CHINA CLASSIFICATION SOCIETY

RULES FOR CONSTRUCTION AND CLASSIFICATION OF SEA-GOING HIGH SPEED CRAFT

AMENDMENTS

2022

Effective from 1 July 2022

Beijing

CONTENTS

CHAPTER 1　GENERAL PROVISIONS

Section 1　China Classification Society and Its Main Services

1.1.4　Main services

1.1.4.1　The services of CCS are mainly as follows:

(1) Classification services for ships, offshore installations and related industrial products (including containers): development and maintenance of rules, plan approval, surveys and certification;

(2) Statutory services for ships, offshore installations and related industrial products, when so authorized: development of technical regulations for statutory surveys, plan approval, surveys and certification;

(3) Surveys and certification delegated by other ship survey organizations, surveys related to notarial matters and safety assessment as well as verification surveys and certification of ships and offshore installations , and investigation of major maritime safety accidents;

(4) Verification, surveys and certification of related industrial facilities and products used on land, and surveys and certification delegated by foreign ship survey organizations for marine facilities and products as well as related industrial facilities and products used on land;

(5) ISM audit and certification;

(6) ISPS audit and certification;

(7) Maritime Labor Convention (MLC) inspection and certification;

(8) Services for EU Regulations on the monitoring, reporting and verification (MRV) of CO_2 emissions from maritime transport and IMO Data collection system for fuel oil consumption of ships (DCS);

~~(7)~~(9) Survey and assessment of ship's technical conditions;

~~(8)~~(10) Certification of quality management systems and environmental management systems in accordance with ISO 9000 and ISO 14000 series or equivalent standards;

~~(9)~~(11) Technical research for classification of ships and offshore installations, safety on waters and environmental protection, survey of marine facilities and products as well as related industrial facilities and products used on land, and research on the application of information technology;

~~(10)~~(12) Other services.

Section 2　Council and Committees

1.2.3　Class committee

1.2.3.2　The Class Committee is entitled to:

(3) accept and confirm the reports submitted by CCS on assignment, suspension, cancel or reinstatement of ~~characters of classification and class notations~~ class of ships and offshore installations;

CHAPTER 2 SCOPE AND CONDITIONS OF CLASSIFICATION

Section 1 General Requirements

2.1.3 Definitions

2.1.3.1 Unless expressly provided otherwise, for the purpose of Rules for Construction and Classification of Sea-going High Speed Craft (hereinafter referred to as the Rules):

(44) Forward and after perpendicular: forward perpendicular means the perpendicular passing through the point of intersection of foreside of the stem and design waterline. After perpendicular means the perpendicular passing through the aft terminal of the Length *L*.

Section 2 Rules for Classification

2.2.1 Bases for classification

2.2.1.2 The rules and relevant applicable guidelines published by CCS are the basis and ~~sole~~ criteria for classification.

2.2.2 Rules development

2.2.2.2 The drafts of CCS rules or their amendments will be distributed to the Administration, ~~designers, shipbuilders and manufacturers, survey units, owners, research institutes and universities~~ CCS, shipping, shipbuilding, designers, universities, research institutes and relevant manufacturing industries related to ships and marine products for comments.

Section 3 Characters of Classification and Class Notations

2.3.2 Class notations

2.3.2.6 For high speed crafts of which the main hull structure is made of fiber reinforced plastic or aluminum alloy, class notations of “FRP” and “ALY” may be assigned respectively.

Section 4 Application and Fees

2.4.1 Application

2.4.1.2 The responsibilities of both parties, characters of classification and class notations, craft’s particulars, etc., are to be clearly specified in the application or contract/agreement. Submitting the application or signing the contract/agreement means that the applicant will have no objection that the representative(s) of third-party independent audit organizations, e.g. representative(s) of an Accredited Certification Body (ACB), IACS observer(s), etc., and the representative(s) of the European Commission (EC), representative(s) of the flag State, assessor(s) of the Entity for the Quality Assessment and Certification of Organizations Recognized by the European Union(QACE), IMO observer(s) and representative(s) of IACS QSCS (Quality System Certification Scheme) Advisory Committee (AVC), may visit onboard or a manufacturer or a shipyard to carry out an audit or an assessment as provided in Article 8(1) of EU Regulation No. 391/2009, and will facilitate such audit/assessment.

2.4.1.4 Applicants are to provide safe and appropriate survey conditions for the Surveyors to CCS, including the convenience for access to locations, workshops, manufactories and craft for carrying out timely and efficient surveys.

CCS has established an Occupational Health and Safety Management System for the purpose of guaranteeing the occupational health and safety of Surveyors. An application for any classification or statutory survey service by CCS means that the applicant respects this system of CCS and is committed to provide conditions for the safety of CCS Surveyors entering the facilities related to the requested survey service in accordance with the national requirements of the State of nationality of the Surveyor and the State where the survey unit is located and/or the technical safety requirements developed by the local competent authorities or equivalent technical standards①, including permanent or temporary means of access and facilities for inspections, compartment environment and safety precautions. CCS Surveyors will confirm the safety of survey conditions with the applicant and persons designated by him prior to performing specific surveys.

Section 5 Submission and Examination of Plans and Surveys

2.5.1 Examination of plans and documents

2.5.1.6 The term "Used for information" means that the plans and documents have been examined and only used as supporting information to the approval of other relevant plans and documents.

Section 6 Approval of Suppliers

2.6.3 List of approved suppliers

2.6.3.1 CCS publishes and maintains a list of suppliers② approved by CCS.

Section 7 Assignment, Maintenance, Suspension, Cancellation and Reinstatement of Class

2.7.2 Suspension and cancel of class

2.7.2.1 Suspension of class

(3)One of the following cases Under either of the following circumstances, the class will leadbe subject tosuspension of the class and invalidation of the classification certificate a suspension procedure, unless the craft is attended by the Surveyor for completion of the overdue surveys:

⑤ when the laying-up maintenance programme agreed by CCS has not been implemented or the laying-up survey has not been performed within the specified time limit during the laying-up period of the ship.

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① Refer to CCS Guidelines for Safety of Survey Locations.
② CCS List of Suppliers is available at https://www.ccs.org.cn.

Section 8 Certificates and Reports

2.8.1 Certificates

~~2.8.1.2 The equipment record attached to the classification certificate is part of the classification certificate.~~

2.8.1.~~3~~2 The classification certificates and related reports are to be issued by CCS independently. The validity, applicability and interpretations of the classification certificate issued based on contracts/agreements are only to be in accordance with CCS rules, and CCS reserves one and only judgment.

2.8.1.~~4~~3 The classification certificate is to contain the terms and conditions as agreed between both parties.

2.8.2 Duration and validity of certificates

~~2.8.2.2 The period of validity of interim classification certificates is not to exceed 5 months.~~

2.8.2.~~3~~2 The period of validity of classification certificates is to be harmonized with that of statutory certificates of the craft as possible.

2.8.2.3 When the special survey is completed within three months before the expiry date of the existing certificate, the new classification certificate is to be valid to a date not exceeding five years from the date of expiry of the existing certificate.

2.8.3 Issue and endorsement of classification certificates

~~2.8.3.1 An interim classification certificate is to be issued by the survey unit on completion of initial surveys.~~

2.8.3.~~2~~1 Upon ~~issue of an interim classification certificate~~completion of classification surveys, the survey unit is to ~~submit the interim~~issue the classification certificate together with records, reports and other technical documents to the related department of CCS Headquarters for review and then submitted by the department to the Class Committee and upon approval by the Committee, ~~a classification certificate will be issued~~the classification of a ship will be finally confirmed by the President of CCS or person(s) authorized by him.

2.8.3.~~3~~2 The classification certificates are to be endorsed by the Surveyor(s) as required after completion of the survey after construction as specified in Section 4, Chapter 3 of the Rules.

2.8.3.~~4~~3 Where a new classification certificate cannot be issued before the expiry date of the existing classification certificates after completion of the special survey, the existing classification certificate may be endorsed by the Surveyor, which is to be valid within 5 months from its expiry date.

2.8.3.~~5~~4 Upon completion of the special survey, the survey unit is to submit a report and other technical documents to the related department of CCS Headquarters or another designated survey unit for review, and after satisfactory review, a new classification certificate will be issued by the President of CCS or person(s) authorized by him.

Section 9 REGISTER OF SHIPS AND LISTS OF APPROVED MARINE PRODUCTS[①]

2.9.1 Register of ships

2.9.1.1 CCS will enter main characteristic particulars and details of all ships classed with CCS, after they are assigned characters of classification and class notations, into CCS Register of Ships periodically published byto provide information for those related to ships, such as builders, owners, underwriters, shippers and charterers.

2.9.1.2 Subsequently, in case changes concerning ships or their characteristic particulars are made, CCS will publish renewed editions ofrenew the Register of Ships or supplements thereto in time.

2.9.2 Lists of approved marine products

2.9.2.1 CCS will enter the names, main characteristic particulars and details of related products as well as detailed information on their manufacturers in respect to those factories and plants and their marine products approved by CCS into CCS Lists of Approved Marine Products periodically published byto provide information for ship-designing institutes, builders, owners, traders and exporters.

