23-400

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part CS Hull Construction and Equipment of Small Ships

Rules for the Survey and Construction of Steel Ships
Part CS 2023 AMENDMENT NO.2
Guidance for the Survey and Construction of Steel Ships
Part CS 2023 AMENDMENT NO.2

Rule No.67 / Notice No.63 22 December 2023
Resolved by Technical Committee on 27 July 2023

ClassNK
NIPPON KAIJI KYOKAI

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part CS Hull Construction and Equipment of Small Ships

2023 AMENDMENT NO.2

Rule No.67 22 December 2023
Resolved by Technical Committee on 27 July 2023

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

Rule No.67 22 December 2023
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part CS HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS

Amendment 2-1

Chapter 4 SUBDIVISIONS

4.2 Subdivision Index

4.2.3 Probability of Survival (s_i)

Sub-paragraph -6 has been amended as follows.

6 Probability of survival (s_i) is to be taken as 0 in ~~those~~ cases where~~, taking into account~~ the final waterline (in consideration of sinkage, heel and trim~~,the openings in accordance with the following **(1)** and **(2)** immerse at the final waterline:~~) immerses the lower edge of openings through which progressive flooding may take place and such flooding is not accounted for in the calculation of the probability of survival (s_i). Such openings are to include air pipes, ventilators and openings which to be closed by means of weathertight doors or hatch covers.

~~(1) The openings through which progressive flooding may take place and such flooding is not accounted for in the calculation of the probability of survival (s_i)~~

~~(2) Air pipes, ventilators and the openings which are closed by means of weathertight doors or hatch covers~~

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of this amendment is 1 January 2024.

Amendment 2-2

Chapter 21 BULWARKS, GUARDRAILS, FREEING ARRANGEMENTS, CARGO PORTS AND OTHER SIMILAR OPENINGS, SIDE SCUTTLES, RECTANGULAR WINDOWS, VENTILATORS AND GANGWAYS

21.4 Side Shell Doors and Stern Doors

21.4.2 Arrangement of Doors

Sub-paragraph -2 has been amended as follows.

1 Doors are to be made weathertight.
2 Where the lower edges of any openings of the doors are situated below the freeboard deck, the doors are to be so designed as to ensure the same watertightness and structural integrity as the surrounding shell plating.
3 Notwithstanding the requirements in **-2**, the lower edges of the doors are not to be below a line drawn parallel to the freeboard deck at side, which has at its lowest point at least 230 *mm* above the deepest subdivision draught specified in **4.1.2(3)**, unless the implementation of additional measures for ensuring watertightness such as the following **(1)** to **(4)**.
(1) A second door of equivalent strength and watertightness is to be fitted inside the watertight door
(2) A leakage detection device is provided in the compartment between the two doors
(3) Drainage of this compartment to the bilges is controlled by a readily accessible screw-down valve
(4) The outer door opens outwards
4 The number of door openings is to be kept to the minimum compatible with design and proper operation of the ship.
5 Doors are generally to open outwards.

Chapter 23 EQUIPMENT

23.2 Towing and Mooring Fittings

23.2.9 Towing and Mooring Arrangement Plan

2 Information provided on the plan is to include the followings:
((1) to (6) are omitted.)

Sub-paragraph (7) has been renumbered to Sub-paragraph (8), and Sub-paragraph (7) has been added as follows.

(7) The length of each mooring line
(~~7~~8) Other information or notes related to the design of shipboard fittings or lines.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2024.

2. Notwithstanding the amendments to the Rules, the current requirements apply to ships other than ships that fall under the following:

(1) for which the contract for construction is placed on or after the effective date; or

(2) in the absence of a contract for construction, the keels of which are laid or which are at *a similar stage of construction* on or after 1 July 2024; or

(3) the delivery of which is on or after 1 January 2028.

(Note) The term "*a similar stage of construction*" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 *tonnes* or 1% of the estimated mass of all structural material, whichever is the less.

Amendment 2-3

Chapter 23 EQUIPMENT

23.2 Towing and Mooring Fittings

23.2.1 General

3 The definitions of terms which appear in this section are as follows.
((1) to (13) are omitted.)

Sub-paragraphs (14) to (16) have been added as follows.

(14) Mooring area
"Mooring area" refers to the dedicated area on a ship where mooring equipment is installed and line-handling takes place. It also includes areas where there is a risk of personnel injury in event of snap-back or other failure of mooring equipment.

(15) Working Load Limit (*WLL*)
"Working Load Limit (*WLL*)" means the maximum load that a mooring line should be subjected to in operational service, calculated from the relevant environmental mooring restraint requirement.

(16) Bend radius (*D*/*d* ratio)
"Bend radius (*D*/*d* ratio)" means the diameter (*D*) of a mooring fitting divided by the diameter (*d*) of a mooring line that is led around or through the fitting.

23.2.5 Mooring Lines

Sub-paragraph -1(3) has been amended as follows.

1 General
((1) and (2) are omitted.)
(3) Fibre ropes used for mooring lines are to be not less than 20 *mm* in diameter. ~~For considering rope age degradation and wear, the line design break force for such ropes is to be in accordance with the following **(a)** or **(b)**. However, neither **(a)** nor **(b)** need to be complied with in cases where consideration of rope age degradation and wear is included in the method specified in **23.2.4-3**.~~
~~(a) Polyamide ropes:~~ $LDBF \geq 120\%$ ~~of~~ MBL_{sd}
~~(b) Other synthetic ropes:~~ $LDBF \geq 110\%$ ~~of~~ MBL_{sd}
((4) and (5) are omitted.)

Sub-paragraph -4 has been added as follows.

4 The arrangement and selection of mooring lines is to in accordance with **14.4.4, Part 1, Part C**.

23.2.6 Mooring Fittings

Sub-paragraph -7 has been added as follows.

7 The arrangement and selection of mooring equipment, capstans, and winches are to be in accordance with **14.4.4, Part 1, Part C**.

23.2.9 Towing and Mooring Arrangement Plan

2 Information provided on the plan is to include the followings:

((1) to (6) are omitted.)

Sub-paragraph (7) has been renumbered to Sub-paragraph (9), and Sub-paragraphs (7) and (8) have been added as follows.

<u>(7) Winch brake holding capacities</u>

<u>(8) For ships of 3,000 gross tonnage and above, documentation confirming that *MSC*.1/*Circ*.1619 has been considered.</u>

(~~7~~<u>9</u>) Other information or notes related to the design of shipboard fittings or lines.

