	Tensile strength①② R_m min. (N/mm^2)	Yield strength R_{eH} min. (N/mm^2)	Elongation A_5 min.(%)		Cross-section reduction rate Z min.(%)	
			Longitudinal	Tangential	Longitudinal	Tangential
Alloy	550	350	20	14	50	35
	600	400	18	13	50	35
	650	450	17	12	50	35

Notes: ① For forgings with a specified minimum tensile strength < 600 N/mm^2, the tensile strength range is 120 N/mm^2; for forgings with a specified minimum tensile strength ⩾ 600 N/mm^2, the tensile strength range is 150 N/mm^2.

② Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation."

Section 3 FORGINGS FOR SHAFTING AND MACHINERY

The new paragraph 4.3.1.3 is added as follows:

"4.3.1.3 Stainless steel forgings are to comply with relevant requirements of CCS *RULES FOR MATERIALS AND WELDING* if used."

The new paragraph 4.3.5.1 is added as follows:

"4.3.5.1 Mechanical properties of carbon steel and carbon manganese steel forgings are to comply with requirements of Table 4.3.5.1.

Mechanical Properties of Forgings for Shafting and Machinery **Table 4.3.5.1**

Steel type	Tensile strength ①② R_m min. (N/mm^2)	Yield strength R_{eH} or $R_{p0.2}$ min. (N/mm^2)	Elongation A_5 min. (%)		Reduction of area Z min. (%)		Hardness ③ (HB)
			Longitudinal	Tangential	Longitudinal	Tangential	
Carbon and carbon manganese	400	200	26	19	50	35	110~150
	440	220	24	18	50	35	125~160
	480	240	22	16	45	30	135~175
	520	260	21	15	45	30	150~185
	560	280	20	14	40	27	160~200
	600	300	18	13	40	27	175~215
	640	320	17	12	40	27	185~230
	680	340	16	12	35	24	200~240
	720	360	15	11	35	24	210~250
	760	380	14	10	35	24	225~265
Alloy steel	600	360	18	14	50	35	175~215
	700	420	16	12	45	30	205~245
	800	480	14	10	40	27	235~275
	900	630	13	9	40	27	260~320
	1000	700	12	8	35	24	290~365
	1100	770	11	7	35	24	320~385

Notes:① For forgings with a specified minimum tensile strength < 900 N/mm^2, the tensile strength range is 150 N/mm^2; for forgings with a specified minimum tensile strength ⩾ 900 N/mm^2, the tensile strength range is 200 N/mm^2.

② Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation.

③ Hardness values are given for information purposes only.”

CHAPTER 5 STEEL CASTINGS

Section 1 GENERAL PROVISIONS

The new paragraph 5.1.1.3 is added as follows:

"5.1.1.3 The requirements of this Chapter only apply to steel castings only for design and acceptance tests related to mechanical properties at the ambient temperature. For other applications, where steel castings are used for low temperature or high temperature, necessary additional tests may be required."

The new paragraph 5.1.2.3 to 5.1.2.4 are added as follows:

"5.1.2.3 Castings are to be made at foundries approved by CCS in accordance with the manufacturer process approved by CCS.

5.1.2.4 For certain components including steel castings subjected to surface hardening process, the proposed method of manufacture may require special approval by CCS."

The new paragraph 5.1.5.3 is added as followss:

"5.1.5.3 The castings are to maintain records of heat treatment identifying the furnace used, furnace charge, date, temperature and time at temperature. The records are to be presented to the Surveyor on request."

The paragraph 5.1.8.2 is revised as follows:

"5.1.8.2 Before acceptance, all castings are to be presented to the Surveyor for visual examination. Where applicable, this is to include the examination of internal surfaces and bores. Unless otherwise agreed, the manufacturer is to be responsible for checking the accuracy of dimensions of castings."

The paragraph 5.110.2 is revised as follows:

"5.1.10.2Complete elimination of the defective material is to be verified by non-destructive testing. Where the defective area is not required to be repaired by welding, the shallow grooves or excavations resulting from the removal of defects are to be blended by grinding and to be smoothly blended to the surface area with a finish equal to that of the adjacent surface, subject to the inspection and acceptance by the Surveyor. Where the defective area is required to be repaired by welding, the excavations are to be suitably shaped to allow good access for welding. All grooves are to have a bottom radius of approximately three times the groove depth."

The new paragraph 5.1.10.11 is added as follows:

"5.1.10.11 The manufacturer is to maintain full records detailing the extent and location of repairs made to each casting and details of weld procedures and heat treatments applied for repairs as well as subsequent survey reports. These documents are to be available to the Surveyor and copies provided on request."

The new paragraph 5.1.11 is added as follows:

"**5.1.11 Identification of castings**

5.1.11.1 All castings 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 logo;

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

(3) test pressure (where applicable);

(4) brand or grade of casting material;

(5) certificate number.

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

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

5.1.11.2 Where small castings are manufactured in large numbers, modified arrangements for identification may be submitted by the manufacturer to CCS for information."

The new paragraph 4.1.9 is added as follows:

"**5.1.12 Certification**

5.1.12.1 The manufacturer is to provide a certificate giving the following particulars for each casting or batch of castings which has been accepted:

(1) purchaser's name and order number;
(2) description of castings and steel quality;
(3) cast number and chemical analysis of ladle samples;
(4) details of heat treatment, including temperatures and holding times;
(5) results of mechanical tests;
(6) test pressure, where applicable;
(7) methods and results of non-destructive testing."

Section 2 CASTINGS FOR HULL STRUCTURES

The paragraph 5.2.3 is revised as follows:

"**5.2.3 Heat treatment**

5.2.3.1 Castings are to be heat treated as follows:

(1) fully annealed;
(2) normalized;
(3) normalized and tempered at a temperature of not less than 550℃; or
(4) quenched and tempered at a temperature of not less than 550℃."

Section 6 STEEL CASTINGS FOR PROPELLERS

The paragraph 5.6.5 is revised as follows:

"**5.6.5 Inspections**

5.6.5.1 All finished propeller castings are to be 100% visually inspected, the surfaces of the finished castings are to be in accordance with the roughness specified in the approved drawings and free from cracks or other imperfections which will interfere with the use of the castings.

5.6.5.2 All propellers are subject to non-destructive testing. The categorization of important portions of the propellers and the corresponding non-destructive testing are to comply with the provisions given in CCS *RULES FOR MATERIALS AND WELDING*.

5.6.5.3 The dimensions of the propellers are to be the responsibility of the manufacturer and the report on the dimensional inspection is to be handed over to the Surveyor for confirmation in his presence.

5.6.5.4 Static balancing is to be carried out on all propellers in accordance with the approved drawing. Dynamic balancing may be required for propellers running above 500 r/min.

5.6.5.5 Defects found in the inspections are to be repaired in accordance with CCS *RULES FOR MATERIALS AND WELDING*. The Surveyor may require areas to be etched for the purpose of investigating weld repairs."

The new paragraph 5.6.6 is added as follows:

"**5.6.6 Identification and Certification**

5.6.6.1 Each casting is to be suitably identified by the manufacturer with the following:

a) heat number or other marking which will enable the full history of the casting to be traced;
b) CCS certificate number;
c) ice class symbol, where applicable;
d) skew angle for high skew propellers;
e) date of final inspection;
f) CCS stamp is to be put on when the casting has been accepted.