2.9.2.2 Subsequently, in case changes concerning performance of the approved products are made or their scope is extended, CCS will publish renewedrenew the Lists of Approved Marine Products or supplements thereto in time.

Section 10 Liability, Disagreement and Arbitration

2.10.1 Liability of each party

2.10.1.9 CCS does not promise the safety of life and property at sea and the seaworthiness of ships, because CCS is not the principal part operating and maintaining the ship between surveys.

2.10.1.10 Shipowners have the obligation to maintain the validity of classification and statutory certificates.

Section 13 Audit

2.13.1 Vertical contract audit

2.13.1.1 The owners, shipyards and marine product manufactories concerned are to assist the IACS quality system auditor(s) or the representative(s) of the Government of the flag State in their vertical contract audit of CCS so as to facilitate their work.

2.13.1.2 Where the auditor(s) or the representative(s) request access to relevant information during the audit, the owners, shipyards and manufacturers concerned are to make such information available to them provided that it is ensured that they will not in any form reproduce such information or transmit it to any other party.

① Register of ships and lists of approved marine products are available at https://www.ccs.org.cn.

CHAPTER 3 MARINE PRODUCTS INSPECTIONS AND CRAFT'S SURVEYS

Section 4 Surveys after Construction

3.4.2 Type and interval of surveys

3.4.2.3 Examinations of the outside of the craft's bottom (hereinafter referred to as docking surveys)

(1) ~~Docking surveys of high speed craft are to be carried out once a year, and within 3 months before or after the due date of the docking survey. The next survey is to be dated from the craft's undocking date. If an up-to-slipway examination of the outside of the craft's bottom is carried out, the next survey is to be dated from the date of completion of the examination. The docking survey may be carried out in conjunction with an annual survey.~~

Docking surveys or up-to-slipway examination of the outside of the high speed craft's bottom are to be carried out within three months before or after each anniversary date of the Certificate in conjunction with an annual survey.

CHAPTER 4 STRUCTURE OF HULL

Section 3 Watertight Integrity and Tests

4.3.3 Other requirements of external openings, including doors, windows and covers, etc.

4.3.3.2 Windows

(6) Rectangle windows are permitted to be fitted in walls of the spaces above the freeboard deck except in front wall of first tier superstructure or deckhouse for craft navigating in open sea and greater coastal service restriction (if side scuttles are fitted, requirements of above (5) are to be met), but they are to be fitted with portable deadlights according to Table 4.3.3.2. The deadlights are to be made of metal or composite material, the strength of which is to be the same as their surrounding structure, and to be stowed in such a way as to provide quick mounting.

Table 4.3.3.2

Service restriction	Number of deadlights/Number of windows	
	The front of the 1st tier superstructure or deckhouse	The side of the 1st tier superstructure or deckhouse The front of the 2nd tier superstructure or deckhouse
OSSR	No permission	One for each type of windows
GCSR	No permission	
CSR	50%	One for each type of windows①
SWSR	25%	
CWSR	—	

Note: ① If impracticable, other measures (e.g. provision of canvas) may be adopted to prevent windows from being damaged and protect personnel from wind and wave.

Section 4 Design Loads

4.4.1 Vertical acceleration at center of gravity of a craft

~~4.4.1.5 According to a pair of $H_{1/3i}$, V_{Hi} specified in 4.4.1.3 and 4.4.1.4, the corresponding vertical acceleration a_{cgi} could be calculated according to the formula in 4.4.1.2. Where the calculated value a_{cgi} is more than 1.0 g, the design unit may take $a_{cgi} \leq 1.0$ g (for passenger craft) and $a_{cgi} \leq 1.2$ g (for cargo craft) as the design vertical acceleration. However the speed V_{Hi} is to be reduced until the acceleration a_{cgi} is not to be more than that obtained according to the formula in 4.4.1.2.~~

~~4.4.1.6 The maximum vertical acceleration of a series of a_{cgi} determined by 4.4.1.5 is to be taken as the design vertical acceleration at center of gravity.~~

4.4.1.~~7~~5 The design value of vertical acceleration at gravity center of a craft, generally not to be greater than 1.2g, is to be ~~finally~~ determined by the design unit or the owner. According to a series of $H_{1/3}$ ~ V_H corresponding to the design vertical acceleration calculated from the formula in 4.4.1.2, the "Speed Limit Curve during Navigating in Wave" is to be drawn and submitted to CCS for approval, and the signalboard is to be fixed in the navigation room. When the craft is navigating, its speed must be limited according to the significant wave height obtained by visual estimation at that time.

4.4.2 Slamming pressure on bottom

4.4.2.2 The slamming pressure P_{sl1} on bottom is to be taken according to the data obtained from model test or full-scale test. If there is no test or measurement information, P_{sl1} is to be taken as:

$$P_{sl1} = 1.16 K_{l1} \left(\frac{\Delta}{nA} \right)^{0.3} \frac{50 - \beta_x}{50 - \beta} a_{cg} d_w^{0.7} \quad \text{kN/m}^2$$

where: K_{l1} – longitudinal distribution factor,

K_{l1} = 1 for forward amidcraft;

K_{l1} = 0.5 for stern;

from stern to midcraft: K_{l1} is to be obtained by linear interpolation;

A –design load area for slamming pressure, in m^2;

for plate panels, A is usually not to be taken greater than $2.5S^2$;

for stiffeners and girders, A is to be taken as the product of spacing × span;

but for plate panels and frames, A is to be in no way less than $0.002\Delta/d$.

n – number of hull, n = 1 for monohull craft and trimaran; n = 2 for various catamarans (including SES);

β – deadrise angle at LCG (°), see 4.4.1.2 (1);

β_x – deadrise angle at calculated transverse section (°), $\beta_{x\,max}$ = 30°; $\beta_{x\,min}$ = 10°;

d_w – slamming draught while a craft navigates in wave, $d_w = cd$, in m;

a_{cg}– vertical acceleration at center of gravity, in m/s^2, to be taken according to 4.4.1.2(1);

where: d is the draught of craft in fully loaded condition with no lift or propulsion machinery active.

c = 1.0 for monohull, normal catamaran and various catamarans and trimaranswave piercer craft,

c = 0.75 for SES.

4.4.3 Slamming pressure on cross deck bottom

4.4.3.2 The slamming pressure P_{sl2} specified in 4.4.3.1 may be determined by the data obtained from model test or full scale test, and if no test data, it is to be taken as:

$$P_{sl2} = K_{l2} \left(\frac{\Delta}{A} \right)^{0.3} a_{cg} \left(1 - \frac{H_{tx}}{C_1 C_2 L} \right) \text{ kN/m}^2$$

P_{sl2} is to be taken not less than the side pressure obtained according to 4.4.4.1.

where: K_{l2} – longitudinal distribution factor, to be taken as:

K_{l2} = 1.3 for aft of amidcraft;

within L/3 from F.P.:

K_{l2} = 2.6 for wave-piercing catamaran and, normal catamaran and trimaran;

K_{l2} = 2.1 for SES and ACV;

K_{l2} = 1.3 for hydrofoil craft;

within L/6 forward of amidcraft: K_{l2} is to be obtained by linear interpolation;

A – design load area for slamming pressure, in m^2, the same as 4.4.2.2;

C_1 – coefficient, to be taken as:

$C_1 = 0.066 - 0.000175L$.

C_2 – coefficient, to be taken as:

$C_2 = 0.5X/L + 1$ if $X/L \le 0.5$

$C_2 = 0.5(X/L - 0.5) + 1$ if $X/L > 0.5$

X - distance from point for pressure calculation of cross deck bottom to after perpendicular, in m;

H_{tx} –vertical distance from point for pressure calculation of cross deck bottom to design waterline, in m, $H_{tx\,max}$ = ~~CL~~C_1C_2L;

a_{cg}– vertical acceleration at center of gravity, in m/s^2, see 4.4.1.2(1) and 4.4.1.2(2).

4.4.4 Pressure on craft's side, deck, superstructure and bulkhead

4.4.4.1 Pressure P_i acting on side is to be taken as:

$$P_i = 9.81h + 0.15P_{sl} \quad \text{kN/m}^2$$

where: h – vertical distance from the load point to ~~upper deck~~freeboard deck, in m, which is not to be less than 0.8 m, but not more than 0.8 times the extent of side;

P_{sl}– slamming pressure on bottom in the same frame, in kN/m^2:

$P_{sl} = P_{sl2}$ for ACV and hydrofoil craft (see 4.4.3.2);

$P_{sl} = P_{sl1}$ for other craft (see 4.4.2.2).

Where the angle of forebody side flare at the considered point of trimaran is more than 22°, the pressure P_i is to be determined by the following formula:

$$P_i = 9.81h + K_h[64.6 - 0.95(90 - \alpha)]H_{1/3} \quad \text{kN/m}^2$$

where: h — vertical distance, in m, from the considered load point to ~~upper deck~~freeboard deck, not less than 0.8 m, nor more than 0.8 times the height at side;

α — angle, in degrees, between vertical line and tangent of the transverse section line at the considered point;

k_h — coefficient, determined according to the longitudinal position of the considered point as follows:

$k_h = 0.85$ from $0.5L$ to $0.75L$;

$k_h = 2.0$ $0.85L$;

$k_h = 2.5$ from $0.95\,L$ to L;

For other area, k is to be obtained by linear interpolation;

$H_{1/3}$ — design significant wave height relating to service restriction area, in m, see 4.4.1.3.