EFFECTIVE DATE AND APPLICATION (Amendment 2-3)

1. The effective date of the amendments is 1 January 2024.

2. Notwithstanding the amendments to the Rules, the current requirements apply to ships other than ships that fall under the following:

(1) for which the contract for construction is placed on or after the effective date; or

(2) in the absence of a contract for construction, the keels of which are laid or which are at *a similar stage of construction* on or after 1 July 2024; or

(3) the delivery of which is on or after 1 January 2027.

(Note) The term "*a similar stage of construction*" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 *tonnes* or 1% of the estimated mass of all structural material, whichever is the less.

Amendment 2-4

Chapter 2 STEMS AND STERN FRAMES

2.2 Stern Frames

Title of Paragraph 2.2.7 has been amended as follows.

2.2.7 Rudder tTrunk

Sub-paragraph -2 has been amended as follows.

2 Materials, welding and connection to hull

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 C_{EQ} not exceeding 0.41 %.

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

For rudder trunks extending below shells or skegs, Tthe fillet shoulder radius r (*mm*) (*See* **Fig. CS2.3**) is to be as large as practicable and to comply with the following formulae:

$r = 0.1 d_l / K_T$

without being less than:

$r = 60$ when $\sigma \geq 40 / K_{ST}$ (N/mm^2)

$r = 30$ when $\sigma < 40 / K_{ST}$ (N/mm^2)

Where:

d_l: rudder stock diameter axis defined in **3.5.2**.

σ: bending stress in the rudder trunk (N/mm^2).

K_{ST}: material factor for the rudder trunk as given in **3.1.2**.

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 the Society.

Sub-paragraph -3 has been amended as follows.

3 Scantlings

The scantlings of the trunk are to be such that:

- the equivalent stress due to bending and shear does not exceed $0.35\,\sigma_Y$,
- the bending stress on welded rudder trunk is to be in compliance with the following formula:

  $\sigma \leq 80 / K_{ST}$ (N/mm^2)

  with:

  σ: As defined in **-2**.

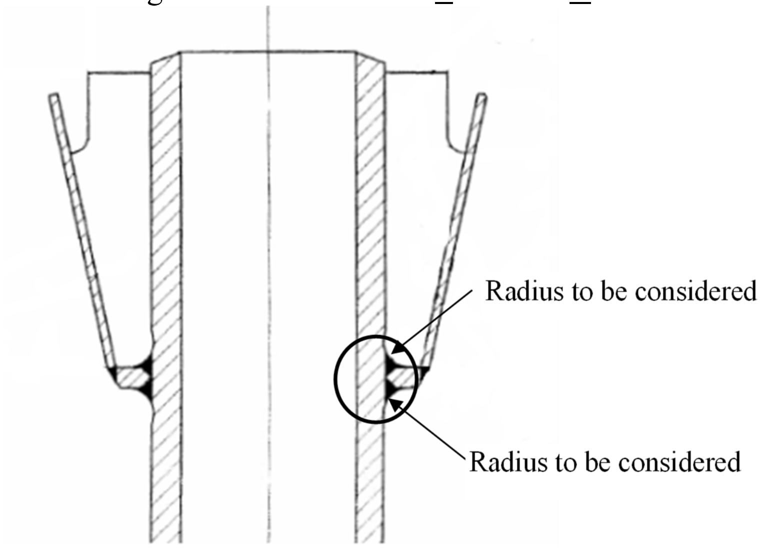
  K_{ST}: Material factor for the rudder trunk as given in **3.1.2**, not to be taken less than 0.7

  σ_Y: Specified minimum yield stress (N/mm^2) of the material used

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.

Title of Fig. CS2.3 has been amended as follows.

Fig. CS2.3 Fillet ~~s~~Shoulder ~~r~~Radius



Chapter 3 RUDDERS

3.1 General

3.1.1 Application*

Paragraphs -2 and -3 have been renumbered to Paragraphs -3 and -4, and Sub-paragraph -2 has been added as follows.

1 (Omitted)
2 This chapter applies to rudders made of steel for ships with $L_1 \geq 24\ m$
~~2~~3 The construction of rudders having three or more pintles and of those having special shape or sectional form will be specially considered by the Society.
~~3~~4 The construction of rudders designed to move more than 35 *degrees* on each side will be specially considered by the Society.

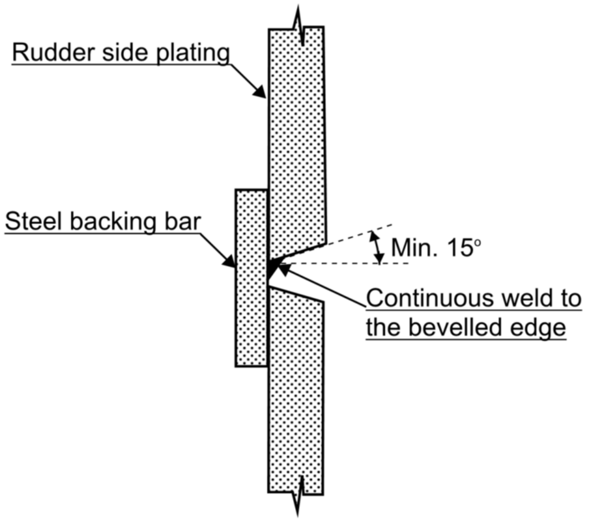
3.1.3 Welding and Design Details

Sub-paragraph -3 has been amended as follows.

3 Welds in the rudder side plating subjected to significant stresses from rudder bending and 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 Type *A* rudders and upper part of Type *C* rudders), cast or welding on ribs is to be arranged. Two sided full penetration welding is normally to be arranged. Where back welding is impossible, one side welding using steel backing bars is, in principle, to be performed. In such cases, one~~-~~ sided continuous welding is to be used to weld the steel backing bars to ~~heavy pieces~~bevelled edge (*See* **Fig. CS3.3**). The bevel angle is to be at least 15 *degrees* for one sided welding. Other welding procedures, however, may be approved when deemed appropriate by the Society.

Fig. CS3.3 has been added as follows.

Fig. CS3.3 Use of Steel Backing Bar in Way of Full Penetration Welding of Rudder Side Plating



Section 3.2 has been amended as follows.

3.2 Rudder Force*

The rudder force F_R is used to determine the rudder scantlings and is obtained from the following formula, for ahead and astern conditions. However, when the rudder is arranged behind the propeller that produces an especially great thrust, the rudder force is to be appropriately increased.

$F_R = K_1 K_2 K_3 132 A V^2$ (N)

Where:

A: Area of rudder plate (m^2)

V: Speed of ship (kt)

When the speed is less than 10 *knots*, V is to be replaced by V_{min} determined from the following formula.

$V_{min} = \frac{V+20}{3}$ (kt)

For the astern condition, the astern speed V_a as defined in **2.1.30, Part A** is to be obtained from the following formula. However, when the maximum astern speed is designed to exceed V_a, the design maximum astern speed is to be used.