5.6.6.2 The manufacturer is to provide the Surveyor with a marine product certificate or equivalent document giving the following particulars for each casting which has been accepted:

a) purchaser's name and order number;
b) vessel identification, where 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 mass;
g) alloy type, heat number and chemical composition;

h) casting identification number;
i) details of time and temperature of heat treatment;
j) results of the mechanical tests and non-destructive testing.
”

CHAPTER 6　IRON CASTINGS

Section 1　GENERAL PROVISIONS

The new paragraph 6.1.1.3 is added as follows:

“6.1.1.3 Small castings made from the same cast with the similar size and heat treated in the same furnace charge may be submitted for batch testing, subject to agreement of CCS.”

The new paragraph 6.1.2.2 and 6.1.2.3 are added as follows:

“6.1.2.2 Iron castings are to be made at foundries approved by CCS.

6.1.2.3 Where iron castings of the same type are produced in regular quantities, the manufacturer is to make procedure confirmation tests to prove that the procedure can guarantee a sound and stable quality of the castings.”

The new paragraph 6.1.10 is added as follows::

“**6.1.10 Identification**

6.1.10.1 All castings 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 logo;
(2) cast number or other marking which will enable the full history of the casting to be traced;
(3) test pressure (where applicable);
(4) brand or grade of casting material;
(5) certificate number.

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

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

Paragraph The new paragraph 6.1.11 is added as follows

“6.1.11 **Certification**

6.1.11.1 The manufacturer is to provide a certificate giving the following particulars for each iron casting or batch of iron castings which has been accepted:

(1) purchaser’s name and order number;
(2) description of castings and quality of cast iron;
(3) identification number (or cast number);
(4) chemical composition (when specially required);
(5) details of heat treatment, where applicable;
(6) results of mechanical tests;
(7) test pressure, where applicable.”

Section 3　SPHEROIDAL OR NODULAR GRAPHITE IRON CASTINGS

The paragraph 6.3.4.1 is revised as follows:

6.3.4.1 The mechanical properties of spheroidal or nodular graphite iron castings are to comply with the requirements of Table 6.3.4.1.

Mechanical Properties of Spheroidal or Nodular Graphite Iron Castings　　Table 6.3.4.1

Tensile strength R_m min. (N/mm^2)		Proof of strength $R_{p0.2}$ min. (N/mm^2)	Elongation A_5 min. (%)	Hardness (HB)	Charpy V-norch impact test		Typical structure of matrix
					Test temperature (℃)	Impact energy (J)	
General qualities	370	230	17	120~180	—	—	Ferrite
	400	250	12	140~200	—	—	Ferrite
	500	320	7	170~240	—	—	Ferrite/ Pearlite
	600	370	3	190~270	—	—	Ferrite/ Pearlite
	700	420	2	230~300	—	—	Pearlite

	800	480	2	250~350	—	—	Pearlite/ Tempered structure
	900	600	2	280～360	—	—	Bainite or Tempered martensite
Special qualities	350	220	22④	110~170	20	17(14)	Ferrite
	400	250	18④	140~200	20	14(11)	Ferrite

Notes: ① Intermediate values may be obtained by interpolation.

② Generally, the tensile strength and elongation are used as the acceptance criteria. However, if required in the design plan, the yield strength and hardness are also to be used as the acceptance criteria.

③ The average impact energy is to be not less than the value specified in the Table, and the single value is to be not less than the value specified in the parentheses.

④ For integral cast samples, the elongation may be 2% less.

CHAPTER 8 ALUMINIUM ALLOYS

Section 1 GENERAL PROVISIONS

The new paragraph 8.1.7 and 8.1.8 are added as follows:

"**8.1.7 Identification**

8.1.7.1 All aluminum alloy products accepted by CCS are to be clearly marked, at least at one position, by the manufacturer with CCS stamp and the following particulars:

(1) name or trade mark of the manufacturer;

(2) alloy grade and temper condition;

(3) "M" showing that products are corrosion tested, if applicable;

(4) identification mark which will enable the full history of the item to be traced..

8.1.7.2 Where the products are bundled together or packed in crates for delivery, the marking specified in 8.1.7.1 may be affixed by a securely fastened tag or label at a position accessible for inspection.

8.1.8 Certification

8.1.8.1 The manufacturer is to provide a certificate giving the following particulars for all the products accepted by CCS:

(1) name of the purchaser and order number;

(2) ship name or structural project number, if known;

(3) number, dimensions and weight of the product;

(4) designation of the aluminum alloy (grade) and of its delivery condition;

(5) chemical composition;

(6) manufacturing batch number or identification mark which will enable the full history of the item to be traced;

(7) mechanical test results;

(8) corrosion test results, if applicable."

Section 2 ALUMINUM ALLOY PLATES AND SECTIONS

Paragraph 8.2.5.5 is revised to The paragraph 8.2.5.5 is revised as follows:

"8.2.5.5 One tensile 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 paragraph 8.2.5.7 is revised as follows:

"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 the profile. The edges of the end may be rounded by filing.

(4) The length of the specimen is to be in accordance with 2.5.1, 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."

(1)

The paragraph 8.2.5.10~8.2.5.13 are revised as follows:

"8.2.5.10 Each batch of aluminium manganese alloys of type 5083, 5383, 5059, 5086 and 5456 in the H116 and H321 tempers intended for use in marine hull construction or in marine applications where frequent direct contact with seawater is expected are to be corrosion tested or examined with respect to exfoliation and intergranular corrosion resistance in accordance with paragraphs 8.2.5.11 to 8.2.5.13.

8.2.5.11 The manufacturers are in general to establish the relationship between microstructure and resistance to corrosion when the above alloys are approved. A reference photomicrograph taken at 500x, under the conditions specified in ASTM B928, Section 9.4.1, is to be established for each of the alloy-tempers and thickness ranges relevant. The reference photographs are to be taken from samples which have exhibited no evidence of exfoliation corrosion and a pitting rating of PB or better, when subjected to the test described in ASTM G66 (ASSET).The samples are also to have exhibited resistance to intergranular corrosion at a mass loss no greater than 15 mg/cm$_2$, when subjected to the test described in ASTM G67 (NAMLT). Upon satisfactory establishment of the relationship between microstructure and resistance to corrosion, the master photomicrographs and the results of the corrosion tests are to be approved by CCS. Production practices are not to be changed after approval of the reference micrographs.

8.2.5.12 For batch acceptance of aluminium alloy (5xxx) alloys in the H116 and H321 tempers, metallographic examination of one sample selected from mid width at one end of a coil or random sheet or plate is to be carried out. The microstructure of the sample is to be compared to the reference photomicrograph of acceptable material in the presence of the Surveyor. A longitudinal section perpendicular to the rolled surface is to be prepared for metallographic examination, under the conditions specified in ASTM B928, Section 9.6.1. If the microstructure shows evidence of continuous grain boundary network of aluminium-magnesium precipitate in excess of the reference photomicrographs of acceptable material, the batch is either to be rejected or tested for exfoliation corrosion resistance and intergranular corrosion resistance subject to agreement of the Surveyor. The corrosion tests are to be in accordance with ASTM G66 and G67 or equivalent standards. Acceptance criteria are that the sample is to exhibit no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to ASTM G66 ASSET test, and the sample is to exhibit resistance to intergranular corrosion at a mass loss no greater than 15 mg/cm^2 when subjected to ASTM G67 NAMLT test. If the results from testing satisfy the acceptance criteria stated in paragraph 8.2.5.11, the batch is accepted, else it is to be rejected.

