

# **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**

**2016 AMENDMENT NO.1**

**Guidance for the Survey and Construction of Steel Ships**

**Part CS**

**2016 AMENDMENT NO.1**

Rule No.40 / Notice No.39      30th June 2016

Resolved by Technical Committee on 5th February 2016

Approved by Board of Directors on 22nd February 2016

**ClassNK**  
NIPPON KAIJI KYOKAI

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**Part CS**

**Hull Construction and Equipment of  
Small Ships**

**RULES**

## **2016 AMENDMENT NO.1**

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Approved by Board of Directors on 22nd February 2016

Rule No.40 30th June 2016

## 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 1-1

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

##### **21.6 Ventilators**

##### **21.6.2 Thickness of Ventilator Coamings**

Sub-paragraph -1 has been amended as follows.

1 The thickness of ventilator coamings in Positions I and II specified in 19.1.2 leading to spaces below the freeboard deck or within enclosed superstructures is not to be less than that given by Line 1 in **Table CS21.7**. Where the height of the coamings is reduced by the provisions in **21.6.1**, the thickness may be suitably reduced.

##### **21.6.5 Closing Appliances**

Sub-paragraph -2 has been amended as follows.

2 All ventilator openings in exposed positions on the freeboard and superstructure decks are to be provided with efficient weathertight closing appliances. Where ~~the height of~~ the coaming of any ventilator ~~exceeds~~ extends to more than 4.5 m above the surface of the deck ~~for the freeboard deck, raised quarter decks and superstructure decks in 0.25L, forward in Position I or more than 2.3 m for the other superstructure decks~~ above the surface of the deck in Position II specified in **19.1.2**, such closing appliances may be omitted unless required in -1.

Paragraph 21.6.7 has been amended as follows.

##### **21.6.7 Ventilators for Emergency Generator Room**

The ~~height of~~ coamings of ventilators supplying the emergency generator room is to ~~be at least~~ extend to more than 4.5m above the surface of the deck ~~in Position I for the freeboard deck, raised quarter decks and superstructure decks in 0.25L, forward, and more than 2.3m for the other superstructure decks~~ above the surface of the deck in Position II specified in **19.1.2**. The ventilator openings are not to be fitted with weathertight closing appliances. However, where due to vessel size and arrangement this requirement is not practicable, the height of ventilator coamings is to be

at the discretion of the Society.

#### EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 30 June 2016.

## Chapter 1 GENERAL

### 1.3 Materials, Scantlings, Welding and End Connections

#### 1.3.1 Materials

Table CS1.1 has been amended as follows.

Table CS1.1 Application of Mild Steels for Various Structural Members

Structural member	Application	Thickness of plate : $t(mm)$					
		$t \leq 15$	$15 < t \leq 20$	$20 < t \leq 25$	$25 < t \leq 30$	$30 < t \leq 40$	$40 < t \leq 50$
(omitted)							
Cargo Hatch							
Cargo hatch coaming longitudinally extended on the strength deck over $0.15L$ (including face plate and its flange, but excluding other stiffeners)	within $0.4L$ amidship	$A$	$B$	$D$		$E$	
Hatch cover	<del>top plates, bottom plates and primary supporting members</del>	$A$			$B$	$D$	
Stern							
Stern frame, rudderhorn, rudder trunk, shaft bracket	—	$A$			$B$	$D$	
Rudder							
Rudder Plate	—	$A$			$B$	$D$	
Other							
Other members than those mentioned above (including stiffeners)		$A$					

(Notes are omitted.)

Table CS1.2 has been amended as follows.