$V_a = 0.5V$ (kt)

Where:

K_1: Factor depending on the aspect ratio Λ of the rudder area obtained from the following formula.

$K_1 = \frac{\Lambda+2}{3}$

Λ: As obtained from the following formula

However, Λ is not required to be greater than 2.

$$\Lambda = \frac{h^2}{A_t}$$

h: Mean height of rudder (m), which is determined according to the coordinate system in **Fig. CS3.~~3~~4**

A_t: Sum of rudder plate area A (m^2) and area of rudder post or rudder horn, if any, within the mean height of rudder h

K_2: Factor depending on the type of rudder profile (*See* **Table CS3.1**)

K_3: Factor depending on the location of rudder, as specified below:

For rudders outside the propeller jet ~~....~~: 0.8

For rudders behind a fixed propeller nozzle ~~....~~: 1.15

Otherwise ~~....~~: 1.0

Fig. CS3.3 has been renumbered to Fig. CS3.4.

Fig. CS3.~~3~~4 Coordinate System of Rudders
(Omitted)

3.3 Rudder Torque

Paragraph 3.3.1 has been amended as follows.

3.3.1 Rudder Torque of Type *B* and *C* Rudders

The rudder torque T_R of Type B and C rudders is to be obtained for ahead and astern conditions, respectively, according to the following formula.

$T_R = F_R r$ (N-m)

Where:

F_R: As specified in **3.2**

r: Distance (m) from the centre of the rudder force on the rudder to the centreline of the rudder stock, determined by the following formula

$r = b(\alpha - e)$

For the ahead condition, r is not to be less than r_{min} obtained from the following formula.

$r_{min} = 0.1b$ (m)

Where:

b: Mean breadth (m) of rudder determined by the coordinate system in **Fig. CS3.~~3~~4**

α: To be as follows:

For ahead condition: 0.33

For astern condition: 0.66

e: Balance factor of the rudder obtained from the following formula.

$$e = \frac{A_f}{A}$$

Where:

A_f: Portion of the rudder plate area (m^2) situated ahead of the centreline of the rudder stock

A: As specified in **3.2**

Paragraph 3.3.2 has been amended as follows.

3.3.2 Rudder Torque of Type *A* Rudder

The rudder torque T_R of Type *A* rudders is to be obtained for the ahead and astern condition, respectively, according to the following formula:

$$T_R = T_{R1} + T_{R2} \quad (N\text{-}m)$$

For the ahead condition, T_R is not to be less than $T_{R\min}$ obtained from the following formula:

$$T_{Rmin} = 0.1 F_R \frac{A_1 b_1 + A_2 b_2}{A} \quad (N\text{-}m)$$

Where~~-~~:

T_{R1} and T_{R2}: Rudder torque (*N-m*) of portions A_1 and A_2, respectively

A_1 and A_2: Areas of respective rectangles (m^2) determined by dividing the rudder area into two parts so that $A = A_1 + A_2$ (A_1 and A_2 include A_{1f} and A_{2f} respectively), as specified in **Fig. CS3.~~4~~5**. A_{1f} and A_{2f} are areas situated ahead of the centreline of the rudder stock.

b_1 and b_2: Mean breadth (m) of portions A_1 and A_2 respectively determined by applying **Fig. CS3.~~3~~4**

F_R and A: As specified in **3.2**

T_{R1} and T_{R2}, the rudder torque of portions A_1 and A_2 respectively, are to be obtained from the following formulae.

$$T_{R1} = F_{R1} r_1 \quad (N\text{-}m)$$

$$T_{R2} = F_{R2} r_2 \quad (N\text{-}m)$$

F_{R1} and F_{R2}, the rudder force of portions A_1 and A_2, are to be obtained from the following formulae.

$$F_{R1} = F_R \frac{A_1}{A} \quad (N)$$

$$F_{R2} = F_R \frac{A_2}{A} \quad (N)$$

r_1 and r_2, the distances from each centre of rudder force of portions A_1 and A_2 to the centreline of the rudder stock, are to be determined from the following formulae.

$$r_1 = b_1(\alpha - e_1) \quad (m)$$

$$r_2 = b_2(\alpha - e_2) \quad (m)$$

e_1 and e_2, the balance factors of portions A_1 and A_2 respectively, are to be determined from the following formulae.

$$e_1 = \frac{A_{1f}}{A_1}, \quad e_2 = \frac{A_{2f}}{A_2}$$

α is to be as follows:

For parts of a rudder not behind a fixed structure such as the rudder horn:

For ahead condition: 0.33

For astern condition: 0.66

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

For ahead condition: 0.25

For astern condition: 0.55

Fig. CS3.4 has been renumbered to Fig. CS3.5.

Fig. CS3.~~4~~5 Division of Rudder

(Omitted)

3.5 Rudder Stocks

Paragraph 3.5.2 has been amended as follows.

3.5.2 Lower Stocks

The diameter d_l of the lower stock, which is the stock below the bearing centre of the rudder carrier subject to the combined forces of torque and bending moment, is to be determined such that the equivalent stress in the rudder stock does not exceed 118/K_S (N/mm^2).

The equivalent stress σ_e is to be obtained from the following formula.

$$\sigma_e = \sqrt{{\sigma_b}^2 + 3{\tau_t}^2} \quad (N/mm^2)$$

The bending stress and torsional stress acting on the lower stock are to be determined as follows:

Bending stress: $\sigma_b = \frac{10.2M}{{d_l}^3} \times 10^3 \quad (N/mm^2)$

Torsional stress: $\tau_t = \frac{5.1T_R}{{d_l}^3} \times 10^3 \quad (N/mm^2)$

Where:

M: Bending moment (N-m) at the section of rudder stock considered

T_R: As specified in **3.3**

When the horizontal section of the lower stock forms a circle, the lower stock diameter d_l may be determined by the following formula:

$$d_l = d_u \cdot \sqrt[6]{1 + \frac{4}{3}\left[\frac{M}{T_R}\right]^2} \quad (mm)$$

Where:

d_u: Diameter of upper stock (mm) as given in **3.5.1**

For a spade rudder with trunk extending inside the rudder, the rudder stock scantlings are to be checked against the following two cases:

(1) pressure applied on the entire rudder area; and

(2) pressure applied only on rudder area below the middle of neck bearing.

3.6 Rudder Plates, Rudder Frames and Rudder Main Pieces of Double Plate Rudders

Paragraph 3.6.1 has been amended as follows.