8.2.5.13 As an alternative to metallographic examination, each batch may be tested for exfoliation corrosion resistance and intergranular corrosion resistance, in accordance with ASTM G66 and G67 under the conditions specified in ASTM B928. If this alternative is used, then the results of the test are to satisfy the acceptance criteria stated in paragraph 8.2.5.12."

8.2.5.14 Deleted.

The paragraph 8.2.7 is revised as follows:

"**8.2.7 Mechanical properties**

8.2.7.1 Mechanical properties of rolled products in various temper conditions are to be in accordance with the requirements given in Table 8.2.7.1.

8.2.7.2Mechanical properties for extruded products in various temper conditions are to be in accordance with the requirements given in Table 8.2.7.2.

Mechanical Properties for Rolled Aluminum Alloy Products **Table 8.2.7.1**

Designation	Temper condition	Thickness t (mm)	Proof of strength $R_{p0.2}$ (N/mm^2)	Tensile strength R_m (N/mm^2)	Minimum elongation A① (%)	
					50mm	5d
5A01	O	3≤t≤50	≥165	≥325	10	
	H112	3≤t≤50	≥165	≥325	10	
	H32	3≤t≤50	≥245	≥365	8	
5454	O	3≤t≤50	≥85	215~285	17	16
	H112	6≤t≤12.5	≥125	≥220	8	—
		12.5<t≤50	≥85	≥215	—	9
	H32	3≤t≤6.3	≥180	250~305	8	—
		6.3<t≤50	≥180	250~305	—	10
5083	O	3≤t≤50	≥125	275~350	16	14

Designation	Temper condition	Thickness t (mm)	Proof of strength $R_{p0.2}$ (N/mm^2)	Tensile strength R_m (N/mm^2)	Minimum elongation A① (%)	
					50mm	5d
	H111	3≤t≤50	≥125	275~350	16	14
	H112	3≤t≤50	≥125	≥275	12	10
	H116	3≤t≤50	≥215	≥305	10	10
	H321	3≤t≤50	215~295	305~385	12	10
5383	O	3≤t≤50	≥145	≥290	—	17
	H111	3≤t≤50	≥145	≥290	—	17
	H116	3≤t≤50	≥220	≥305	10	10
	H321	3≤t≤50	≥220	≥305	10	10
5059	O	3≤t≤50	≥160	≥330	24	24
	H111	3≤t≤50	≥160	≥330	24	24
	H116	3≤t≤20	≥270	≥370	10	10
		20<t≤50	≥260	≥360	—	10
	H321	3≤t≤20	≥270	≥370	10	10
		20<t≤50	≥260	≥360	—	10
5086	O	3≤t≤50	≥95	240~305	16	14
	H111	3≤t≤50	≥95	240~305	16	14
	H112	3≤t≤12.5	≥125	≥250	8	—
		12.5<t≤50	≥105	≥240	—	9
	H116	3≤t≤50	≥195	≥275	10②	9
5456	O	3≤t≤6.3	130~205	290~365	16	—
		6.3<t≤50	125~205	285~360	16	14
	H116	3≤t≤30	≥230	≥315	10	10
		30<t≤40	≥215	≥305	—	10
		40<t≤50	≥200	≥285	—	10
	H321	3≤t≤12.5	230~315	315~405	12	—
		12.5<t≤40	215~305	305~385	—	10
		40<t≤50	200~295	285~370	—	10
5754	O	3≤t≤50	≥80	190~240	18	17
	H111	3≤t≤50	≥80	190~240	18	17

Notes: ① Elongation in 50 mm applies to thicknesses up to and including 12.5 mm and in 5d to thicknesses over 12.5 mm.

② 8 % for thicknesses up to and including 6.3 mm.

③ The mechanical properties for the O and H111 tempers are the same. However, they are separated to discourage dual certification as these tempers represent different processing.

Mechanical Properties of Extruded Aluminium Alloy Products **Table 8.2.7.2**

De	Temper condition	Thickness t (mm)	Proof of strength $R_{p0.2}$ (N/mm^2)	Tensile strength R_m (N/mm^2)	Minimum elongation A notes 1, 2 (%)	
					50mm	5d
5A01	H112	3≤t≤50	≥170	≥330	10	
5454	H112	3≤t≤50	≥100	≥230	10	
5083	O	3≤t≤50	≥110	270~350	14	12
	H111	3≤t≤50	≥165	≥275	12	10
	H112	3≤t≤50	≥110	≥270	12	10
5383	O	3≤t≤50	≥145	≥290	17	17
	H111	3≤t≤50	≥145	≥290	17	17
	H112	3≤t≤50	≥190	≥310	—	13
5059	H112	3≤t≤50	≥200	≥330	—	10

5086	O	3≤t≤50	≥95	240~315	14	12
	H111	3≤t≤50	≥145	≥250	12	10
	H112	3≤t≤50	≥95	≥240	12	10
5456	H112	3≤t≤50	≥130	≥300	10	
5754	H112	3≤t≤50	≥80	≥180	10	
6005A	T5	3≤t≤50	≥215	≥260	9	8
	T6	3≤t≤10	≥215	≥260	8	6
		10<t≤50	≥200	≥250	8	6
6061	T6	3≤t≤50	≥240	≥260	10	8
6082	T5	3≤t≤50	≥230	≥270	8	6
	T6	3≤t≤5	≥250	≥290	6	—
		5<t≤50	≥260	≥310	10	8

Note 1: Elongation in 50 mm applies to thicknesses up to and including 12.5 mm and in 5*d* to thicknesses over 12.5 mm.

Note 2: The values are applicable to both longitudinal and transverse tensile test specimens.”

CHAPTER 9 OTHER NON-FERROUS MATERIALS

Section 1 COPPER CASTINGS FOR PROPELLERS

The paragraph 9.1.2 is revised as follows:

"**9.1.2 Approval**

9.1.2.1 Manufacturers (including foundries and machining works) are to apply for works approval in accordance with the relevant requirements of CCS.

9.1.2.2 The approved works are to be subject to periodical verification by CCS, covering the quality assurance system and the technical conditions and accuracy of production, testing and inspection facilities. The manufacturers not frequently engaged in producing such castings are to be checked in accordance with the details of the approval test, in addition to the fore-mentioned requirements."

The paragraph 9.1.9.3 is revised as follows

"9.1.9.3 Generally, welding repair is not to be conducted on propellers. If necessary, the repair is to be carried out in accordance with relevant requirements of CCS *RULES FOR MATERIALS AND WELDING*. And the repaired portion is to be subject to NDT for certifying that the product is as required."

The new paragraph 9.1.4 is added as follows:

"**9.1.4 Marking and certification**

9.1.4.1Each 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.

9.1.4.2 Each satisfactorily inspected propeller casting is to be provided with a marine product certificate or equivalent document containing the following details:

a) purchaser's name and order number;
b) ship's name, 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 testing;
k) results of mechanical tests;
l) proportion of α phase in metallographic examination (for Cu1 and Cu2 alloys only)."