Table CS1.2 Application of High Tensile Steels for Various Structural Members

Structural member	Application	Thickness of plate : $t(mm)$					
		$t \leq 15$	$15 < t \leq 20$	$20 < t \leq 25$	$25 < t \leq 30$	$30 < t \leq 40$	$40 < t \leq 50$
(Omitted)							
Cargo Hatch							
Cargo hatch coaming longitudinally extended on the strength deck over $0.15L$ (including face plate and its flange, but excluding other stiffeners)	within $0.4L$ amidship	<i>AH</i>			<i>DH</i>		<i>EH</i>
Hatch cover	<del>—top plates, bottom plates and primary supporting members</del>	<i>AH</i>					<i>DH</i>
Stern							
Stern frame, rudder horn, rudder trunk, shaft bracket	—	<i>AH</i>					<i>DH</i>
Rudder							
Rudder Plate	—	<i>AH</i>					<i>DH</i>
Other							
Other members than those mentioned above (including stiffeners)		<i>AH</i>					

(Notes are omitted.)

## Chapter 2 STEMS AND STERN FRAMES

### 2.2 Stern Frames

Paragraph 2.2.7 has been added as follows.

#### **2.2.7 Rudder trunk**

##### **1 Materials, welding and connection to hull**

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

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

The fillet shoulder radius  $r$  (mm) (See Fig.CS2.3) is to be as large as practicable and to comply with the following formulae:

$$r = 60 \quad \text{when} \quad \sigma \geq 40 / K_s \quad (N/mm^2)$$

$$r = 0.1d_i \text{ without being less than } 30, \quad \text{when} \quad \sigma < 40 / K_s \quad (N/mm^2)$$

Where

$d_i$ : rudder stock diameter axis defined in 3.5.2.

$\sigma$ : bending stress in the rudder trunk ( $N/mm^2$ ).

$K_s$ : material factor 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.

##### **2 Scantlings**

Where the rudder stock is arranged in a trunk in such a way that the trunk is stressed by forces due to rudder action, the scantlings of the trunk are to be such that:

- the equivalent stress due to bending and shear does not exceed  $0.35 \sigma_{Y_2}$ .

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

$$\sigma \leq 80 / K_s \quad (N/mm^2)$$

with:

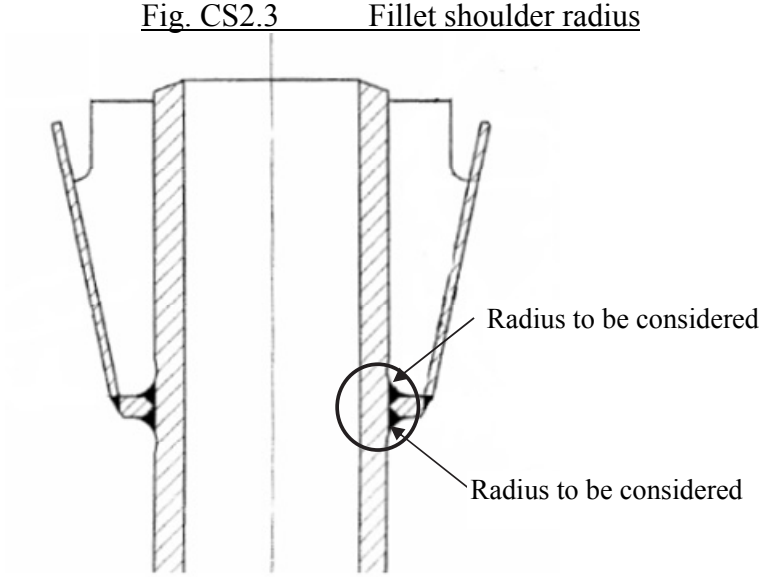
$\sigma$ : As defined in -1.

$K_s$ : Material factor for the rudder trunk as given in 3.1.2, not to be taken less than 0.7

$\sigma_{Y_2}$ : 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.

Fig. CS2.3 has been added as follows.





Chapter 3 has been amended as follows.