3.6.1 Rudder Plate

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

$$t = 5.5S\beta\sqrt{\left(~~d~~d_s + \frac{F_R \times 10^{-4}}{A}\right)K_{p1}} + 2.5 \quad (mm)$$

Where:

d_s: Scantling draught (m) (*See* **15.2.1-1**)

A and F_R: As specified in **3.2**

K_{pl}: Material factor for rudder plate as given in **3.1.2**

β: To be obtained from the following formula:

$$\beta = \sqrt{1.1 - 0.5\left(\frac{S}{a}\right)^2} \quad maximum\ 1.0\ \left(\frac{a}{S} \geq 2.5\right)$$

Where:

S: Spacing (m) of horizontal or vertical rudder frames, whichever is smaller

a: Spacing (m) of horizontal or vertical rudder frames, whichever is greater

The rudder plating in way of the solid part is to be of increased thickness per **3.7.4**.

3.7 Connections of Rudder Blade Structure with Solid Parts

Paragraph 3.7.3 has been amended as follows.

3.7.3 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 (cm^3) formed by vertical web plates and rudder plating, which is connected with the solid part where the rudder stock is housed is to be not less than:

$$c_s d_l^{\,3}\left(\frac{H_E-H_X}{H_E}\right)^2 \frac{K_{pl}}{K_S} 10^{-4} (cm^3)$$

Where:

c_S :Coefficient, to be taken equal to:

c_S = 1.0 if there is no opening in the rudder plating or if such openings 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_l :Rudder stock diameter (mm)

H_E : Vertical distance between the lower edge of the rudder blade and the upper edge of the solid part (mm)

H_X : Vertical distance between the considered cross-section and the upper edge of the solid part (mm)

K_{pl} : Material factor for the rudder blade plating as given in **3.1.2**.

K_s: Material factor for the rudder stock as given in **3.1.2**.

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 (m) to be considered for the calculation of section modulus is to be not greater than:

$$b = s_V + 2\frac{H_X}{3}$$

Where:

s_V=: spacing between the two vertical webs (m) (*See* **Fig. CS3.56**)

Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted (*See* **Fig. CS3.56**).

Fig. CS3.5 has been renumbered to Fig. CS3.6.

Fig. CS3.56 Cross-section of the Connection between Rudder Blade Structure and Rudder Stock Housing (in cases where there is an opening on only one side) (Omitted)

3.9 Couplings between Rudder Stocks and Main Pieces

3.9.1 Horizontal Flange Couplings*

Sub-paragraph -5 has been amended as follows.

5 The welded joint between the rudder stock and the flange is to be made in accordance with **Fig.CS3.~~6~~7** or equivalent.

Fig. CS3.6 has been renumbered to Fig. CS3.7.

Fig. CS3.~~6~~7 Welded Joint between Rudder Stock and Coupling Flange
(Omitted)

3.9.3 Cone Couplings with Key

Sub-paragraphs -1 and -3 have been amended as follows.

1 Tapering and coupling length

Cone couplings that are mounted or dismounted without hydraulic arrangements (e.g. oil injection and hydraulic nut) are to have a taper c on diameter of 1:8 ~ 1:12. (*See* **Fig. CS3.~~7~~8** and **Fig.CS3.~~9~~10**)

Where:

$c = (d_0 - d_e)/\ell_c$

The diameters d_0 and d_u are shown in **Fig. CS3.~~7~~8** and the cone length ℓ_c is defined in **Fig. CS3.~~9~~10**.

The cone coupling is to be secured by a slugging nut. The nut is to be secured, e.g. by a securing plate.

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

2 (Omitted)

3 The dimensions of the slugging nut as specified in **-1** are to be as follows (*See* **Fig. CS3.~~7~~8**):

External thread diameter: $d_g \geq 0.65d_0$ (mm)

Height: $h_n \geq 0.6d_g$ (mm)

Outside diameter: $d_n \geq 1.2d_e$ or $1.5d_g$ (mm), whichever is greater

(-4 to -7 are omitted.)

Fig. CS3.7 has been renumbered to Fig. CS3.8.

Fig. CS3.~~7~~8 Cone Coupling with Key
(Omitted)

Fig. CS3.8 has been renumbered to Fig. CS3.9.

Fig. CS3.~~8~~9 Gudgeon Outer Diameter
(Omitted)

Fig. CS3.9 has been renumbered to Fig. CS3.10.

Fig. CS3.~~9~~10 Cone Length and Coupling Length
(Omitted)

Fig. CS3.10 has been renumbered to Fig. CS3.11.

Fig. CS3.~~10~~11 Cone Coupling without Key
(Omitted)

3.9.4 Cone Couplings with Special Arrangements for Mounting and Dismounting the Couplings*

Sub-paragraph -2 has been amended as follows.

2 Push-up pressure

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

$$p_{req1} = \frac{2M_Y}{d_m^2\,\ell\,\pi\,\mu_0}10^3 \quad (N/mm^2)$$

$$p_{req2} = \frac{6M_{\cancel{b}c}}{\ell^2\,d_m}10^3 \quad (N/mm^2)$$

Where:

M_Y : Design yield moment of rudder stock, as defined in **3.9.3-2** (*N-m*)

d_m : Mean cone diameter (*mm*) (*See* **Fig. CS3.~~7~~8**)

ℓ : Coupling length (*mm*)

μ_0 : Frictional coefficient, equal to 0.15

$M_{\cancel{b}c}$: Bending moment in rudder stock at the top of the cone coupling (e.g. in case of spade rudders) (*N-m*)

For spade rudder with trunk extending inside the rudder, the coupling is to be checked against the following two cases:

(1) pressure applied on the entire rudder area; and

(2) pressure applied only on rudder area below the middle of neck bearing.

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 is to be determined by the following formula:

$$p_{perm} = \frac{0.95\sigma_Y(1-\alpha^2)}{\sqrt{3+\alpha^4}} - p_b$$

$$p_b = \frac{3.5M_{\cancel{b}c}}{d_m\ell^2}10^3$$

Where:

σ_Y : Specified minimum yield stress (N/mm^2) of the material of the gudgeon

$$\alpha = \frac{d_m}{d_a}$$

d_m : Mean cone diameter (*mm*) (*See* **Fig. CS3.~~7~~8**)

d_a : Outer diameter of the gudgeon (*See* **Fig. CS3.~~7~~8** and **Fig. CS3.~~8~~9**. The least diameter is to be considered.) (*mm*)

The outer diameter of the gudgeon is not to be less than 1.25 d_0, with d_0 defined in **Fig. CS3.~~7~~8**.