CHAPTER 11 EQUIPMENT

Section 1 ANCHORS

The new paragraph 11.1.5 is added as follows:

"11.1.5 **Certificate and Markings**

11.1.5.1 Accepted anchors are to have marine product certificates or equivalent documents with the details as follows:

(1) manufacturer's name
(2) order number, if any;
(3) fluke and shank identification numbers;
(4) type, nominal and actual mass of anchor;
(5) details of heat treatment;
(6) grade or make of anchor material;
(7) proof test load;
(8) markings on anchors.

11.1.5.2 Accepted anchors are to be stamped with CCS approval and other markings as follows on the fluke and the shank:

(1) manufacturer's mark;
(2) number of the product certificate;
(3) total mass of anchor;
(4) mass of the shank;
(5) the designation HHP or SHHP when approved as high holding power or super high holding power anchors;
(6) unique cast identification number (the number is to be cast on the shank and the fluke).

On the fluke, these markings are to be approximately at a distance of two thirds from the tip of the bill to the center line of the crown on the right hand fluke looking from the crown towards the shank. The markings on the shank are to be approximately level with the fluke tips."

Section 2 ANCHOR CHAIN CABLES AND ACCESSORIES

Paragraph 11.2.2.3 is added as follows: The new paragraph 11.2.2.3 is added as follows

"11.2.2.3 Except as agreed in the contract, steel bars intended for chains are usually supplied in the as-rolled condition."

Paragraph 11.2.4.2 is revised to The paragraph11.2.4.2 is revised as follows:

"11.2.4.2 The following tolerances are applicable to links:

(1) The diameter measured at the crown is to be taken twice at the same location, one in the plane of the link and the other perpendicular to the plane of the link. The tolerance on the nominal diameter *d* is to be in compliance with the requirements of Table 11.2.4.2(1) and the cross-sectional area must have no negative tolerance:

Allowable Tolerance of Diameter at Crown **Table 11.2.4.2(1)**

Nominal diameter (mm)	$d \le 40$	$40 < d \le 84$	$84 < d \le 122$	$d > 122$
Allowable tolerance (mm)	$-1 \sim +0.05d$	$-2 \sim +0.05d$	$-3 \sim +0.05d$	$-4 \sim +0.05d$

(2) The diameter measured at locations other than the crown is to have no negative tolerance. The plus tolerance may be up to 5% of the nominal diameter. The plus tolerance of the diameter at the flash-butt weld is to comply with the requirements of the approved specification.

(3) The allowable manufacturing tolerance of a length of 5 links is to be 0% to +2.5% (measured with the chain under tension after proof load test).

(4) All other dimensions are to be subjected to a manufacturing tolerance of ±2.5%, provided that all of the final link parts of the chain cable fit together properly.

(5) Studs are to be located in the links centrally and at right angles to the sides of the links. The following tolerances are acceptable provided that the stud fits snugly and its ends lie practically flush against the inside of

the link (measured in accordance with Figure 11.2.4.2(5)):
1) maximum off-centre distance $X = (A - a) / 2$ is 10% of the nominal diameter;
2) maximum deviation from the 90 °position is ≤ 4° .

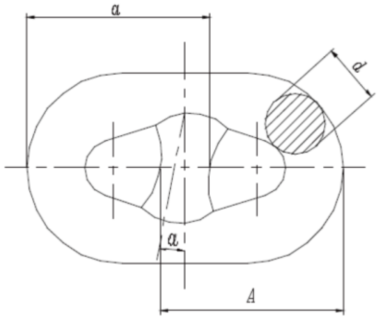


Figure 11.2.4.2(5)

The new paragraph 11.2.4.4 is added as follows:

“11.2.4.4 Unless otherwise specified in the contract, the tolerances of diameter and roundness of steel bars directly used for welding chain cables are to be in compliance with the requirements of Table 11.2.4.4. For steels intended for mooring chains, at least 1% of a batch of steel bars are to be sampled for roundness measurement. The roundness is to be taken by measuring the maximum and minimum diameters at a cross section. The tolerance on roundness is the difference between them.

Tolerance of Diameter and Roundness for Steel Barb **Table 11.2.4.4**

Nominal diameter l (mm)	< 25	25~35	36~50	51~80	81~100	101~120	121~160	161~222
Tolerance on diameter (mm)	-0~+1.0	-0~+1.2	-0~+1.6	-0~+2.0	-0~+2.6	-0~+3.0	-0~+4.0	-0~+5.0
Tolerance on roundness(mm)	0.6	0.8	1.1	1.5	1.95	2.25	3.00	4.00

”

The paragraph 11.2.5.3 is revised as follows:

“11.2.5.3 Steel bars are to be presented for testing in batches not exceeding 50 t from the same heat and of the same diameter. A test sample having a suitable length is to be taken at random from each batch of steel bars for testing, and be subjected to the heat treatment provided for the finished chain cables.”

The new paragraph 11.2.12 is added as follows:

“**11.2.12 Marking and certification**

11.2.12.1 The chain cables and accessories accepted by CCS are to be stamped with the following marks on both ends of each length of chain cable as shown in Figure 11.2.12.1:

(1) Chain cable grade;

(2) Certificate number;

(3) CCS symbol.

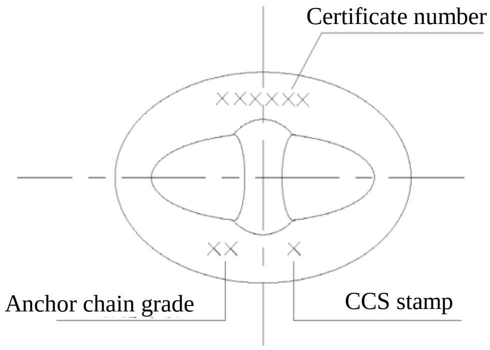


Figure 11.2.12.1

The certificate number may be an abbreviation or other equivalent marking, and is to be stated in the corresponding certificate.

11.2.12.2 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 to accessories);

(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)."

CHINA CLASSIFICATION SOCIETY

RULES FOR THE CONSTRUCTION OF OCEAN-GOING STEEL FISHING VESSELS

2019 AMENDTENTS

PART 8 WELDING

Effective from 1 July 2018

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

The paragraph 1.1.1.1 is revised as follows:

"1.1.1.1 This PART applies to the welding of hull structures, boilers, pressure vessels, piping systems and important machinery components, as well as to the approval of welding consumables. Where such approval complies with corresponding provisions of CCS *RULES FOR MATERIALS AND WELDING*, it shall be deemed as also complying with requirements of this PART."

The new paragraph 1.1.5 is added as follows:

"1.1.5 **Qualification tests of welders**

1.1.5.1 The qualification tests of welders intended to be engaged in the fusion welding (including shielded metal arc welding, semi-automatic welding and TIG welding) of ship structures, machinery, boilers and pressure vessels as well as piping with carbon steels, carbon-manganese steels, alloy steels or aluminum alloys as the base metal are to comply with requirements of Chapter 4, PART 3 of CCS *RULES FOR MATERIALS AND WELDING*."

Section 2 TESTING

The new paragraph 1.2.3.5 is added as follows:

"1.2.3.5 Longitudinal butt-weld face and root bend specimens are to be machined to the dimensions as shown in Figure 1.2.3.5 and Table 1.2.3.5. The welds of upper and lower surfaces of the specimen are to be machined flush with the surface of the plate. If the joint thickness is more than 20 mm or the capacity of the test machine is insufficient, the compression side of the specimen may be machined to 20 mm. The edges on the tension side may be rounded to a radius of 1 to 2 mm. The radius of the former is to be as required for high strength of base metal.