## **Chapter 3 RUDDERS**

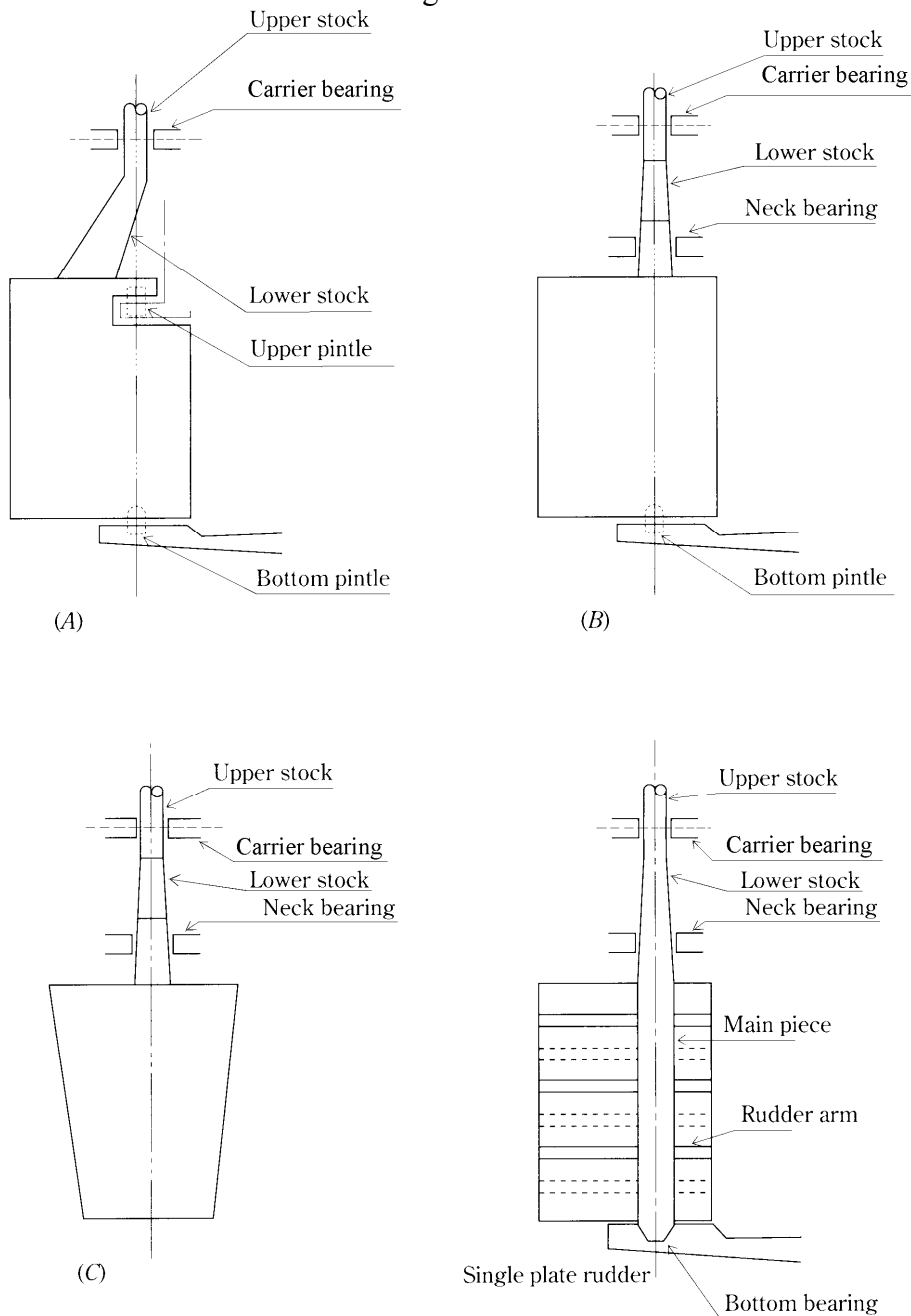
### **3.1 General**

#### **3.1.1 Application**

**1** The requirements in this Chapter apply to double plate rudders of stream line section and ordinary shape, being divided into the following types, and single plate rudders.

- (1) Type *A*: Rudders with upper and bottom pintles (*See Fig. CS3.1 (A)*)
- (2) Type *B*: Rudders with neck bearing and bottom pintle (*See Fig. CS3.1 (B)*)
- (3) Type *C*: Rudders having no bearing below the neck bearing (*See Fig. CS3.1 (C)*)

Fig CS3.1



2 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 The construction of rudders designed to move more than 35 degrees on each side will be specially considered by the Society.