4.4.4.2 Pressure P_{d1} acting on exposed freeboard deck is to be taken as:

$$P_{d1} = K_{l3}(0.2L + C) \quad \text{kN/m}^2$$

where: K_{l3} – longitudinal pressure distribution factor:

$K_{l3} = 1.0$ for forward of amidcraft,

$K_{l3} = 0.75$ for stern,

factors between midcraft and stern is to be obtained by linear interpolation;

C – service restriction coefficient:

$C = 10.6$ for OSSR,

$C = 7.6$ for GCSR and CSR,

$C = 4.6$ for SWSR and CWSR.

4.4.4.3 Pressure P_{d2} acting on unexposed freeboard deck, ~~un~~exposed deck of first tier superstructure/deckhouse and inner deck contributing to global strength is to be taken as:

$$P_{d2} = 0.1L + 4.6 \quad \text{kN/m}^2$$

4.4.4.6 Pressure P_{sd} acting on superstructures and deckhouses

(1) Pressure acting on end and side walls of superstructure and deckhouse is to be taken as:

$$P_{sd} = 8.52K_1K_2(CL + 0.8 - 0.3h) \quad \text{kN/m}^2$$

where: K_1 – location factor, to be taken as follows:

K_1 = 1.0 for fore end wall of first tier superstructure;

K_1 = 0.75 for fore end wall of second tier and above superstructure;

K_1 = ~~0.5~~0.6 for side and aft end walls of superstructure and deckhouse.

K_2 – location factor, obtained according to the location of superstructure and deckhouse:

K_2 = 1.0 for area of ~~forward amidcraft~~forward perpendicular;

K_2 = ~~0.75~~0.7 for area of aft amidcraft~~.~~;

Other locations are to be determined by liner interpolation.

C – service restriction coefficient:

C = 0.058 for OSSR;

C = 0.047 for GCSR and CSR;

C = 0.035 for SWSR;

C = 0.024 for CWSR.

h – vertical distance from load point to full load water line, in m. For ACV, h is to be vertical distance from load point to skirt base line.

(2) Pressure P_{sd} acting on open top of superstructure and deckhouse is not to be less than 4 kN/m^2, but the pressure P_{sd} acting on top of first tier superstructure or deckhouse forward of amidcraft is not to be less than 6.6 kN/m^2. For exposed deck other than those specified in 4.4.4.2 and 4.4.4.3, the requirements of this paragraph will be implemented.

(3) Minimum pressure of fore end wall of the first tier superstructure is not to be less than the pressure of exposed deck forward amidcraft in the formula of 4.4.4.2. Minimum pressure of other end and side walls of superstructure and deckhouse is not to be less than 4 kN/m^2.

Section 5 Scantlings of Hull Structure Made of Aluminum or Steel

4.5.1 General requirements

4.5.1.3 Symbols

t – Rule thickness of plating, in mm;

W— Rule section modulus (including effective plate flange), in cm^3. The effective breadth b_e of the attached plate is to be taken as:

For secondary member, $b_e = s$;

For primary member, $b_e = 0.3s\left(\frac{l}{s}\right)^{2/3}$, but not greater than $l/5$;

When the member web is not vertical to attached plate and angle α between web and attached plate is less than 75°, the actual section modulus may be determined according to the following formula:

$W = W_0 \sin\alpha$, in cm^3, where:

W_0— section modulus, assuming web is vertical to attached plate, in cm^3;

σ_s – yield strength of material, in N/mm^2:

$\sigma_s = \sigma_{p0.2}$ for aluminum alloy, see the relevant requirements of CCS Rules for Materials and Welding;

for steel, see the relevant requirements of CCS Rules for Materials and Welding;

σ_{sw} – yield strength of material in welded condition, in N/mm^2:

$\sigma_{p0.2}$ is to be taken as the yield stress of the material in annealed condition for aluminum, see the relevant requirements of CCS Rules for Materials and Welding (for aluminum alloy material supplied not in annealed condition, yield strength of the material in welded condition may be determined by welding test);

$\sigma_{sw} = \sigma_s$ for steel.

4.5.2 Minimum scantlings

4.5.2.1 Minimum thickness t_{min} of plating is to be taken as follows:

$$t_{min} = \frac{k_0 k_1 \sqrt[3]{L}}{\sqrt{\sigma_s}} + 1.5 \quad \text{mm}$$

where: K_0 — coefficient, obtained from Table 4.5.2.1. For trimaran, the value of strength deck contributing to longitudinal strength is to be taken as that of main deck plating;

K_1 — coefficient, $K_1 = s/s_b$, to be taken as not less than 0.5 nor greater than 1.0;

S — spacing of members, in m;

s_b — standard spacing of members, in m, $s_b = 0.0016L + 0.2$;

L — craft length, in m;

σ_s — yield strength of material, in N/mm^2, see 4.5.1.3 of this Section. For aluminum alloy, it is to be taken as not greater than 70% of tensile strength.

The minimum thickness of plate keel for monohull, catamarans and trimarans is to be increased by 2 mm over the above value. The width of plate keel is not to be less than 0.1B (for catamarans, B is the maximum molded width of one hull; for trimarans, B is the maximum molded width of main hull). Where it is impracticable for the bottom structure to be fitted with plate keel, other equivalent structures may be used as substitution.

Coefficient K_0 **Table 4.5.2.1**

Item			k_0	
			Steel	Aluminum
Bottom			12	15
Cross deck bottom			11	12
Side (up to 0.15 m above design waterline)			12	12
Side (more than 0.15 m above design waterline)			11	12
Main deck forward amidcraft			9	10
Main deck aft amidcraft			7	~~9~~8
Unexposed deck plate			6	6
Collision bulkhead plate			8.5	~~11~~10
Liquid tank bulkhead plate			8.5	9
Watertight bulkhead plate			8.5	8
Superstructure and deckhouse	Front	First tier	6.5	6.5
		Second tier	6.5	6.5
		Third tier and above	4	4
	Side, behind	First tier	5.5	5.5
		Second tier	2.5	2.5
		Third tier and above	2.5	2.5
	Top		3	2
	First tier exposed deck forward amidcraft		3	3
	First tier exposed deck aft amidcraft		3	2

The minimum plate thickness of main engine foundation (including face plate and web plate) of any type of high speed craft is to be calculated by $t_{min} = 1.9\sqrt[3]{L}$.

For craft with round chine, the bilge plating is divided by the point of intersection of the deadrise line β and round chine line (see Fig 4.4.1.2 (1)), the portion above the point is considered as the side plating, and the portion below the point is considered as the bottom plating.

4.5.2.2 Built-up sections of bottom, including engine seating, is to comply with the following requirements.

(1) The minimum thickness t_{min} of the face plate is to be taken as:

$$t_{min} = \frac{b}{12} \quad \text{mm} \quad \text{for aluminum alloy}$$

$$t_{min} = \frac{b}{15} \quad \text{mm} \quad \text{for steel}$$

where: b – face plate width, in mm.

(2) The minimum thickness t_{min} of the web is to be taken as:

$$t_{min} = \frac{h}{50} \quad \text{mm} \quad \text{for aluminum alloy}$$

$$t_{min} = \frac{h}{70} \quad \text{mm} \quad \text{for steel}$$

where: h – ~~web depth~~length of shorter side of upper panel on the web, in mm.

The thickness of web stiffener is generally not less than that of the web of built-up section and its width is generally not less than 8 times its thickness and not greater than 0.5 times the width of the face plate of the built-up section (for flanged section, the width is not to be greater than that of the face plate).

4.5.3 Bending strength for aluminum alloy structure

4.5.3.2 Stiffeners and frames

The section modulus W of stiffeners and frames is not to be less than:

$$W = K\frac{l^2 sP}{\sigma_{sw}} \quad \text{cm}^3$$

(1) K is to be obtained from Table 4.5.3.1.

(2) The yield strength σ_{sw} in welded condition is to be taken for all longitudinals except bulkhead stiffeners.

(3) The yield strength σ_s of the material may be taken as in the above formula for all girders, web frames and web beams, except for hull bottom and cross deck bottom.

(4) $\sigma_{sw} = 0.9\,\sigma_s$ for riveting structure.

Coefficient *K* **Table 4.5.3.1**

Location \ Item	Plating	Secondary members			Primary members
		Longitudinal	Transverse, frame, floor	~~Vertical~~ ~~s~~Stiffener	Girder, web frame, plate floor, web beam
Bottom, cross deck bottom	25.0	115	135		135
Side	25.8	130	150		150
Deck (including superstructure & deckhouse top)	27.8	130	150		150
Superstructure & deckhouse front	25.8			170	150
Superstructure & deckhouse side, behind	25.8			150	~~150~~140
Collision & liquid tank bulkheads	25.8			130	150
Watertight bulkhead	23.4			120	150

4.5.4 Bending strength for steel structure

4.5.4.2 Stiffeners and frames:

The section modulus W of stiffeners and frames is not to be less than:

$$W = K_2\frac{l^2 sP}{\sigma_s} \quad \text{cm}^3$$

where: K_2 – coefficient, obtained from Table 4.5.4.2.