Dimensions of Longitudinal Bend Specimen **Table 1.2.3.5**

a	*b*	*L*
$a \le 6$	20	180
$6 < a \le 10$	30	200
$10 < a \le 20$	50	250

Figure 1.2.3.5 Longitudinal Bend Specimen"

Paragraphs 1.2.3.5~1.2.3.7are revised to 1.2.3.6~1.2.3.8.

CHAPTER 2　WELDING PROCEDURE APPROVAL TESTS

Section 1　GENERAL PROVISIONS

The paragraph 2.1.2.2 is revised as follows:

“2.1.2.2 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. The shipbuilder or manufacturer is to prepare a detailed preliminary welding procedure specification. The preliminary welding procedure specification submitted for approval is to include the following:

(1) type, grade, thickness and delivery condition of the parent metal;

(2) designation, grade and size of the welding consumables (electrode, wire, flux and shielding gas);

(3) type and main performance parameters of welding equipment;

(4) design of and requirements for edge preparation; backing material (if any);

(5) number and order of welding metal disposition and welding sequence;

(6) welding positions (downhand, horizontal, vertical and overhead);

(7) rule welding parameters (electric polarity, welding current, arc voltage, travel speed and shielding gas flow);

(8) pre-heating, interpass temperatures, post-weld heat treatment and post-weld stress-relieving;

(9) welding site conditions (at site or in the shop);

(10) other special requirements.”

The paragraph 2.1.3.3 is revised as follows::

“2.1.3.3 The application of a welding procedure specification to steel is specified as follows:

(1) For each strength level, welding procedures are considered applicable to the same and lower toughness grades as that tested.

(2) For each toughness grade where the minimum value of the specified yield strength of steel is not more than 390 N/mm^2, welding procedures are considered applicable to the same and two lower strength levels as that tested. For high strength quenched and tempered steel, welding procedures are considered applicable to the same and one lower strength level as that tested.

(3) For high heat input processes above 50 kJ/cm, the welding procedure is only applicable to that toughness grade tested and one strength level below.

(4) For steel forgings and castings (carbon steel and carbon-manganese steel), welding procedures are considered applicable to the same or lower strength level as that tested.

(5) For steels with delivery conditions other than those tested, unless specified below, CCS will put forward test requirements as appropriate:

① the approval of quenched and tempered steels does not qualify steels with other delivery conditions and vice versa;

② in general the approval of normalized, as rolled and controlled rolling steels qualifies TMCP steels but not vice versa.”

Section 2　WELDING PROCEDURE APPROVAL TESTS FOR BUTT WELDS

The paragraph 2.2.2 is revised as follows::

“**2.2.2　Test assemblies**

2.2.2.1 The base metals and welding consumables selected for test assemblies are to comply with the requirements of the preliminary welding procedure specification.

2.2.2.2 The direction in which test pieces are cut from rolled steel is to be determined as required for impact tests (see Figure 2.2.2.2). For normal and higher strength hull structural steel plates, the butt weld of the test piece is to be perpendicular to the rolling direction (longitudinal impact) of the two plates, and for other rolled plates the butt weld of the test piece is to be parallel to the rolling direction (transverse impact) of the two plates.

For aluminum alloys, the butt weld of the test piece is to be parallel to the rolling direction of the two plates.

2.2.2.3 The test plate is to be of a size sufficient to ensure a reasonable number of specimens and at least the following requirements are to be complied with:

(1) Dimensions of butt weld test plates are to comply with the requirements of Table 2.2.2.3.

Dimensions of Butt Weld Test Plates **Table 2.2.2.3**

Welding process	Test plate dimension(mm)	
	Length L	Width b
Manual and semi-automatic welding	≥350(6t)①	≥150(3t)①
Automatic welding	≥1000	≥200(4t)①

Notes: ① 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.

(2)The test length L of pipes is not to be less than 150 mm. Where the diameter of a pipe is over 600 mm, a test plate may be substituted as the pipe for butt welding at the corresponding position.

2.2.2.4 The preparation of test plates, the beveling of plate edges, tacking, welding and heat-treatment procedures are to comply with the preliminary welding procedure specification.

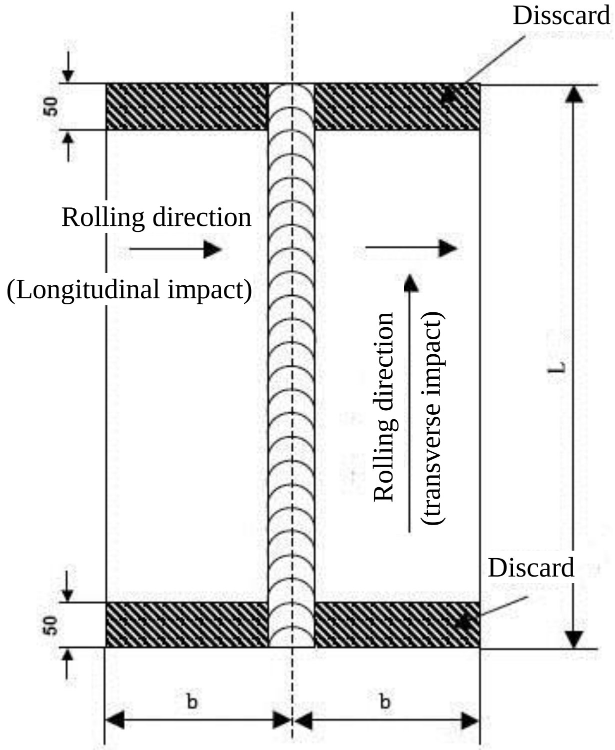


Figure 2.2.2.2 Test Assembly for Butt Weld"

The new paragraph 2.2.3 is added as follows:

"**2.2.3 Sampling**

2.2.3.1 Test assemblies are to be examined by 100% visual testing and by 100% non-destructive surface and internal testing prior to the cutting of test specimens. In case any post-weld heat treatment or aging is required or specified, the non-destructive testing is to be performed after the heat treatment or aging. For high strength quenched and tempered steels with specified minimum yield strength of 420 N/mm^2 and above, the non-destructive testing is to be delayed for a minimum of 48 h, unless the heat treatment has been carried out. NDT procedures are to be agreed with CCS.

2.2.3.2 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 10042 (excess weld metal, excessive convexity and excess penetration for which level C applies) or other equivalent standards.

2.2.3.3 If the test piece fails to comply with any of the requirements for visual or non-destructive testing, one further test piece is to be welded and subjected to the same examination. If this additional test piece does not comply with the relevant requirements, the preliminary welding procedure specification is to be modified and the relevant approval test is to be carried out."