### 3.1.2 Materials

1 Welded members of rudders such as rudder plates, rudder frames, rudder main pieces are to be made of rolled steel conforming to the requirements in Part K of the Rules.

2 The required scantlings may be reduced when high tensile steels are used. When reducing the scantling, the material factor  $K$  is to be the values specified in 1.3.1-2(1).

3 Rudder stocks, pintles, coupling bolts, keys, edge bars, and cast parts of rudders are to be made

of rolled steel, steel forging or carbon steel casting conforming to the requirements in **Part K of the Rules**.

**4** For rudder stocks, pintles, coupling bolts, keys, and edge bars, the minimum yield stress is not to be less than  $200 \text{ N/mm}^2$ . The requirements in this Chapter are for materials with a yield stress of  $235 \text{ N/mm}^2$ . If materials having a yield stress differing from  $235 \text{ N/mm}^2$  are used, the material factor  $K$  is to be determined by the following formula.

$$K = \left[ \frac{235}{\sigma_Y} \right]^e$$

Where:

$e$ : 0.75 for  $\sigma_Y > 235 \text{ N/mm}^2$

$e$ : 1.00 for  $\sigma_Y \leq 235 \text{ N/mm}^2$

Where:

$\sigma_Y$ : Yield stress ( $\text{N/mm}^2$ ) of material used, and is not to be taken as greater than  $0.7 \sigma_B$  or  $450 \text{ N/mm}^2$ , whichever is the smaller

$\sigma_B$ : Tensile strength ( $\text{N/mm}^2$ ) of material used

~~**25**~~ When the rudder stock diameter is reduced because of using steels with a yield stresses exceeding  $235 \text{ N/mm}^2$ , special consideration is to be given to deformation of the rudder stock to avoid excessive edge pressures at the edge of bearings.

~~**3**~~ ~~Welded members of rudders such as rudder plates, rudder frames, rudder main pieces are to be made of rolled steel conforming to the requirements in Part K of the Rules. The required scantlings may be reduced when high tensile steels are used.~~

~~When reducing the scantling, the material factor  $K$  is to be the values specified in 1.3.1-2(1).~~

### **3.1.3 Welding and design details**

**1** Slot welding is to be limited as far as possible. Slot welding is not to be used in areas with large in-plane stresses transversely to the slots or in way of cut-out areas of Type A rudder.

When slot welding is applied, the length of slots is to be minimum  $75 \text{ mm}$  with breadth of  $2t$ , where  $t$  is the rudder plate thickness ( $\text{mm}$ ). The distance between ends of slots is not to be more than  $125 \text{ mm}$  (See Fig. CS3.2). The slots are to be fillet welded around the edges and filled with a suitable compound, e.g. epoxy putty. Slots are not to be filled with weld.

Continuous slot welds may be used in lieu of slot welds. When continuous slot welding is applied, the root gap is to be between  $6\text{-}10 \text{ mm}$ . The bevel angle is to be at least  $15^\circ$  (See Fig. CS3.2).

**2** In way of the rudder horn recess of Type A rudder the radii in the rudder plating are not to be less than  $5 \text{ times}$  the plate thickness, but in no case less than  $100 \text{ mm}$ . Welding in side plate are to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.

**3** Welds between plates and heavy pieces (solid parts in forged or cast steel or very thick plating) are to be made as full penetration welds. In way of highly stressed areas e.g. cut-out of 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. Other welding procedures, however, may be approved when deemed appropriate by the Society.

**4** Requirements for welding and design details of rudder trunks are described in 2.2.7.

**5** Requirements for welding and design details when the rudder stock is connected to the rudder by horizontal flange coupling are described in 3.9.1-5.

**3.1.4 Equivalence**

- 1 The Society may accept alternatives to requirements given in this Chapter, provided they are deemed to be equivalent.
- 2 Direct analyses adopted to justify an alternative design are to take into consideration all relevant modes of failure, on a case by case basis. These failure modes may include, amongst others: yielding, fatigue, buckling and fracture. Possible damages caused by cavitation are also to be considered.
- 3 If deemed necessary by the Society, lab tests, or full scale tests may be requested to validate the alternative design approach.