Coefficient K_2 **Table 4.5.4.2**

Location	Secondary members			Primary members
	longitudinal	transverse, frame, floor	~~vertical~~ stiffener	girder, web frame, plate floor, web beam
Bottom, cross deck bottom	136	150		135
Side	128	150		150
Deck (incl. superstructure/ deckhouse top)	Deck*: 212/128 Superstructure/deckhouse top: 150	150		150
Superstructure/deckhouse front, side			150	150
Superstructure/deckhouse behind			150	150
Collision & liquid tank bulkheads			150	150
Watertight bulkhead			109	109

* Where the actual midsection modulus in way of the deck is equal to rules midsection modulus, K_2 is to be taken as 212; where the midsection modulus in way is equal to or greater than 2 times rules value, K_2 is to be taken as 128; intermediate values are to be obtained by linear interpolation.

Section 7 Vehicle Deck, Ramp and Propeller Shaft Brackets

4.7.1 Vehicle deck

4.7.1.1 Symbols

t – Rule thickness of plating, in mm;

W – Rule section modulus, including effective plate flange, in cm^3, the same as 4.5.1.3;

σ_s – yield strength of material, in N/mm^2,

$\sigma_s = \sigma_{p0.2}$ for aluminum alloy, see the relevant requirements of CCS Rules for Materials and Welding; for steel, see the relevant requirements of CCS Rules for Materials and Welding;

σ_{sw} – yield stress of material in welded condition, in N/mm^2, $\sigma_{sw} = \sigma_s$ for steel;

$\sigma_{P0.2}$ is to be taken as the yield stress of the material in annealed condition for aluminum, see the relevant requirements of CCS Rules for Materials and Welding (for aluminum alloy material supplied not in annealed condition, yield strength of the material in welded condition may be determined by welding test);

s – calculated spacing of beams or longitudinals, in m;

l – calculated span of beams or longitudinals, in m.

Section 8 Hull Girder Strength

4.8.3 The longitudinal bending moment in displacing navigating condition

4.8.3.1 The hogging bending moment and sagging bending moment are to be determined respectively by the sum of still water bending moment and wave bending moment.

~~4.8.3.2 When calculating the wave bending moment, it is assumed that the length of wave equals the craft length and the maximum (significant value) wave height of the service restriction of the craft is to be taken.~~

4.8.3.2 For still water bending moment taken for check, the maximum value of still water bending moment may be determined according to the loading condition specified in 4.8.1.6.

4.8.3.3 The wave bending moment taken for check may be determined by direct calculation of wave loads:

(1) loading conditions are determined according to 4.8.1.6;

(2) long-term prediction for linear wave bending moment is to be carried out according to 1.5.7.2 and 1.5.7.3 of Section 5, Chapter 1, PART TWO of Rules for Classification of Sea-Going Steel Ships, and wave scatter diagram of IACS Rec.34 is taken for wave information with the probability level taken as 10^{-8};

(3) wave bending moment is to be calculated as follows:

$$M_W = C_1 C_2 M_L \quad \text{kN·m}$$

where: C_1 — correction factor for service:

$C_1 = 0.9$	open sea service restriction
$C_1 = 0.8$	greater coastal service restriction
$C_1 = 0.7$	coastal service restriction
$C_1 = 0.6$	sheltered water service restriction
$C_1 = 0.4$	calm water service restriction

C_2 — correction factor for bending moment, calculated as follows:

$C_2 = 1.495 - 0.431C_b$	for sagging
$C_2 = 0.505 + 0.431C_b$	for hogging

M_L — long-term prediction value for linear wave bending moment, in kN·m.

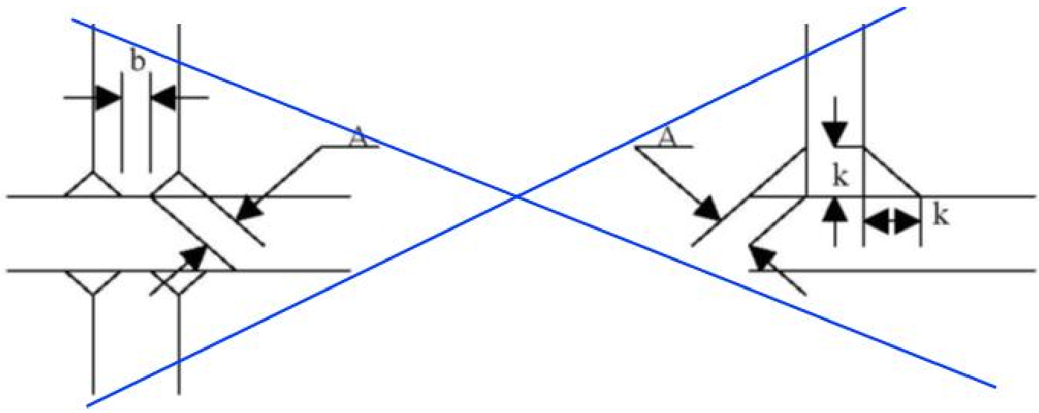
4.8.3.34 For high speed monohull craft with Froude number ($Fn = v/\sqrt{gL}$)less than 0.80, the check of longitudinal midcraft bending moment in displacing navigating condition may be exempted.

Section 12 Weld Design for Metal Hull Structures

4.12.3.2 Where full penetration welds are are welded, plates with thickness under 5 mm may be welded ungrooved; plates with thickness over 8 mm are to be groove welded with a groove angle of generally 60° to 90°, the root face to be 1.5 to 3 mm and the gap to be 0 to 4 mm.Where plates of different thickness are to be butt welded and the difference in thickness is equal to or greater than 4 mm, the edge of the thicker plate is to be tapered so as to ensure a uniform transition. The width of taper is not to be less than 3 times the difference in thickness. Where the difference in thickness is less than 4 mm, the transition may be achieved within the width of the weld.

4.12.5 Design of fillet welds

4.12.5.1 Fillet welds may be of T shape or cross shape joints, and are generally to be the double side welds (as shown in Figure 4.12.5.1(a)). These two joint types may be sub-divided into double side continuous welding, double side intermittent welding and staggered intermittent welding (as shown in Figure 4.12.5.1(b)).



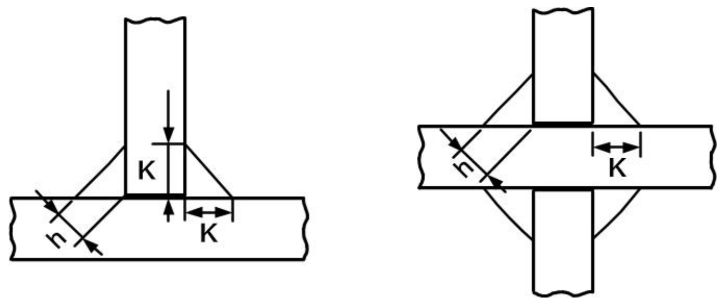
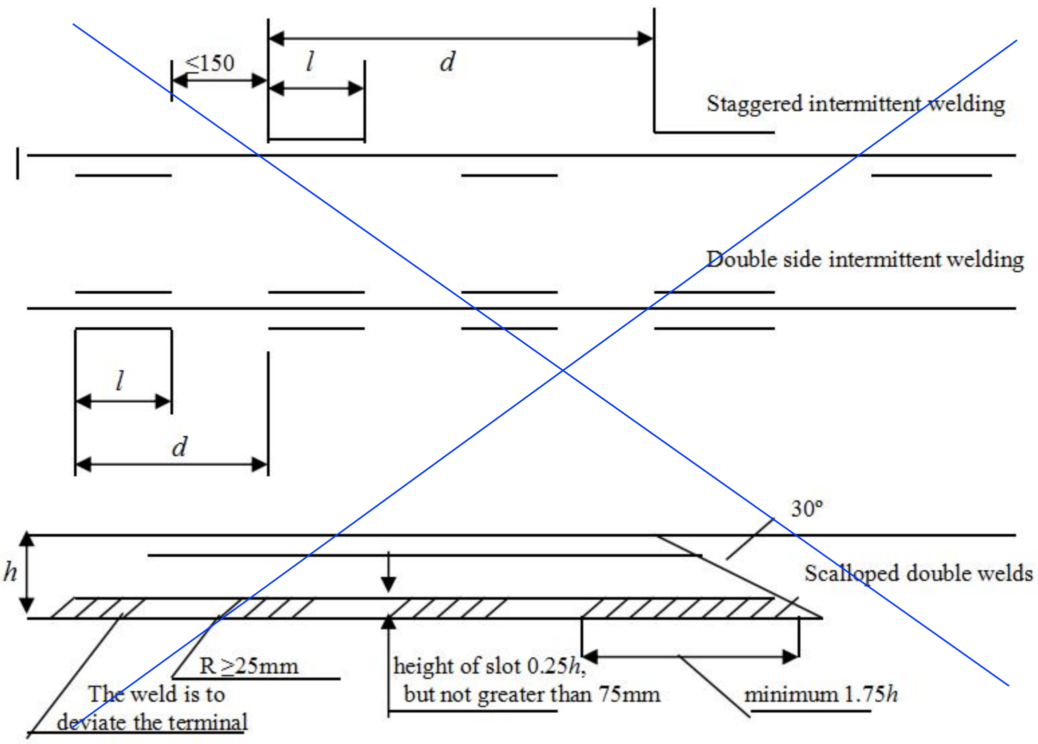