3 Push-up length

The push-up length $\Delta\ell$ (*mm*) is to comply with the following formula:

$$\Delta\ell_1 \le \Delta\ell \le \Delta\ell_2$$

Where:

$$\Delta\ell_1 = \frac{p_{req} d_m}{E\left(\frac{1-\alpha^2}{2}\right) c} + \frac{0.8 R_{tm}}{c}$$

$$\Delta\ell_2 = \frac{p_{perm} d_m}{E\left(\frac{1-\alpha^2}{2}\right) c} + \frac{0.8 R_{tm}}{c}$$

R_{tm} : Mean roughness (*mm*) taken equal to about 0.01 *mm*

c : Taper on diameter according to **3.9.3-1**

E : Young's modulus (N/mm^2), to be taken as 2.06×10^5

Note: In case of hydraulic pressure connections the required push-up force P_e for the cone (N) may be determined by the following formula:

$$P_e = p_{req}\, d_m \pi\, \ell \left(\frac{c}{2} + 0.02\right)$$

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 the Society.

3.10 Pintles

3.10.2 Construction of Pintles

Sub-paragraph -2 has been amended as follows.

2 Push-up pressure for pintle

The required push-up pressure for pintle in case of dry fitting (N/mm^2) is to be determined by p_{req1} as given below. The required push-up pressure for pintle in case of oil injection fitting (N/mm^2) is to be determined by the ~~following formula:~~ maximum pressure of p_{req1} and p_{req2} as given below.

$$p_{req1} = 0.4 \frac{B d_0}{d_m^2\, \ell}$$

$$p_{req2} = \frac{6 M_{bp}}{\ell^2 d_m} \times 10^3 \ (N/mm^2)$$

Where:

B : As defined in **3.10.1**

d_m, ℓ : As defined in **3.9.4-2**

d_0 : Pintle diameter (*mm*) (*See* **Fig. CS3.~~7~~8**)

M_{bp}: bending moment in the pintle cone coupling (N-m) to be determined by:

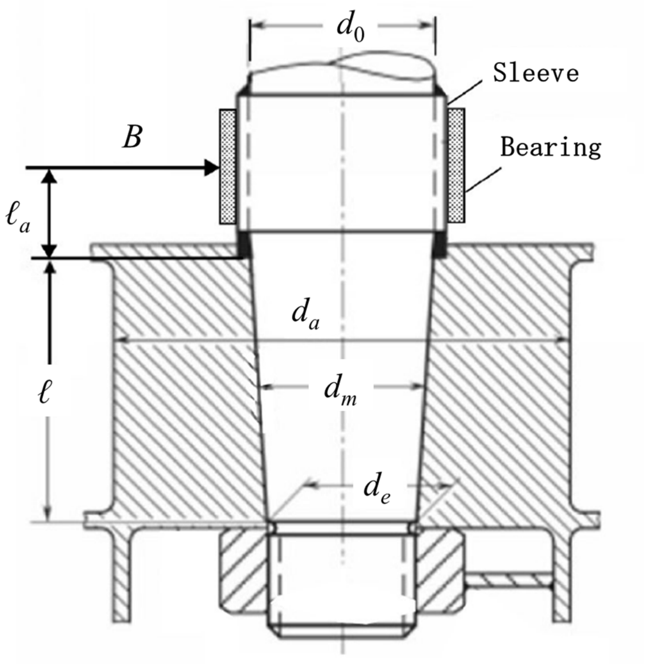
~~$M_{bp} = B\ell_a$~~

ℓ_a: Length between middle of pintle-bearing and top of contact surface between cone coupling and pintle (m) (*See* **Fig. CS3.12**)

The required push up length $\Delta\ell_1$ is to be calculated similarly as in **3.9.4-3**, using the required push-up pressure (as defined above) and properties for the pintle.

Fig. CS3.12 has been added as follows.

Fig. CS3.12 Pintle Cone Coupling Indicating ℓ_a



3.11 Bearings of Rudder Stocks and Pintles

3.11.1 Sleeves and Bushes

Sub-paragraph -1 has been amended as follows.

1 Rudder stock bearing

Sleeves and bushes are to be fitted in way of bearings. For rudder stocks and pintles having diameter less than 200 *mm*, sleeves in way of bushes may be provided optionally. The minimum thickness of sleeves and bushes is to be equal to:

- t_{min} = 8 *mm* for metallic materials and synthetic material
- t_{min} = 22 *mm* for lignum material

EFFECTIVE DATE AND APPLICATION (Amendment 2-4)

1. The effective date of the amendments is 1 July 2024.

2. Notwithstanding the amendments to the Rules, the current requirements apply to ships for which the date of contract for construction* is before the effective date.

3. For ships subject to Part C of the Rules for the Survey and Construction of Steel Ships and the Guidance for the Survey and Construction of Steel Ships prior to its comprehensive revision by Rule No.62 on 1 July 2022 and Notice No.47 on 1 July 2022 (herein after referred to as “old Part C of the Rules” and “old Part C of the Guidance”), and which the date of contract for construction* is on and after the effective date, this amendment also applies to following requirements.

2.2.8-2 and -3, old Part C of the Rules
3.1.3-3, old Part C of the Rules
Fig.C3.3, old Part C of the Rules (new)
3.2, old Part C of the Rules
3.3.1, old Part C of the Rules
3.3.2, old Part C of the Rules
3.5.2, old Part C of the Rules
3.6.1, old Part C of the Rules
3.7.3, old Part C of the Rules
3.8.1, old Part C of the Rules
3.8.3, old Part C of the Rules
3.8.4-2, old Part C of the Rules
3.9.2-2, old Part C of the Rules
Fig.C3.12, old Part C of the Rules (new)
3.10.1-1, old Part C of the Rules
C3.4.1-3, old Part C of the Guidance
Fig.C3.4.1-3, Fig.C3.4.1-6 and Fig.C3.4.1-7 (new), old Part C of the Guidance
C3.9.2-4, old Part C of the Guidance
C3.11.1-3, old Part C of the Guidance

* “contract for construction” is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of “contract for construction” of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of “contract for construction” of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a “series of vessels” if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of “contract for construction” for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a “new contract” to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of “contract for construction” of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part CS

Hull Construction and Equipment of Small Ships

GUIDANCE

2023 AMENDMENT NO.2

Notice No.63 22 December 2023

Resolved by Technical Committee on 27 July 2023

Notice No.63　　22 December 2023
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part CS　　HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS

Amendment 2-1

CS4　SUBDIVISIONS

CS4.2　Subdivision Index

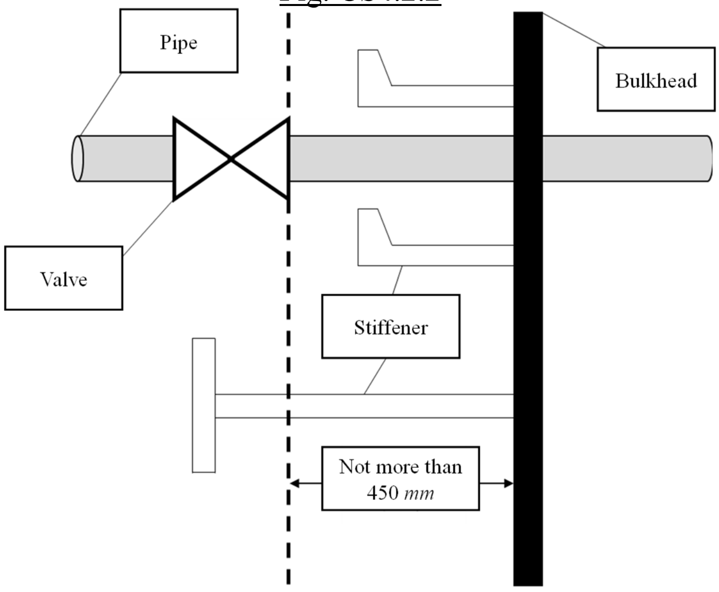
CS4.2.1　Subdivision Index

Sub-paragraph -8 has been amended as follows.

8　Pipes and valves directly adjacent or situated as close as practicable to a bulkhead or to a deck can be considered to be part of the bulkhead or deck, provided the separation distance on either side of the bulkhead or deck is of the same order as the bulkhead or deck stiffening structure. The same applies for small recesses, drain wells, etc. In no case is the separation distance on either side of the bulkhead or deck to be more than 450 *mm* measured from the valve's near end to the bulkhead or deck. An example is shown in **Fig. CS4.2.2**.

Fig. CS4.2.2 has been added as follows.

Fig. CS4.2.2



EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 1 January 2024.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to ships other than ships that fall under the following:

(1) for which the contract for construction is placed on or after the effective date; or

(2) in the absence of a contract for construction, the keels of which are laid or which are at *a similar stage of construction* on or after 1 July 2024; or

(3) the delivery of which is on or after 1 January 2028.

(Note) The term "*a similar stage of construction*" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 *tonnes* or 1% of the estimated mass of all structural material, whichever is the less.

Amendment 2-2

CS4 SUBDIVISIONS

CS4.2 Subdivision Index

Paragraph CS4.2.2 has been amended as follows.

CS4.2.2 Compartment Flooding Probability (p_i)

In application of the requirement of **4.2.2-1, Part CS** of the Rules, in case where the longitudinal bulkhead is not paralleled to the side shell plating, the assumed vertical plane which is considered in the determination of transverse distance (*b*) between longitudinal bulkhead and side shell plating is to be refer to a example specified in **Fig.CS4.2.~~2~~3**.

Fig. CS4.2.2 has been renumbered to Fig. CS4.2.3.

Fig. CS4.2.~~2~~3 Examples of Assumed Vertical Plane (In case of Single Damage Zone)
(Omitted.)

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2024.

Amendment 2-3

CS3 RUDDERS

CS3.4 Rudder Strength Calculation

CS3.4.1 Rudder Strength Calculation

Sub-paragraph -3(3) has been amended as follows.

3 Method of evaluating moments and forces

The method of evaluating moments and forces is to be as in the following **(1)** to **(3)** below.

((1) and (2) are Omitted)

(3) Simplified method

The moments and forces for rudders of each type may be obtained from the following formulae.

(a) Type *A* rudders

$$M_R = \frac{{B_1}^2(l_{10}+l_{30})}{2F_R} \ (N\text{-}m)$$

$$M_b = \frac{B_3(l_{30}+l_{40})(l_{10}+l_{30})^2}{l_{10}^2} \ (N\text{-}m)$$

$$M_s = B_3 l_{40} \ (N\text{-}m)$$

$$B_1 = \frac{F_R h_c}{l_{10}} \ (N)$$

$$B_2 = F_R - 0.8B_1 + B_3 \ (N)$$

$$B_3 = \frac{F_R {l_{10}}^2}{8l_{40}(l_{10}+l_{30}+l_{40})} \ (N)$$

(b) Type *B* rudders

$$M_R = \frac{{B_1}^2 l_{10}}{2F_R} \ (N\text{-}m)$$

$$M_b = B_3 l_{40} \ (N\text{-}m)$$

$$M_s = \frac{3M_R l_{30}}{l_{10}+l_{30}} \ (N\text{-}m)$$

$$B_1 = \frac{F_R h_c}{l_{10}+l_{30}} \ (N)$$

$$B_2 = F_R - 0.8B_1 + B_3$$

$$B_3 = \frac{F_R(l_{10}+l_{30})^2}{8l_{40}(l_{10}+l_{30}+l_{40})} \ (N)$$

(c) Type *C* rudders

$$M_b = F_R h_c \ (N\text{-}m)$$

$$B_2 = F_R + B_3 \ (N)$$

$$B_3 = \frac{M_b}{l_{40}} \ (N)$$

The maximum moment M_c in top of the cone coupling (as shown in **Fig.CS3.4.1-3.**) is applicable for the connection between the rudder and the rudder stocks.

Notwithstanding the above, ~~the value is as follow~~ the strength is to be checked against the following two cases for rudders with rudder trunks supporting rudder stocks.

i) pressure applied on the entire rudder area;

ii) pressure applied only on rudder area below the middle of the neck bearing.

The moments and forces for the two cases defined above may be determined according to **Fig. CS3.4.1-4** and **Fig. CS3.4.1-5**, respectively.

~~M_R is the greatest of the following values:~~

$M_{FR1} = F_{R1}\ (CG_{1Z} - l_{10})$

$M_{FR2} = F_{R2}\ (l_{10} - CG_{2Z})$

where A_1 and A_2 are the rudder blade area which are above the lower bearing and below respectively and symbols are as follows (*See* **Fig. CS3.4.1-4** and **Fig. CS3.4.1-5**)

F_{R1} : Rudder force over the rudder blade area A_1

F_{R2} : Rudder force over the rudder blade area A_2

CG_{1Z}: Vertical position of the centre of gravity of the rudder blade area A_1 from base

CG_{2Z}: Vertical position of the centre of gravity of the rudder blade area A_2 from base