The paragraph 2.2.3 is revised as follows:

"**2.2.4 Butt welding procedure test items**

2.2.4.1 For butt welding procedure tests regarding steels, the following specimens are generally to be taken from the test assembly as shown in Figure 2.2.4.1 and the dimensions of specimens are to comply with the relevant requirements in Section 2, Chapter 1 of this PART:

(1) two transverse tensile test specimens;

(2) two transverse face and two transverse root bend specimens. They may be substituted by four side-bend specimens where the thickness of the test assembly is not less than 12 mm. For butt joints in heterogeneous steel plates, face and root longitudinal bend test specimens may be used instead of the transverse bend test specimens;

(3) several sets of impact specimens (three specimens each set) are to be taken at positions shown in Figure 2.2.4.1(3) based on heat input range, welding procedure and plate thickness of the test assembly and according to the requirements of Table 2.2.4.1(3);

(4) one specimen for macro examination and one specimen for hardness test (usually cut at welded joints). Steels with specified yield strength less than 355 N/mm^2 may be exempted from hardness test;

(5) one longitudinal tensile test specimen of weld metal (only where the welding consumable is not approved). Where more than one welding process or type of consumables has been used to make the test weld, test specimens are to be taken from the area of the weld where each was used with the exception of those processes or consumables used to make the first weld run or root deposit.

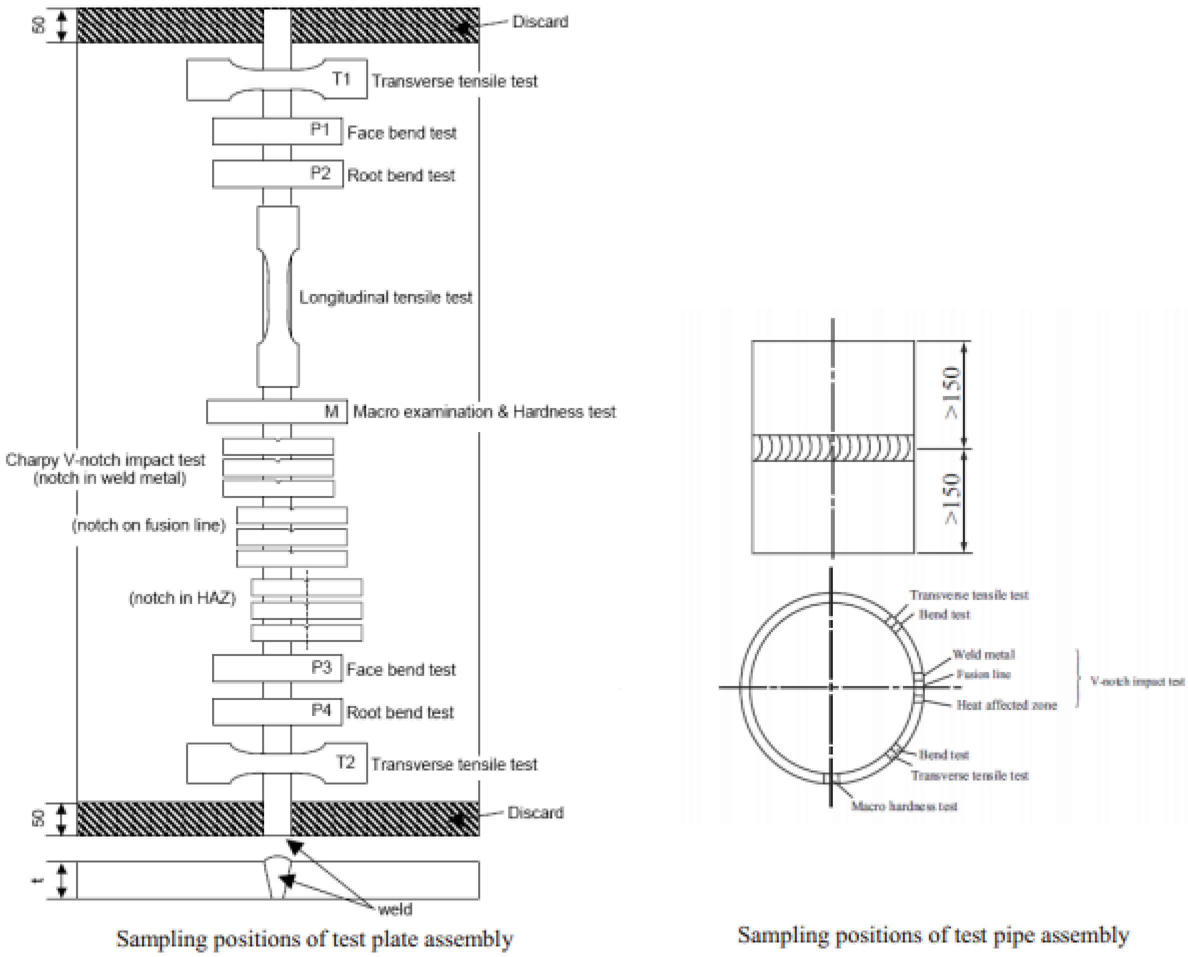
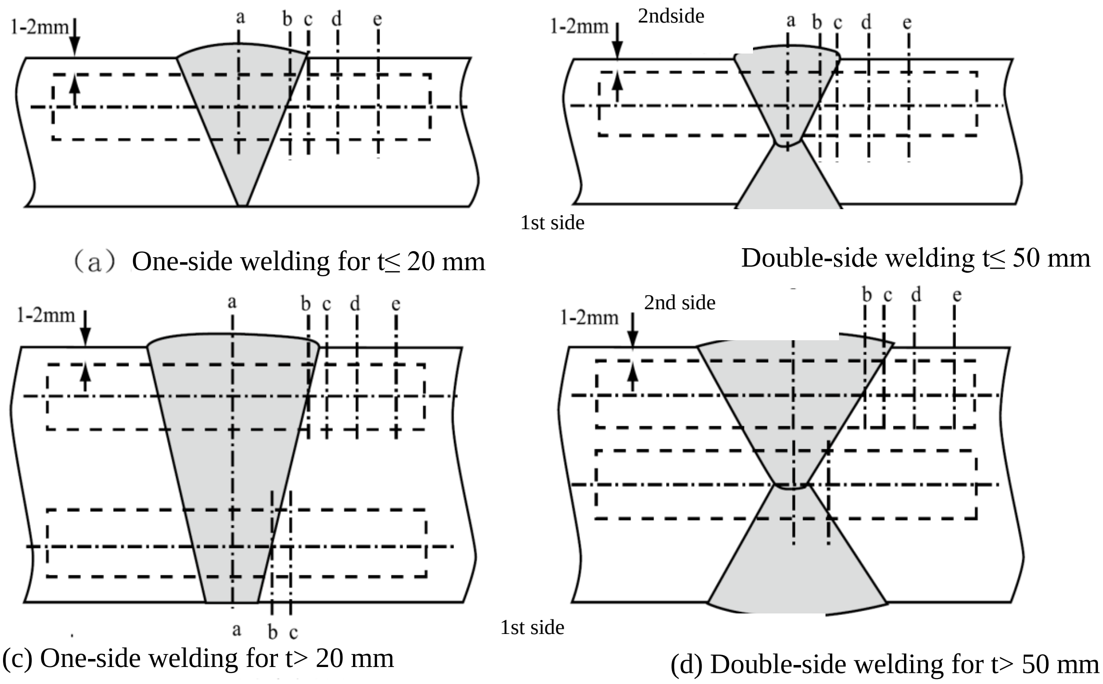