Figure 4.12.5.1 (a)



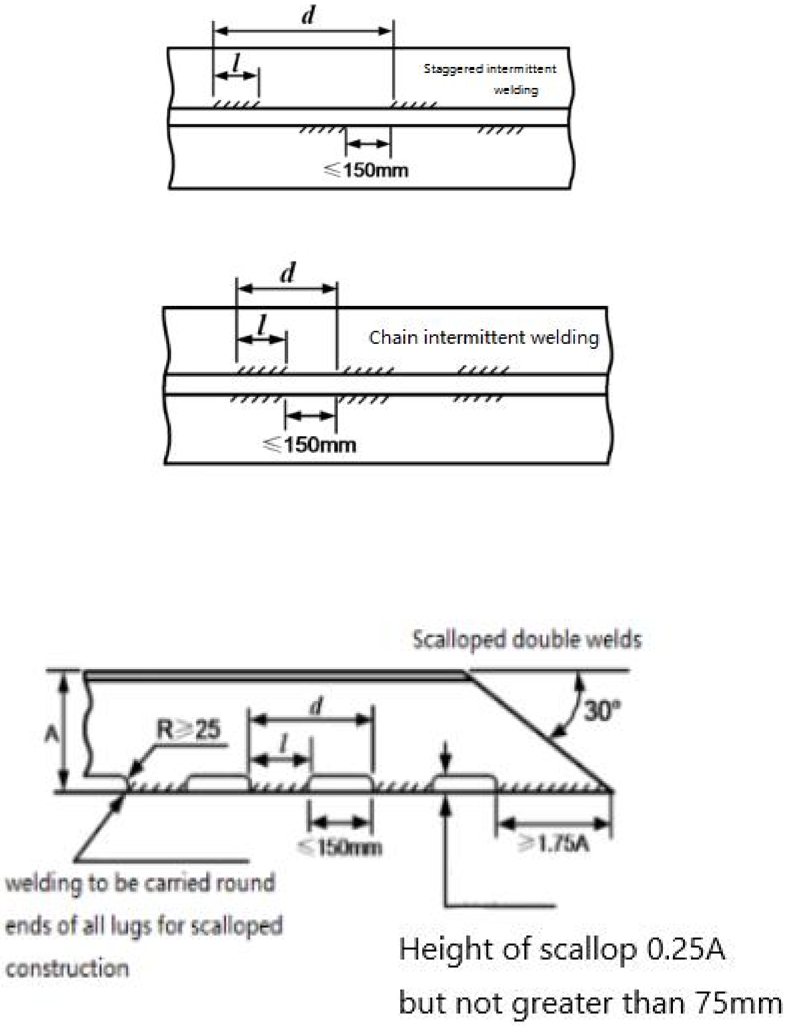


Figure 4.12.5.1 (b)

4.12.5.2 For fillet welds subject to high stress level, ~~deep~~partial penetration welding (as shown in Figure 4.12.5.2) with vertical beveled plate may be used, ~~or even~~ the full penetration double side welding is to be used in high stress areas. For fillet welds subject to ~~medium~~ stress level which is not high, chain intermittent welding or staggered intermittent welding may be allowed. The application of single side fillet welding is to be subject to agreement of CCS.

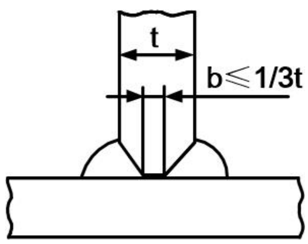


Figure 4.12.5.2

4.12.6 Design of slot welds

4.12.6.1 For the connection of plating to internal webs, where access for fillet welding is not practicable, the closing plating (aluminum) is to be attached by continuous full penetration welds or slot fillet welds to face plates fitted to the webs. Slots are to have a minimum length of 75 mm and a minimum width of twice the plating thickness, with well rounded ends, and spaced not more than 150 mm apart.

Section 14 Supplementary Requirements for Aluminum Alloy Stiffened Plates

4.14.3 Secondary members

4.14.3.1 The moment of inertia I of stiffened plate member is not to be less than the value calculated by the following formula:

$$~~I = 0.012Kl^2sP~~ \qquad I = 0.012Kl^3sP \qquad \text{cm}^4$$

where:

K — see Table 4.5.3.1.

CHAPTER 5　EQUIPMENT AND OUTFITS

Section 1　Rudders

5.1.3　Rudder stock

5.1.3.3　The diameter D_1 of the rudder stock at the lower bearing and the diameter D~~$_1$~~$_2$ of the rudder stock ~~at the upper bearing~~required for transmitting rudder stock torque may be respectively calculated by the following formulae:

$$D_1 = 42 \times \sqrt[6]{1 + \frac{4}{3}\left(\frac{M_B}{M_T}\right)^2} \times \sqrt[3]{\frac{M_T}{f_1}} \quad \text{mm}$$

$$D_2 = 42 \times \sqrt[3]{\frac{M_T}{f_1}} \quad \text{mm}$$

The above-mentioned formulae are also applicable to rudder stock of flat plate rudder.

5.1.6　Connection of rudder stock and rudder blade of steam-lined rudder

5.1.6.2　Where the rudder stock and the rudder blade are connected by nut and key with cone coupling:

(3) The design yield torque of rudder stock M_{TS} is to be calculated by the following formula:

$$M_{TS} = 26.64 D_2^3 f_1 \times 10^{-6} \quad \text{kN·m}$$

where: D_2 – diameter of rudder stock ~~at upper bearing~~ obtained from 5.1.3.3, in mm, where the practical diameter of the stock is greater than D_2, the practical diameter is to be taken, but not more than 1.15 D_2;

f_1 – material factor of rudder stock.

5.1.8　Bearings

5.1.8.1　The load area of bearing liner $A_b = D_{11} h_b$. The area is to comply with the requirement of the following formula:

$$A_b \geqslant \frac{P}{[P]} \times 10^6 \quad \text{mm}^2$$

where: D_{11} – diameter of rudder stock at liners, in mm;

h_b – height of touching surface of bearing liner, in mm;

P – reaction force at the bearing, in kN.

The reaction force P at upper and lower bearings may be taken as given in the following:

$$P = \frac{M_B}{l_3} \quad \text{kN, at upper bearing;}$$

$$P = F + \frac{M_B}{l_3} \quad \text{kN, at lower bearing.}$$

where: M_B – bending moment acting on the stock, in kN·m, it may be obtained from the formula in 5.1.3.2;

l_3 – distance between upper bearing liner center and lower bearing liner center, in m, see Figure 5.1.2.1;

F – rudder force acting on the stock, in kN, it may be obtained from the formula in 5.1.2;

$[P]$ – maximum allowable surface pressure for various bearings, in kN/m^2, it is dependent on the materials of the stock and bearing liner as follows:

[P] = 7000 kN/m^2 for steel against stainless steel or bronze;

[P] = 4500 kN/m^2 for steel against white metal, oil lubricated;

[P] = 5500 kN/m^2 for steel against synthetic material with hardness① between 60 and 70 Shore D, water lubricated;

[P] = 2500 kN/m^2 for steel or bronze against lignum vitae.

5.1.8.4 With metal bearings, clearances are not to be less than d_{bl} / 1000 + 1.0 mm on the diameter, where d_{bl} is inner diameter of bushing. The bearing clearance of non-metallic bearing material is to be specially determined considering the material's swelling and thermal expansion properties, normally not less than $2 \times d_{bl}$ / 1000 + 1.0mm, where d_{bl} is inner diameter of bearing liner. If smaller clearance is used to maintain watertightness, bearings manufactured according to the standards accepted by CCS are to be used or the approval by CCS is to be obtained. 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.

5.1.9 Connection of rudder tiller to stock

5.1.9.1 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 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 of the stock calculated according to 5.1.6.2(3) of this Section.

5.1.9.2 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.

5.1.9.3 For torque transmission by friction and key together, at least 50% of the torque is to be transmitted by friction.

5.1.9.4 For torque transmission by key, the shear area As of the key is not to be less than that obtained from the following formula:

$$A_s = \frac{70 M_{TS}}{D_s \sigma_s} \times 10^3 \quad \text{cm}^2$$

where: M_{TS} — torque transmitted by key, in kN • m;

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

σ_S — yield strength, in N/mm^2, of key material.