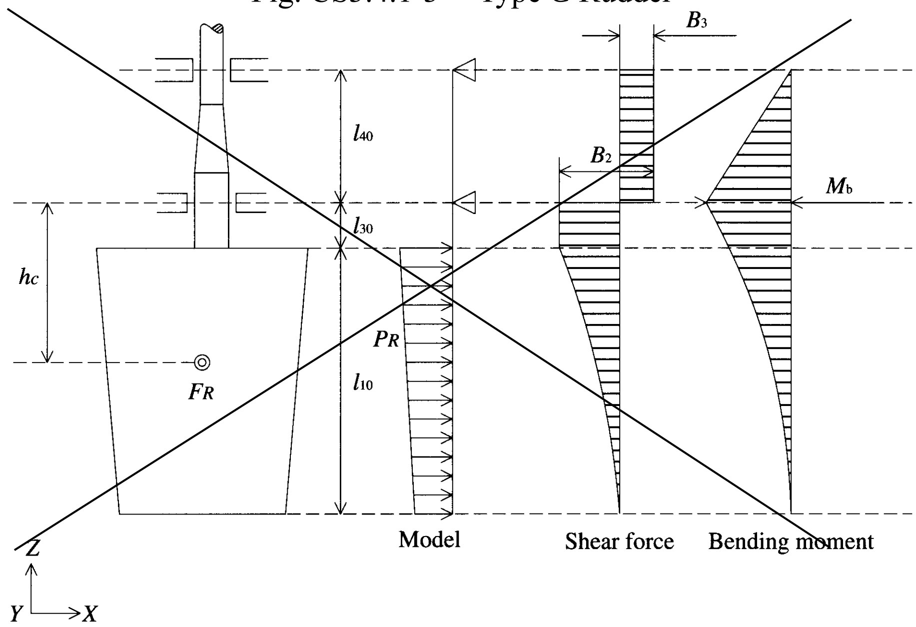
$F_R = F_{R1} + F_{R2}$

$B_2 = F_R + B_3$

$$B_3 = \frac{M_{FR2} - M_{FR1}}{\ell_{20} + \ell_{40}}$$

Fig. CS3.4.1-3 has been amended as follows.

Fig. CS3.4.1-3 Type *C* Rudder



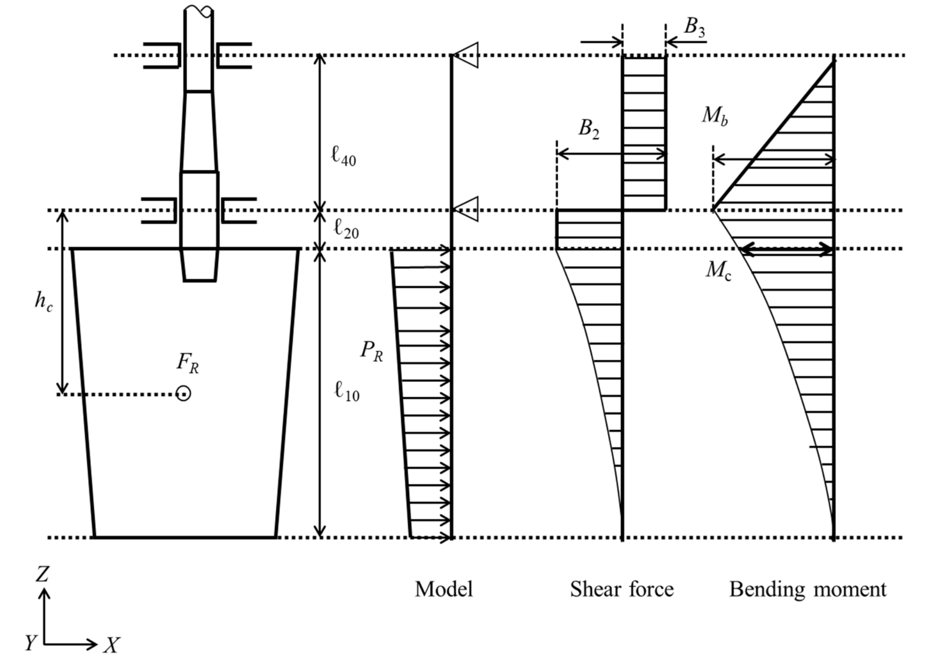
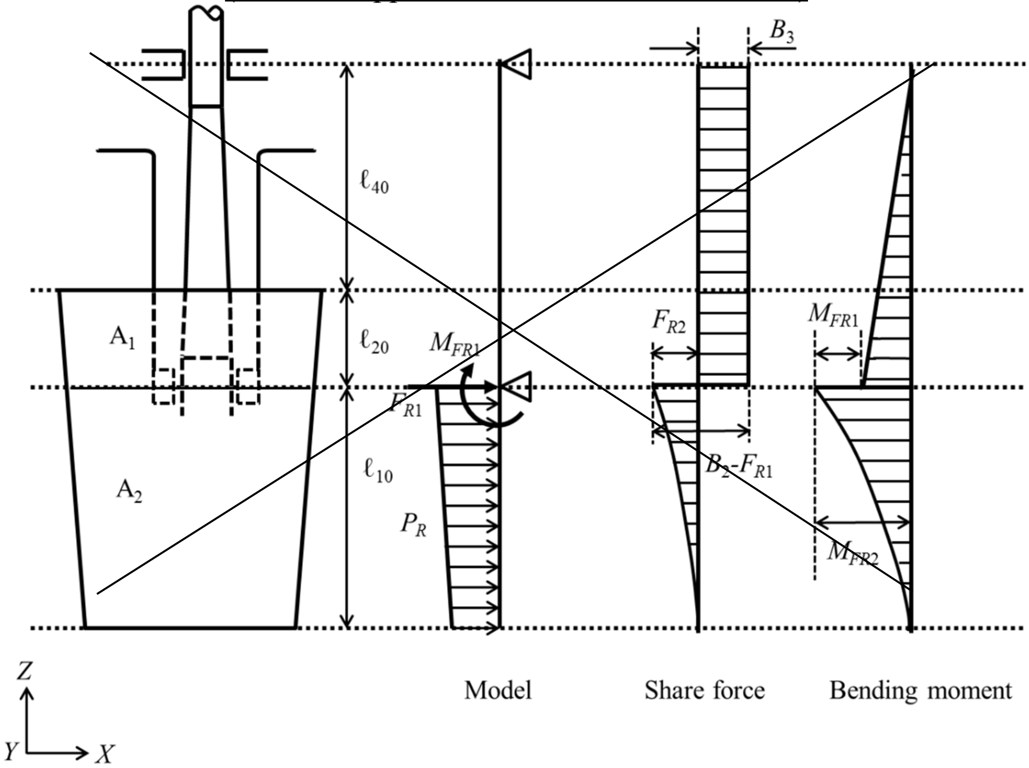


Fig. CS3.4.1-4 has been amended as follows.