Figure 2.2.4.1 Sampling Positions of Test Assemblies

Sampling Positions of Impact Specimens **Table 2.2.4.1(3)**

Heat input range (kJ/cm)	Welding procedure	Thickness of test assembly (mm)	Sampling position of impact specimen	
			Surface ①	Root
≤50②	One side	t≤20	a, b, c, d	—
		20<t≤50	a, b, c, d	a
		t>50	a, b, c, d	a, b
	Double side	t≤50	a, b, c, d	—
		t>50	a, b, c, d	a
>50③	One side	t≤20	a, b, c, d, e	—
		t>20	a, b, c, d, e	a, b, c
	Double side	t≤50	a, b, c, d, e	—
		t>50	a, b, c, d, e	a, c

Notes: ① For double side welding, the 2nd side is to be taken.
② Only when the approved procedure is to be used for joining primary parts of offshore engineering facilities, a specimen at position d is to be additionally taken.
③ Only when the heat input is more than 200 kJ/cm, a specimen at position e is to be additionally taken.
④ When butt welds are made between different steel grades/types, the test specimens are to be taken from the side of the joint with lower toughness of steel. Temperature and absorbed energy results are to be in accordance with the requirements for the lower toughness steel.
⑤ Where more than one welding process or type of consumables has been used to make the test weld, impact test specimens are to be taken from the respective areas where each was employed. This is not to apply to the process or consumables used solely to make the first weld run or root deposit.
⑥ When the thickness of the test assembly or the pipe diameter is not enough to make impact specimen of 5 mm, impact tests may be exempted.



In the Figure, a, b, c, d and e are notch locations of impact specimens where: a − center of weld, b − fusion line, c − heat affected zone, 2 mm from fusion line, d − heat affected zone, 5 mm from fusion line, e − heat affected zone, 10 mm from fusion line.

Figure 2.2.4.1(3) Sampling Positions of Impact Specimens

2.2.4.2 In addition to the tests required in 2.2.4.1 of this Section, the following examinations and test items may be required when deemed necessary by the Surveyor according to the actual situation:
(1) chemical analysis of deposited weld metal;
(2) chemical analysis of parent plate;
(3) micro-structure of the whole joint."

Section 3 WELDING PROCEDURE APPROVAL TESTS FOR FILLET WELDS

The paragraph 2.3.2.2 is revised as follows:

"2.3.2.2 The test assembly is to be of a size sufficient to ensure a reasonable heat distribution, normally in accordance with Table 2.3.2.2:

Size of Fillet Weld Test Plate **Table 2.3.2.2**

Size of test plate / Welding process	Length L	Breadth b
Manual and semi-automatic welding	≥350(6t)①	150(3t)①
Automatic welding	≥1000	150(3t)①

Notes: ① The greater of the two is to be taken (t being thickness of the test plate, in mm).

For pipe-to-plate assemblies, the length of sides of the plate is to be at least 100 mm greater than the outside diameter of the test pipe.

For pipe-to-plate assemblies, the length of the test pipe is to be more than 150 mm."

CHAPTER 3 WELDING CONSUMABLES

Section 1 GENERAL PROVISIONS

The Table 3.1.2.4 is revised as follows:

“ **Grade of Steel for Approval Test** **Table 3.1.2.4**

Grade of welding consumables	Grade of steel for test	Grade of welding consumables	Grade of Steel for Test
1	A	5Y50	FH500
2	B, D	3Y55	DH550
3	E	4Y55	EH550
4	F	5Y55	FH550
1Y	AH32, AH36	3Y62	DH62
2Y	DH32, DH36	4Y62	EH620
3Y	EH32, EH36	5Y62	FH620
4Y	FH32, FH36	3Y69	DH690
2Y40	DH40	4Y69	EH690
3Y40	EH40	5Y69	FH690
4Y40	FH40	0.5Ni	0.5Ni
3Y42	DH420	1.5Ni	1.5Ni
4Y42	EH420	3.5Ni	3.5Ni
5Y42	FH420	5Ni	5Ni
3Y46	DH460	9Ni	9Ni
4Y46	EH460	AS1—A	00Cr18Ni10
5Y46	FH460	AS1－B	00Cr17Ni14Mo3
3Y50	DH500	AS2—A	0Cr18Ni9Ti
4Y50	EH500	AS2—B	1Cr18Ni11Nb

”

Paragraphs 3.1.3~3.1.5 are added as follow The new paragraph3.1.3~3.1.5 are added as follows :

“**3.1.3 Works Approval**

3.1.3.1 Welding consumables are to be made at works which have been approved by CCS, and the steels used for making the welding consumables are also to be supplied by steelmakers which have been approved by CCS.

3.1.3.2 Manufacturers of welding consumables are to have good conditions of production, mature manufacturing procedures and a perfect quality management system so as to ensure stable and reliable quality of products.

3.1.3.3 Builders of ships and offshore installations as well as manufacturers of marine products are to use the welding consumables approved by CCS.

3.1.4 Maintenance of approval

3.1.4.1 Welding consumables which have been approved are to be subjected to annual inspection and tests so as to maintain the approval of the welding consumables.

3.1.4.2 Where any alteration to the manufacturing processes or procedures of the approved welding consumables is proposed by the manufacturer, CCS is to be notified of this alteration, and CCS will consider, according to the particular circumstances of such an alteration, whether the approval will be maintained or a new approval test is to be made.

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

(1) where the consumables fail to meet the requirements at the annual inspection and testing; or

(2) where the manufacturer fails to receive annual inspection and testing without acceptable reasons; or

(3) where the results of any random check indicate that the quality of the welding consumables is remarkably worse than that at the approval test.

3.1.5 Marking and instructions for use

3.1.5.1 Each box or package of welding consumables approved by CCS is to be clearly marked with CCS approval logo.

3.1.5.2 For the approved welding consumables, a copy of instructions for use, containing the storing, baking and welding parameters recommended by the manufacturer is to be attached to each package or box of the consumables."

Section 3　ELECTRODES FOR MANUAL ARC WELDING

Paragraph 3.3.9.5 is added as follows The new paragraph 3.3.9.5 is added as follows:

"3.3.9.5 Electrodes which have been approved by CCS are, in general, to be subjected to annual inspections and tests in the presence of the Surveyor."

Section 4　WIRE-FLUX COMBINATIONS FOR SUBMERGED ARC AUTOMATIC WELDING

Paragraph 3.4.5.1 is revised to The paragraph 3.4.5.1 is revised as follows:

"3.4.5.1Two butt weld test assemblies for the two-run technique are to be made respectively from a pair of plates of different thicknesses and having an appropriate strength level according to the grades of wire-flux combinations for which approval is required. The thicknesses of test plates are shown in Table 3.4.5.1. Each test plate is not to be less than 150 mm in width and of sufficient length to allow the cutting out of test specimens of the prescribed number and size.

Butt Weld Test Plate Thicknesses Required for Different Grades of Welding Consumables in Respect to Two-Run Technique　　Table 3.4.5.1

Grade of welding consumables	Thickness of thinner test plate (mm)	Thickness of thicker test plate (mm)
1,1Y	12~15	20~25
2,2Y,3,3Y,4Y, 2Y40,3Y40,4Y40	20~25①	30~35①

Note: ① A limitation of the approval to the medium range (up to the maximum welded plate thickness) may be agreed to by CCS. Test assemblies are then to be welded using plates of 12 to 15 mm and 20 to 25 mm irrespective of the grade for which the approval is requested. This is applicable to thicknesses up to 25 mm only."