The compressed area of key is not to be less than 0.3 times shear area of key. Where two keys are fitted, the shear area and compressed area of each key may be taken as 2/3 of the value obtained for one key.

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

CHAPTER 6 MACHINERY INSTALLATIONS

Section 4 Craft's Piping and Ventilating Systems

6.4.2 Craft-side valves and fittings (other than those on scuppers and sanitary discharges)

6.4.2.1 All sea inlet and overboard discharge pipes are to be fitted with valves or cocks secured direct to the shell plating, or to the plating of fabricated ~~steel~~ sea chests attached to the shell plating. The valves or cocks are to be secured by means of studs screwed into but not penetrating through the pads ~~welded on~~attached to the shell plating or sea chests.

6.4.2.2 If impractical, the valves or cocks mentioned in 6.4.2.1 may also be secured to the distance piece ~~welded~~attached to the shell plating. The wall thickness and diameter of the distance piece are to be so chosen that the distance piece can reach equivalent strength of adjacent hull structure, and the corrosion-resistance capability of the material for the distance piece is also to be considered.

6.4.3 Bilge pumping system

6.4.3.25 The bilge pump complying with the following requirements is to be provided for each hull of multi-hull craft or each monohull craft fitted with bilge main line:

(1) at least two bilge pumps are to be provided, one of them may be engine driven pump;

(2) all bilge pumps are to be driven by power and at least one ~~the~~ bilge pump is to be of fixed type ~~or portable type~~;

(3) each bilge pump is to be capable of giving a speed of water through the required main bilge pipe of not less than 2 m per second, therefore, the output Q is not to be less than the value calculated by the following formula:

$$Q = 5.66 d_1^2 \times 10^{-3} \quad \text{m}^3/\text{h}$$

where: d_1 — internal diameter of bilge main, obtained from the formula in 6.4.3.10 of this Section, in mm;

(4) for multi-hull cargo craft, if bilge water of one certain hull can be drawn by the bilge pump of other hull, the aforesaid hull may only be provided with one bilge pump;

(5) independent power sanitary, ballast and general service pumps may be accepted as independent power bilge pumps, provided that they are of the required capacity of the self-priming type or with the self-priming arrangement and connected to the bilge main.

(6) an ejector with an adequate capacity may be accepted as an independent power bilge pump, and the spindles of the inlet valves for the ejector driving water are to extend well above the floor plates.

6.4.3.28 The passenger craft ~~of category B~~ is to comply with the following requirements.

(1) For monohull craft of category B, at least 3 and for monohull craft of category A, at least 2 power bilge pumps are to be fitted connected with bilge main, one of which may be driven by the propulsion machinery, and the requirements of following (2) to (4) are to be complied with; As an alternative, requirements of 6.4.3.26 may be complied with;

(2) The arrangement of bilge pumping system is to be so arranged that at least one power bilge

pump is to be available for use in all flooding conditions which the craft is required to withstand as follows:

① one of the required bilge pump is to be an emergency pump of a reliable submersible type having an emergency source of power; or

② the bilge pumps and their sources of power are to be so distributed throughout the length of the craft that at least one pump in an undamaged compartment will be available.

(3) Distribution boxes, cocks and valves in connection with the bilge pumping system are to be so arranged that, in the event of flooding, one of the bilge pumps may be operative in any compartment. In addition, damage to a pump or its connecting to the bilge main is not to put the bilge system out of action. When, in addition to the main bilge pumping system, an emergency bilge pumping system is provided, it is to be independent of the main system and so arranged that a pump is capable of operating in any compartment under flooding conditions. In that case only the valves necessary for the operation of the emergency system need to be capable of being operated from above the datum.

(4) All cocks and valves referred to in 6.4.3.28(3) which can be operated from above the datum are to have their controls at the place of operation clearly marked and are to be provided with means to indicate whether they are open or closed.

6.4.9 Ventilation

6.4.9.1 The ventilating ducts are generally not to be led through watertight bulkhead below the bulkhead deck, ~~at least not below the boundary line~~if it is not avoidable, necessary measures are to be taken to keep the original watertight integrity and the trunk is to be capable of withstanding the potential flooding pressure.

Section 5 Machinery Piping Systems

6.5.3 Cooling systems

6.5.3.4 Strainers are to be provided to the suction pipes between the sea inlets and the suction of sea water cooling pumps. And the strainers are to be so arranged that they can be cleaned without leading to the loss of global power and propulsion ~~interrupting the cooling water supply~~.

Section 6 Machinery

6.6.2 Gas turbines

~~6.6.2.1 The gas turbines used for high speed craft are to be furnished with the certificates for marine products issued or approved by CCS[①].~~

6.6.3 Gearings

~~6.6.3.1 The gearings used for propulsion units and lift devices of high speed craft are to be furnished with the certificates for marine products issued or approved by CCS[①].~~

① The subsequent numbering is put ahead accordingly.

Section 8 Propulsor

6.8.3 Waterjet units

~~6.8.3.1 The waterjet units intended for high speed craft are to be furnished with the marine product certificates issued by CCS.~~[①]

Section 9 Directional Control Systems

6.9.1 General requirements

6.9.1.1 ~~The requirements in this Section apply for water rudder, air rudder, rudder-propeller device and other equivalent rudder equipment.~~ For high speed craft, directional control is normally achieved by means of various steering force units as follows or by a combination of these devices. This Section applies to the arrangements for ship's directional control used for the manoeuvring of these devices:

(1) air rudders;

(2) water rudders;

(3) steerable propellers;

(4) steerable jets.

6.9.1.2 Directional control arrangements normally include main steering arrangement and auxiliary steering arrangement defined as follows:

(1) Main steering arrangement is the machinery, actuators, power units, if any, and necessary ancillary equipment, and the means of transmitting and applying torque to the steering force units (e.g. tiller, quadrant or components serving the same purpose) necessary for the purpose of steering the ship under design conditions.

(2) Auxiliary steering arrangement is the equipment other than any part of the main steering arrangement necessary to steer the ship in the event of failure of the main steering arrangement, but not including the tiller, quadrant or components serving the same purpose.

(3) Steering arrangement power unit is:

① in the case of electric steering arrangement, an electric motor and its associated electrical equipment;

② in the case of electrohydraulic steering arrangement, an electric motor and its associated electrical equipment and connected pump; or

③ in the case of other hydraulic steering arrangement, a driving engine and connected pump.

(4) Steering actuator is the component provided turning the steering force unit by transferring hydraulic power or electric power to mechanical power, e.g. hydraulic cylinders, electric motors and gearing, hydraulic motors and gearing, etc.

(5) Steering actuating system includes steering gear power unit, steering actuators and hydraulic piping (if fitted).

~~6.9.1.2 The directional control systems are to be furnished with the certificates for marine products issued by CCS.~~

6.9.1.3 The hydraulic systems of ~~steering gears~~directional control arrangements are to comply with the relevant requirements in Section 5 of this Chapter.

6.9.1.4 Unless otherwise specified in this Section, directional control arrangements for water rudders, steerable propellers and steerable jets are normally to comply with the equivalent requirements for steering gears in 13.1.4 to 13.1.7 of Chapter 13, PART THREE of CCS Rules for Classification of Sea-Going Steel Ships.

6.9.2 Reliability

6.9.2.1 Each high speed craft is to be provided with main steering gear and auxiliary steering gear to ensure that a single failure in one of them will not render the other one inoperativeUnless the requirements of 6.9.2.4, 6.9.2.5 and 6.9.2.6 of this Section are met, one set of main steering arrangement and one set of auxiliary steering arrangement are to be provided for each steering force unit. The main steering arrangement and the auxiliary steering arrangement are to be so arranged that a single failure in one of them will not render the other one inoperative.

6.9.2.2 The main steering arrangements are to be:

(1) of adequate strength and capable of steering the ship at all navigable speed and design condition which are to be demonstrated at trial;

(2) operated by power when manual operation can not meet the requirements for manoeuvreability of the ship;

(3) so designed that they will not be damaged at maximum astern speed.

6.9.2.3 The auxiliary steering arrangements are to be:

(1) of adequate strength and capable of steering the ship at minimum navigable speed and being brought speedily into action in an emergency;

(2) operated by power when manual operation can not meet the requirements for minimum manoeuvreability of the ship in an emergency.

6.9.2.24 Where a main steering gear arrangement comprises two or more identical power units, an auxiliary steering arrangement need not be fitted, provided that:

(1) in a passenger ship, the main steering arrangement is capable of being operated according to the provisions of 6.9.2.2(1) of this Section to the satisfaction of CCS while any one of the power units is out of operation;

(2) in a cargo ship, the main steering arrangement is capable of being operated according to the provisions of 6.9.2.2(1) of this Section while all power units are operating; and

(23) the main steering gear arrangement is so arranged that after a single failure in its piping system or in one of the power units, the defect can be isolated and the steering capability can be maintained or speedily regained.

6.9.2.3 The high speed craft having waterjet units with steering function, auxiliary steering gears can be exempted.

6.9.2.5 For crafts fitted with two or more sets of steering force units, an auxiliary steering arrangement need not be fitted if it is demonstrated that any single failure of one of main steering arrangements will not influence the normal directional performance of the craft.