Fig. CS3.4.1-4 Type *C* Rudder with Rudder Trunk Supporting Rudder Stock
(Pressure Applied on the Entire Rudder Area)



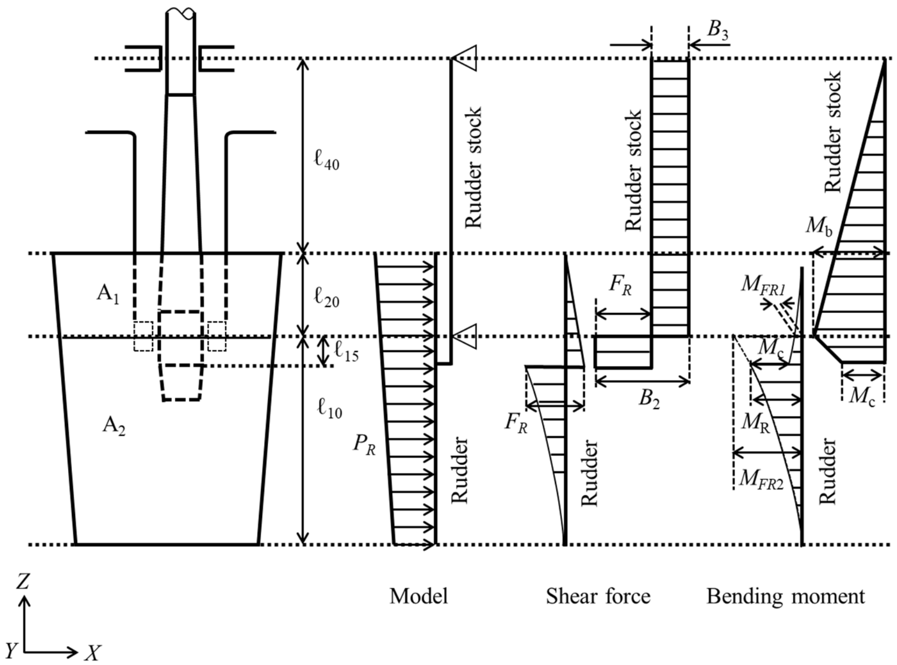
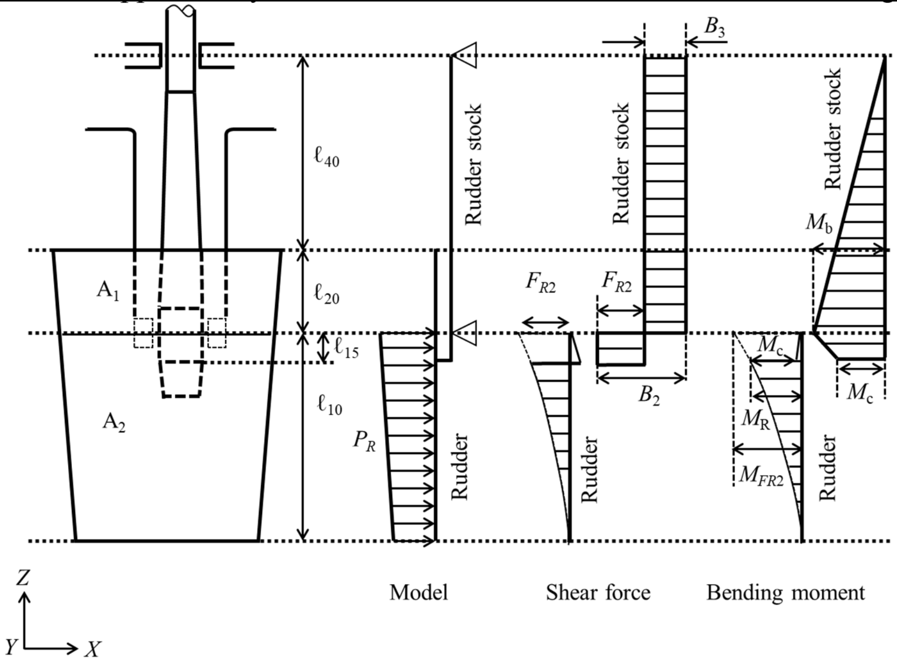


Fig. CS3.4.1-5 has been added as follows.

<ins>Fig. CS3.4.1-5 Type *C* Rudder with Rudder Trunk Supporting Rudder Stock</ins>
<ins>(Pressure applied only on rudder area below the middle of neck bearing)</ins>



CS3.12 Rudder Accessories

CS3.12.1 Rudder Carriers

Sub-paragraph -3(1) has been amended as follows.

3 Watertightness of rudder carrier part

(1) 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 <ins>at scantling draught (without trim),</ins> two separate <ins>watertight seals or</ins> stuffing boxes are to be provided.

(2) It is recommended that the packing gland in the stuffing box have an appropriate clearance from the rudder stock corresponding to the position of the stuffing box. The standard clearance is to be 4 *mm* for the stuffing box provided at the neck or intermediate bearing, and 2 *mm* for the stuffing box at the upper stock bearing.

EFFECTIVE DATE AND APPLICATION (Amendment 2-3)

1. The effective date of the amendments is 1 July 2024.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to ships for which the date of contract for construction* is before the effective date.

3. For ships subject to Part C of the Rules for the Survey and Construction of Steel Ships and the Guidance for the Survey and Construction of Steel Ships prior to its comprehensive revision by Rule No.62 on 1 July 2022 and Notice No.47 on 1 July 2022 (herein after referred to as “old Part C of the Rules” and “old Part C of the Guidance”), and which the date of contract for construction* is on and after the effective date, this amendment also applies to following requirements.

2.2.8-2 and -3, old Part C of the Rules
3.1.3-3, old Part C of the Rules
Fig.C3.3, old Part C of the Rules (new)
3.2, old Part C of the Rules
3.3.1, old Part C of the Rules
3.3.2, old Part C of the Rules
3.5.2, old Part C of the Rules
3.6.1, old Part C of the Rules
3.7.3, old Part C of the Rules
3.8.1, old Part C of the Rules
3.8.3, old Part C of the Rules
3.8.4-2, old Part C of the Rules
3.9.2-2, old Part C of the Rules
Fig.C3.12, old Part C of the Rules (new)
3.10.1-1, old Part C of the Rules
C3.4.1-3, old Part C of the Guidance
Fig.C3.4.1-3, Fig.C3.4.1-6 and Fig.C3.4.1-7 (new), old Part C of the Guidance
C3.9.2-4, old Part C of the Guidance
C3.11.1-3, old Part C of the Guidance

* “contract for construction” is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of “contract for construction” of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of “contract for construction” of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.
For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a “series of vessels” if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:
(1) such alterations do not affect matters related to classification, or
(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.
The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of “contract for construction” for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a “new contract” to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of “contract for construction” of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.