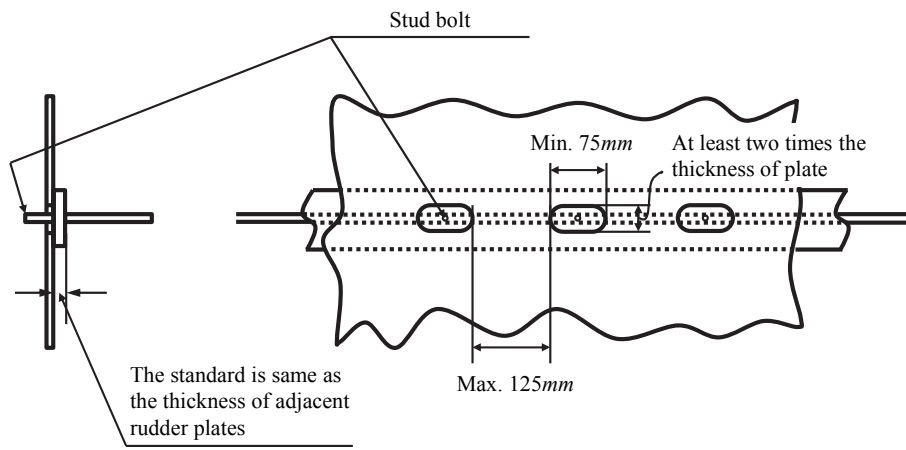
**3.1.35 Increase in Diameter of Rudder Stock for Special Cases**

- 1 In ships which may be frequently steered at a large helm angle when sailing at their maximum speed, such as fishing vessels, the diameters of rudder stocks and pintles, as well as the section modulus of main pieces, are not to be less than 1.1 *times* those required in this Chapter.
- 2 In ships which might require quick steering, the diameter of rudder stocks is to be properly increased beyond the requirements in this Chapter.

**3.1.46 Sleeves and bushes**

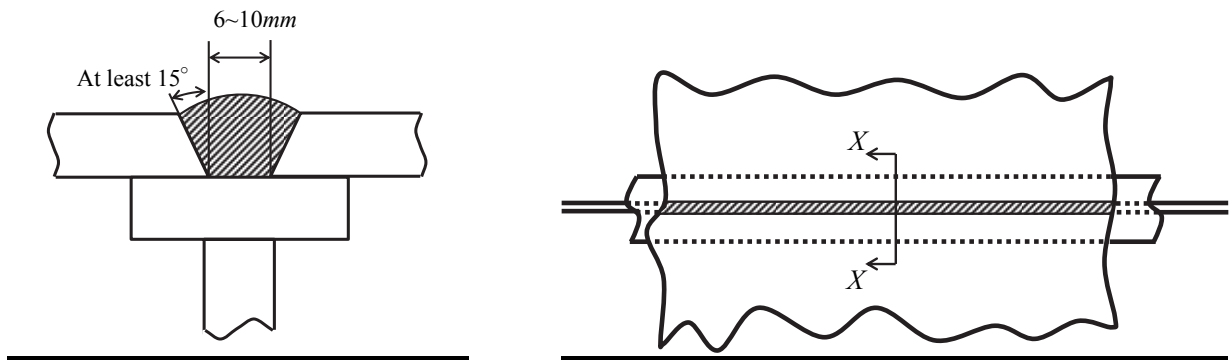
Bearings located up to well above the designed maximum load line are to be provided with sleeves and bushes.

Fig. CS3.2 Slot welding and Continuous slot welding



Note: The standard leg length of slot welding is  $F_1$ .

(a) Slot welding



[Section X-X]

(b) Continuous slot welding

### 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.

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

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.

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

For the astern condition, the astern speed  $V_a$  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.

$$V_a = 0.5V \quad (kt)$$

Where:

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

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

~~Where:~~

$A$ : As obtained from the following formula

However,  $A$  is not required to be greater than 2.