6.9.2.46 Where the main steering gearsarrangement uses steering without dynamical operating, auxiliary steering gearsarrangement can be exempted.

6.9.2.57 As soon as the power for steering gearsarrangement is restored after its failure, the power unit is to be capable of starting at once for operation.

6.9.3 Alarms

6.9.3.1 The low level alarms are to be provided for the circulating oil boxes of each hydraulic system of hydraulic ~~gears~~arrangement and to give audible and visual alarms in machinery spaces and bridge room.

6.9.3.2 Where the power source is in failure, audible and visual alarms are to be given in bridge room.

6.9.4 Miscellaneous

6.9.4.1 Manually operated arrangements are only acceptable provided that its operation does not require an effort exceeding 160 N under the normal conditions and it is to ensure that its construction will not result in a destroying reaction against the wheel.

6.9.4.2 All steering ~~gears~~arrangements in high speed craft, including head-propellers for air-cushion vehicles, are to be so constructed that any failure in transmissions is not to make any hazard to the safety of craft.

6.9.4.3 Indications of steering response or rudder angle indicators are to be provided in all spaces including navigation bridge from which directional control arrangements can be operated, and are to be independent of the system for directional control.

CHAPTER 7 ELECTRICAL INSTALLATIONS

Section 5 Electrical Drives for Auxiliary Engine and Equipment

7.5.2 Steering and stabilization

7.5.2.5 For craft engaged on non-international voyage and category A passenger craft engaged on international voyage, which are provided with twin-screw propulsions, where the source of emergency electrical power is unable to supply power to the steering gear, at least two independent circuits are to supply from the main source of electrical power.

Section 8 Safety Systems for Craft and Persons onboard

~~**7.8.1 Public address system**~~

~~7.8.1.1 There is to be a public address system covering all areas where passengers and crew have access, escape routes, and places of embarkation into survival craft. The system is to be such that flooding or fire in any compartment does not render other parts of the system inoperable.~~

~~7.8.1.2 In the event of failure of supply from the main source of electrical power, the supply to public address system is to be changed automatically to emergency electrical source (if any) or additional electrical source.~~

~~**7.8.2 General emergency alarms**~~

~~7.8.2.1 A general emergency alarm system is to be provided. The alarm is to be audible throughout all the public spaces, corridors and stairways, crew accommodation and normal crew working spaces and open decks.~~

~~The alarm is to continue to function after it has been triggered until it is switched off manually or is interrupted by the public address system.~~

~~7.8.2.2 The general emergency alarm system is to be powered from the main source of electrical power and the emergency source of electrical power, in case that the emergency source of electrical power is not provided as required by 7.4.3, the system is to be provided from the additional source of electrical power.~~

~~7.8.2.3 Sufficient number of alarm devices for general alarm system are to be provided to ensure that all persons on board craft can hear the emergency alarm signal.~~

~~7.8.2.4 If necessary, alarm devices with light or flash light are to be fitted in the compartments where noise may occur loudly.~~

7.8.1 General emergency alarms

7.8.1.1 In order to sound general emergency signals, a general emergency alarm system comprised of the ship's whistle or siren and additionally an electrically operated bell or klaxon or other equivalent apparatus, is to be provided on all passenger crafts and cargo crafts.

In passenger craft, the alarm is to be capable of being given separately or simultaneously to crew and passengers.

7.8.1.2 The system is to be capable of operation from the navigation bridge and, except for the ship's whistle or siren, also from at least one other strategic points (e.g. fire control station, embarkation station, etc.). The alarm is to continue to function after it has been triggered until it is manually turned off or is temporarily interrupted by a message from the public address system.

7.8.1.3 Where the general emergency alarm system is in operation, the acoustic system for entertainment is to be interrupted automatically.

7.8.1.4 The general alarm system is to be supplied from special feeders, being capable of automatically converting to the emergency source of electrical power (if fitted) in the event of failure of the main source of electrical power. In passenger craft, the system is also to be capable of being supplied by a temporary emergency source of electrical power (if fitted).

7.8.1.5 The system is to be audible throughout all the accommodation and normal crew working spaces, including open decks in passenger craft.

The minimum sound pressure level for the emergency alarm tone in interior and exterior spaces is to be 80 dB(A) and at least 10 dB(A) above ambient noise levels existing during normal equipment operation with the ship underway in moderate weather. The sound pressure levels at the sleeping position in cabins and in cabin bathrooms are to be at least 75 dB(A) and at least 10 dB(A) above ambient noise levels.

7.8.1.6 Each electrically operated bell or klaxon or other equivalent warning equipment is to be separately protected against short circuit.

7.8.2 Public address system

7.8.2.1 All cargo crafts are to be provided with a public address system in compliance with the following requirements:

(1) capable of broadcasting messages from spaces such as navigation bridge and fire control station, etc. to all spaces where crew are normally present and muster stations;

(2) no operation required for receivers to accept the broadcast message;

(3) protected against unauthorized use;

(4) amplifiers have sufficient output power so that all loudspeakers for the purpose of emergency announcement can be operated at the same time;

(5) arranged to prevent feedback or any other interference;

(6) with the ship underway in normal conditions, the minimum sound pressure level for broadcasting emergency announcements is to be:

① in interior spaces, 75 dB(A) and at least 20 dB(A) above the speech interference level;

② in exterior spaces, 80 dB(A) and at least 15 dB(A) above the speech interference level;

(7) capable of being supplied by both main and emergency power sources (if fitted);

(8) if the public address system is used to give the general alarm, the following requirements are to be fulfilled:

① the performance requirements of 7.8.1 of this Section are to be complied with;

② at least two amplifiers are to be provided, each of them separately supplied;

③ the loudspeaker circuits are to be so arranged that an announcement at a reduced acoustic irradiation is maintained in the event of a failure of an amplifier or loudspeaker circuit;

④ where loudspeakers with built-in volume controls are used, the volume controls are to be disabled by the release of the alarm signal;

⑤ it is to be possible to transmit the clearly audible alarm signal at all times and other simultaneous signal transmissions are to be automatically interrupted;

⑥ an independent short-circuit protection is to be provided for each loudspeaker.

7.8.2.2 All passenger crafts are to be provided with a public address system in compliance with the following requirements:

(1) capable of simultaneously broadcasting messages from bridge and central control station, etc. to all spaces where crew and passengers or both are normally present and muster stations, and capable of broadcasting messages to crew and passengers separately;

(2) complying with the requirements of 7.8.2.1(2) to (6);

(3) capable of interrupting at the control position on the navigation bridge any broadcast of the system from any other position onboard;

(4) the spaces where control units of the system are located are to be provided with the following emergency function controls:

① clearly indicating any emergency function;

② automatically overriding any other input system or programme;

③ automatically overriding all volume controls and on/off controls so that the required volume for the emergency mode is achieved in all spaces;

(5) at least two independent and separate amplifiers are to be provided, each of them separately supplied;

(6) at least two loudspeaker circuits connected to their respective amplifiers are to be installed in each fire zone, and their cables are to be laid as widely apart as practicable for their entire length;

(7) independent short-circuit protection is to be provided for each loudspeaker;

(8) capable of being supplied by main, emergency (if fitted) and temporary emergency (if fitted) sources of electrical power;

(9) if the public address system is used to give the general emergency alarm, the requirements of 7.8.1 of this Section are also to be complied with.

CHAPTER 8 REMOTE CONTROL, ALARM AND SAFETY SYSTEMS

Section 2 Emergency Controls

8.2.1 In all craft, the station or stations in the operating compartment from which control of craft manoeuvring and/or of its main machinery is exercised are to be provided, within easy reach of the crew member at that station, with controls for use in an emergency to:

(1) activate fixed fire-extinguishing systems;

(2) close ventilation openings and stop ventilating machinery supplying spaces covered by fixed fire-extinguishing

systems, if not incorporated in (1);

(3) shut off emergency stop devices complying with 7.5.3.2;

(4) disconnect all electrical power sources ~~from the normal power distribution system~~ connected with main and emergency switchboard (the operating control is to be guarded to reduce the risk of inadvertent or careless operation); and

(5) stop main engine(s) and auxiliary machinery.

Section 3 Alarm Systems

8.3.3 Alarm items

8.3.3.1 Emergency alarms giving indication of conditions requiring immediate action are to be distinctive and in full view of crew members in the operating compartment, and are to be provided for the following:

(1) activation of a fire-detection system;

(2) ~~total loss of normal electrical supply~~loss of power supply of main switchboard;

(3) overspeed of main engines;

(4) thermal runaway of any permanently installed nickel-cadmium battery.