The new paragraph 3.4.6.5 is added as follows:

"3.4.6.5 Wire-flux combinations which have been approved by CCS are, in general, to be subjected to annual inspections and tests in the presence of the Surveyor."

Section 5　WIRES AND WIRE-GAS COMBINATIONS FOR SEMI-AUTOMATIC AND AUTOMATIC WELDING

The new paragraph 3.5.2.4 is added as follows:

"3.5.2.4 Wires or wire-gas combinations approved for semi-automatic and automatic multi-run welding may be tested according to the requirements of 3.5.2.1 when semi-automatic and automatic multi-run welding are performed in the same conditions of welding current and energy, without additional tests for automatic multi-run welding."

The new paragraph 3.5.8.4 is added as follows:

"3.5.8.4 Wires and wire-gas combinations for semi-automatic and automatic welding which have been approved by CCS are, in general, to be subjected to annual inspections and tests in the presence of the Surveyor."

Section 6　CONSUMABLES FOR USE IN ELECTRO-SLAG OR

ELECTRO-GAS VERTICAL WELDING

The new paragraph 3.6.3.2 is added as follows:

"3.6.3.2 Consumables for use in electro-slag and electro-gas vertical welding which have been approved by CCS are, in general, to be subjected to annual inspections and tests in the presence of the Surveyor."

Section 7 CONSUMABLES FOR USE IN ONE-SIDE WELDING WITH TEMPORARY BACKING MATERIALS

The new paragraph 3.7.3.2 is added as follows:

"3.7.3.2 Consumables for use in one-side welding with temporary backing materials which have been approved by CCS are, in general, to be subjected to annual inspections and tests in the presence of the Surveyor."

CHAPTER 5   WELDING OF BOILERS AND PRESSURE VESSELS

Section 2   WELDING TEST OF BOILER AND PRESSURE VESSEL PRODUCTS

The paragraph 5.2.2.6 is revised as follows:

"5.2.2.6 If a batch of Class II boilers or pressure vessels is made by the same manufacturer using the same welding process and the variation of plate thickness is not more than 5 mm, one test assembly may be welded for each 35 m of length, with the thickness being equal to the thickness of the thickest shell plate, and at least one test assembly is to be welded for each batch."

CHAPTER 7 WELDING OF PRESSURE PIPES

Section 3 INSPECTION OF WELDING QUALITY

The paragraph 7.3.3 is revised as follows:

"**7.3.3 Non-destructive testing**

7.3.3.1 All butt joints of Class I pipes having an external diameter greater than 75 mm are to be subjected to radiographic or gammagraphic examination.

7.3.3.2 10% of butt joints of Class II pipes having an external diameter greater than 100 mm and Class I pipes having an external diameter equal to or less than 75 mm are to be subjected to radiographic or gammagraphic examination.

7.3.3.3 An approved ultrasonic testing procedure may be accepted in lieu of radiographic testing where the conditions are such that a comparable level of welding quality is assured.

7.3.3.4 Fillet welds on flange pipe connections of Class I pipes are to be examined by the magnetic particle method or by other appropriate non-destructive methods. For pipes of other classes, magnetic particle examination or equivalent non-destructive testing may be required for fillet welds depending upon the material, wall thickness and outside diameter of pipes and the nature of the medium being carried.

7.3.3.5 Ultrasonic examination in addition to the above non-destructive testing may be required in special cases.

7.3.3.6 Radiographic, gammagraphic and ultrasonic examinations are to be performed by Grade II operators certified by CCS, using an appropriate procedure. If necessary, complete details of the radiographic, gammagraphic and ultrasonic procedures are to be submitted for examination.

7.3.3.7 Magnetic particle examination is to be performed with suitable equipment and procedures, using a magnetic flux output sufficient for defect detection. If necessary, the equipment is to be checked against standard samples.

7.3.3.8 The welds are to meet an acceptable standard. Unacceptable defects are to be removed and repaired as required."

Section 4 is revised to The Section 4 is revised as follows:

"Section 4 HEAT TREATMENT

7.4.1 General requirements

7.4.1.1 According to different materials and processing conditions of pressure pipes, heat treatment after forming and welding may be required as necessary, in compliance with the requirements of this Section..

7.4.1.2 The heat treatment is not to impair the specified properties of the materials. Verifications may be required to this effect as necessary.

7.4.1.3 The heat treatment is in general to be carried out in a furnace provided with temperature recording equipment. However, localized heat treatment of a sufficient length with an approved procedure can be accepted for welded joints.

7.4.2Stress relieving heat treatment

7.4.2.1Steel pipes and fabricated branch pieces are to be subjected to stress relieving heat treatment in the following cases according to the requirements of Table 7.4.2.1:

(1) Cr-Mo and Cr-Mo-V pipes where hot forming is carried out in the temperature range of 850 ~ 1,000℃;

(2) cold bent pipes of all Classes, except for carbon and carbon-manganese pipes with tensile strength not greater than 410 N/mm^2;

(3) pipes are joined by arc welding.

Requirements of Stress Relieving Heat Treatment **Table 7.4.2.1**

Type of steel	Thickness of thicker part (mm)	Stress relief heat treatment temperature (℃)
Carbon steel and carbon manganese steel	≥15①③	550~620

0.3Mo	≥15①	580~640
1Cr0.5Mo	>8	620~680
2.25CrMo and 0.5Cr0.5Mo0.25V	All②	650~720

Notes: ① When steels with specified Charpy V notch impact properties at low temperatures are used, the thickness above which postweld heat treatment is to be applied may be increased by special agreement with CCS.

② Heat treatment may be omitted for pipes having thickness ≤ 8 mm, diameter ≤ 100 mm and minimum service temperature 450℃.

③ For C and C-Mn steels, heat treatment may be omitted up to 30 mm thickness by special agreement with CCS.

7.4.2.2 The stress relieving heat treatment is to heat and cool pipes slowly and uniformly, with the soaking time taken as one hour per 25 mm of thickness (at least 0.5 h). They are to be cooled in the furnace to a temperature not exceeding 400℃and subsequently cooling in a still atmosphere.

7.4.2.3 In any case, the heat treatment temperature is not to be greater than t_T-20℃ where t_T is the temperature of the final tempering treatment of the material.

7.4.3 Other heat treatments

7.4.3.1 Steel pipes and fabricated branch pieces of all Classes are to be subjected to a heat treatment of normalizing or normalizing and tempering in the following cases according to the requirements of Table 7.4.3.1:

(1) the hot forming is carried beyond the temperature range specified in 7.4.2.1(1);

(2) pipes are cold bent to a radius of less than 4 times the external pipe diameter;

(3) the oxy-acetylene welding procedure is employed.

Requirements of Heat Treatment for Different Types of Steel Table 7.4.3.1

Type of steel	**Heat treatment and temperature (℃)**
C and C-Mn	Normalizing 880~940
0.3Mo	Normalizing 900~940
1Cr0.5Mo	Normalizing 900~960 Tempering 640~720
2.25CrMo	Normalizing 900~960 Tempering 650~780
0.5Cr0.5Mo0.25V	Normalizing 930~980 Tempering 670~720

7.4.3.2 Copper and copper alloy pipes which have been hardened by cold bending are to be suitably heat treated on completion of fabrication and prior to hydraulic testing. Copper pipes are to be annealed and copper alloy pipes are to be either annealed or stress relief heat treated. Detailed requirements are to be determined in accordance with the chemical composition.”