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

~~Where:~~

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

**CS3.23**

$A_t$ : 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. CS3.23 Coordinate system of rudders

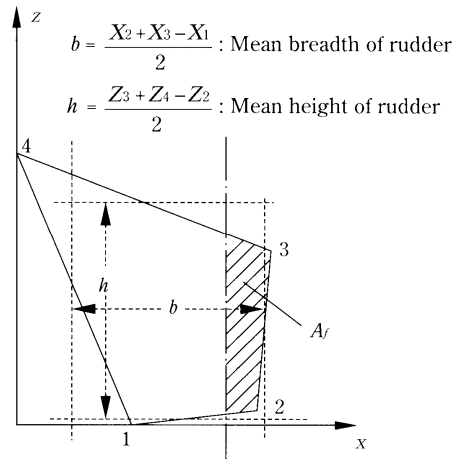
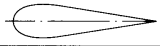

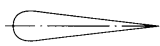


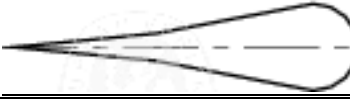

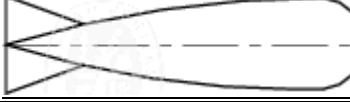
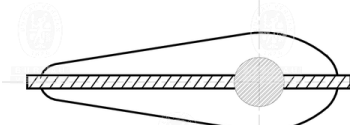


Table CS3.1 Factor  $K_2$

Profile type	$K_2$	
	Ahead condition	Astern condition
NACA-00 Göttingen-profiles 	1.1	0.80
Hollow profiles 	1.35	0.90
Flat side profiles 	1.1	0.90

Profile Type	$K_r$	
	Ahead condition	Astern condition
NACA-00 series Göttingen 	1.10	0.80
Flat side 	1.10	0.90
Hollow 	1.35	0.90
High lift rudders 	1.70	to be specially considered; if not known: 1.30
Fish tail 	1.40	0.80
Single plate 	1.00	1.00
Mixed profiles (e.g. HSVA)	1.21	0.90

### 3.3 Rudder Torque

#### 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.

$$T_R = F_R r \quad (N-m)$$

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.

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

Where:

$b$ : Mean breadth (m) of rudder determined by the coordinate system in **Fig. CS3.23**

$\alpha$ : 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

### 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:

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

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

$$T_{Rmin} = 0.1F_R \frac{A_1b_1 + A_2b_2}{A} \quad (N-m)$$

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.

**CS3.34**.  $A_{1f}$  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. **CS3.23**

$F_R$  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.

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

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

$F_{R1}$  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.

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

$\alpha$  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

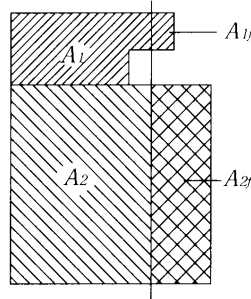
For astern condition: 0.66

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. CS3.34 Division of rudder



### 3.4 Rudder Strength Calculation

#### 3.4.1 Rudder Strength Calculation

1 The rudder strength is to be sufficient to withstand the rudder force and rudder torque as given in 3.2 and 3.3. When the scantling of each part of a rudder is determined, the following moments and forces are to be considered.

For rudder body: bending moment and shear force

For rudder stock: bending moment and torque

For pintle bearing and rudder stock bearing: supporting force

2 The bending moments, shear forces, and supporting forces to be considered are to be determined by direct calculation or by a simplified approximation method as deemed appropriate by the Society.

### 3.5 Rudder Stocks

#### 3.5.1 Upper Stocks

The diameter  $d_u$  of the upper stock, which is the stock above the bearing centre of the rudder carrier required for the transmission of the rudder torque, is to be determined such that torsional stress does not exceed  $68/K_S$  ( $N/mm^2$ ).

Considering this, the diameter of the upper stock may be determined by the following formula:

$$d_u = 4.2\sqrt[3]{T_R K_S} \quad (mm)$$

Where:

$T_R$ : As specified in 3.3

$K_S$ : Material factor for rudder stock, as given in 3.1.2

#### 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  $\sigma_e$  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:

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

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

Where:

$M$ : Bending moment ( $N\cdot m$ ) 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:

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

Where:

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

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

#### 3.6.1 Rudder Plate

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

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

Where:

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

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

$\beta$ : To be obtained from the following formula:

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

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**.