8.3.3.2 A visual alarm distinct from the alarm referred to in 8.3.3.1 is to be given, indicating conditions requiring action to prevent degradation to an unsafe condition. These are to be provided for at least the following:

(1) exceeding the limiting value of any craft, machinery or system parameter other than engine overspeed;

(2) failure of normal power supply to powered directional or trim control devices;

(3) operation of any automatic bilge pump;

(4) failure of compass system;

(5) low level of a fuel tank contents;

(6) fuel oil tank overflow/high level;

(7) extinction of side, masthead or stern navigation lights;

(8) low level of contents of any fluid reservoir the contents of which are essential for normal craft operation, such as water level of domestic tanks, oil level of daily service oil tanks, water level of M.E. & Aux. E. fresh water expansion tanks;

(9) failure of any connected electrical power sourceloss of main source of electrical power or emergency source of electrical power (if fitted);

(10) failure of any ventilation fan installed for ventilating spaces in which inflammable vapours may accumulate;

(11) failure of diesel engine high-pressure fuel line (fuel delivery lines between the high-pressure fuel pumps and fuel injectors).

(12) detection of bilge water in each watertight compartment (except for liquid tanks) below the design waterline.

Appendix 2 Guidelines for Direct Calculations of Hull Structure Strength of Steel/Aluminum High Speed Craft

7 Check of buckling strength

7.1 General requirements

7.1.4 Symbols and definitions

t_p — net thickness of panel, in mm;

h_w — height of longitudinal, stiffener or stiffener web, in mm;

t_w — net thickness of longitudinal, stiffener or stiffener web, in mm;

b_f — breadth of face plate of longitudinal or stiffener, in mm;

t_f — net thickness of face plate of longitudinal or stiffener, in mm, taken as average net thickness of bulb for bulb flat;

s — length of shorter side of panel, in mm, taken as considered spacing of longitudinals or stiffeners for stiffened panel;

ℓ — length of longer side of panel, in mm; for stiffened panel, taken as considered span of longitudinal or stiffener, in mm;

x — defined as axial direction of longer side of panel;

y — defined as axial direction of shorter side of panel;

E — modulus of elasticity of material. For steel, $E = 2.06\times10^5$ N/mm^2; for aluminum, $E = 0.70\times10^5$ N/mm^2;

v — Poisson's ratio for material, $v = 0.3$;

σ_{sw} — yield strength of material in welded condition, in N/mm2: $\sigma_{p0.2}$ is to be taken as the yield stress of material in annealed condition for aluminum, see relevant requirements of CCS Rules for Materials and Welding (for aluminum alloy material supplied not in annealed condition, yield strength of the material in welded condition may be determined by welding test); $\sigma_{sw} = \sigma_s$ for steel, σ_{sw_p} and σ_{sw_s} are σ_{sw} of plate and stiffener respectively;

τ_s —— $\dfrac{\sigma_{sw}}{\sqrt{3}}$

k_x — buckling coefficient for the shorter side subjected to compression and bending, to be calculated according to Table 7.2.2.1.1(1). In general, taken as 4.0 if based on FEM;

k_y — buckling coefficient for the longer side subjected to compression and bending, to be calculated according to Table 7.2.2.1.1(1). Where compressive stress varies in axial direction of the shorter side between panels to a large extent, a linearly distributed stress in axial direction of the longer side, which deviates from the actual stress distribution as small as possible, is to be assumed first, and then taken as in Table 7.2.2.1.1(1) for calculation;

k_t— shear buckling coefficient, to be calculated according to Table 7.2.2.1.1(1);

C_1, C_2— boundary coefficient, see Table 7.2.2.1.1(2);

β— slenderness coefficient of panel, $\beta = \frac{s}{t_p}\sqrt{\frac{\sigma_{sw}}{E}}$

σ_x, σ_y, τ_{xy}— respectively as calculated value, in N/mm2, of compressive stress along axes x and y and shear stress within x-y plane for elementary panel in the same condition. The average value (to be negative value when compressive stress is applied) of in-plane stresses (membrane stresses) at the centroid of all plate elements is to be considered in calculation. Where the calculated values of σ_x and/or σ_y are greater than zero, they are to be taken as zero;

$\sigma_{x\,max}$,$\sigma_{y\,max}$, $\tau_{xy\,max}$— respectively as maximum calculated value, in N/mm2, of compressive stress along axes x and y and shear stress within x-y plane for stiffened panel in the same condition, to be taken as in the case of σ_x, σ_y and τ_{xy};

σ_e— equivalent (Von Mises) stress of the panel, $\sigma_e = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau_{xy}^2}$, in N/mm2;

σ_{xcr_e}, σ_{ycr_e}, τ_{cr_e}— respectively as critical elastic compressive buckling stress along axes x and y under uniaxial stress and critical shear buckling stress within x-y plane for panel, in N/mm^2, see 7.2.2.1.2(1), (2) and (3);

σ_{xcr}, σ_{ycr}, τ_{cr}— respectively as critical compressive buckling stress along axes x and y under uniaxial stress and critical shear buckling stress within x-y plane for panel, in N/mm^2, see 7.2.2.1.2;

σ_{xu},σ_{yu},τ_{xyu}— respectively as ultimate compressive stress along axes x and y under uniaxial stress and ultimate shear stress of stiffened panel, in N/mm^2, see 7.3.2.1;

σ_{a_max} — maximum axial compressive stress of longitudinal or stiffener in ultimate limit state, in N/mm^2;

σ_{b_max} — maximum bending stress of longitudinal or stiffener in ultimate limit state, in N/mm^2, see 7.3.3.2;

p_{max} — maximum laterally and uniformly distributed load of the stiffened panel at the ultimate limit state, in N/mm^2;

σ_{cr_a} — critical compressive buckling stress of longitudinal or stiffener, in N/mm^2, see 7.3.3.2;

P_{max} — uniformly distributed load of the panel (obtained from finite element model, and pressure difference value is to be taken when both two sides (internal and external) of the panel are subjected to compression at the same time), in N/mm^2.

Appendix 4 Method of Checking Longitudinal Strength of Steel/Aluminum High Speed Trimarans

3 Check of overall strength

3.1 Hull girder strength

3.1.2 Check of longitudinal strength

3.1.2.3 The midcraft section modulus W in way of hull girder deck and keel is to meet following requirements:

$$W > f_{sr} C L^2 B (C_b + 0.7) k_m \quad \text{cm}^3$$

where: f_{sr} — service area factor, see 2.3.1 of this Appendix;

C — coefficient, see 2.3.1 of this Appendix;

k_m —coefficient of material effects, for steel hull, $k_m = K$, K is material factor, see 1.3.1.7, Chapter 1, PART TWO of CCS Rules for Classification of Seagoing Steel Ships; for aluminum hull, $k_m = 235/\sigma_{sw}$;

where: σ_{sw} —yield strength of aluminum material after welding, in N/mm², to be taken as yield strength $\sigma_{p0.2}$ of aluminum material in annealed condition, see relevant provisions of CCS Rules for Materials and Welding (for aluminum alloy material supplied not in annealed condition, yield strength of the material in welded condition may be determined by welding test).

3.1.3 Allowable stress

3.1.3.1 Allowable stress for check of overall strength is as follows:

(1) For steel hull, allowable bending stress of members $[\sigma]$ is to be taken as:

$[\sigma] = 175/K$, N/mm², within 0.4L amidcraft;

$[\sigma] = 125/K$, N/mm², within 0.1 L from craft ends;

For other areas, it is to be determined by linear interpolation.

Allowable shear stress of members $[\tau]$ is to be taken as:

$[\tau] = 110/K$, N/mm²

where: K —material factor, see 1.3.1.7, Chapter 1, PART TWO of CCS Rules for Classification of Seagoing Steel Ships;

(2) For aluminum hull, allowable bending stress of members $[\sigma] = 0.76\sigma_{sw}$, allowable shear stress of members $[\tau] = 0.43\sigma_{sw}$.

where: σ_{sw} — yield strength of material after welding, in N/mm², to be taken as yield strength $\sigma_{p0.2}$ of aluminum material in annealed condition, see relevant provisions of CCS Rules for Materials and Welding (for aluminum alloy supplied not in annealed condition, yield strength of the material in welded condition may be determined by welding test).

3.2 Transverse strength of cross deck

3.2.3 Allowable stress

3.2.3.1 Allowable stress for transverse strength check of cross deck is as follows:

(1) For steel hull, allowable stress $[\sigma]$ for bending stress of members is to be taken as:

$[\sigma] = 168/K$, N/mm²;

Allowable stress $[\tau]$ for shear stress of members is to be taken as:

$[\tau] = 110/K$, N/mm²。

Allowable stress $[\sigma]$ for equivalent stress of members is to be taken as:

$[\sigma] = 210/K$, N/mm²。

where: K —material factor, see 1.3.1.7, Chapter 1, PART TWO of CCS Rules for Classification of Seagoing Steel Ships;

(2) For aluminum hull, allowable stress for bending stress of members $[\sigma] = 0.76\sigma_{sw}$, allowable stress for shear stress $[\tau] = 0.43\sigma_{sw}$, allowable stress for resulting stress $[\sigma] = 0.80\sigma_{sw}$

where: σ_{sw} — yield strength of material after welding, in N/mm², to be taken as yield strength $\sigma_{p0.2}$ of aluminum material in annealed condition, see relevant provisions of CCS Rules for Materials and Welding (for aluminum alloy supplied not in annealed condition, yield strength of the material in welded condition may be determined by welding test).