#### 3.6.2 Rudder Frames

**1** The rudder body is to be stiffened by horizontal and vertical rudder frames enabling it to withstand bending like a girder.

**2** The standard spacing of horizontal rudder frames is to be obtained from the following formula:

$$0.2 \left( \frac{L}{100} \right) + 0.4 \text{ (m)}$$

**3** The standard distance from the vertical rudder frame forming the rudder main piece to the adjacent vertical frame is to be 1.5 times the spacing of horizontal rudder frames.

**4** The thickness of rudder frames is not to be less than 8  $mm$  or 70% of the thickness of the rudder plates as given in **3.6.1**, whichever is greater.

#### 3.6.3 Rudder Main Pieces

**1** Vertical rudder frames forming the rudder main piece are to be arranged forward and afterward

of the centreline of the rudder stock at a distance approximately equal to the thickness of the rudder if the main piece consists of two rudder frames, or at the centreline of the rudder stock if the main piece consists of one rudder frame.

2 The section modulus of the main piece is to be calculated in conjunction with the vertical rudder frames specified in -1 above and the rudder plates attached thereto. The breadth of the rudder plates normally taken for the calculation is to be as follows:

(1) Where the main piece consists of two rudder frames, the breadth is 0.2 *times* the length of the main piece.

(2) Where the main piece consists of one rudder frame, the breadth 0.16 *times* the length of the main piece.

3 The section modulus and the web area of a horizontal section of the main piece are to be determined so that bending stress, shear stress and equivalent stress should not exceed the following stresses, respectively.

$$\text{Bending stress: } \sigma_b = \frac{110}{K_m} \text{ (N/mm}^2\text{)}$$

$$\text{Shear stress: } \tau = \frac{50}{K_m} \text{ (N/mm}^2\text{)}$$

$$\text{Equivalent stress: } \sigma_e = \sqrt{\sigma_b^2 + 3\tau^2} = \frac{120}{K_m} \text{ (N/mm}^2\text{)}$$

Where:

$K_m$ : Material factor for the rudder main piece as given in 3.1.2

In the case of a Type A rudder, however, the section modulus and the web area of a horizontal section of the main piece in way of cut-outs are to be determined so that bending stress, shear stress and equivalent stress should not exceed the following stresses, respectively, regardless of high tensile or ordinary steels.

$$\text{Bending stress: } \sigma_b = \frac{75}{K_m} \text{ (N/mm}^2\text{)}$$

$$\text{Shear stress: } \tau = \frac{50}{K_m} \text{ (N/mm}^2\text{)}$$

$$\text{Equivalent stress: } \sigma_e = \sqrt{\sigma_b^2 + 3\tau^2} = \frac{100}{K_m} \text{ (N/mm}^2\text{)}$$

~~Where:~~

~~$K_m$ : Material factor for the rudder main piece as given in 3.1.2~~

4 The upper part of the main piece is to be so constructed as to avoid structural discontinuity.

5 The maintenance openings ~~and the rudder plate cut-out of Type A rudders~~ are to be rounded off properly.

### 3.6.4 Connections

Rudder plates are to be effectively connected to rudder frames, free from defects, with due attention paid to the workmanship.

### 3.6.5 Painting and draining

The internal surfaces of rudders are to be coated with effective paint, and a means for draining is to be provided at the bottom of the rudders.

### **3.7 Connections of rudder blade structure with solid parts**

#### **3.7.1 Solid part protrusions**

Solid parts in forged or cast steel, which house the rudder stock or the pintle, are normally to be provided with protrusions.

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

- 10 mm for web plates welded to the solid part on which the lower pintle of Type A rudders is housed and for vertical web plates welded to the solid part of the rudder stock coupling of Type C rudders.
- 20 mm for other web plates.

#### **3.7.2 General**

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

#### **3.7.3 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:

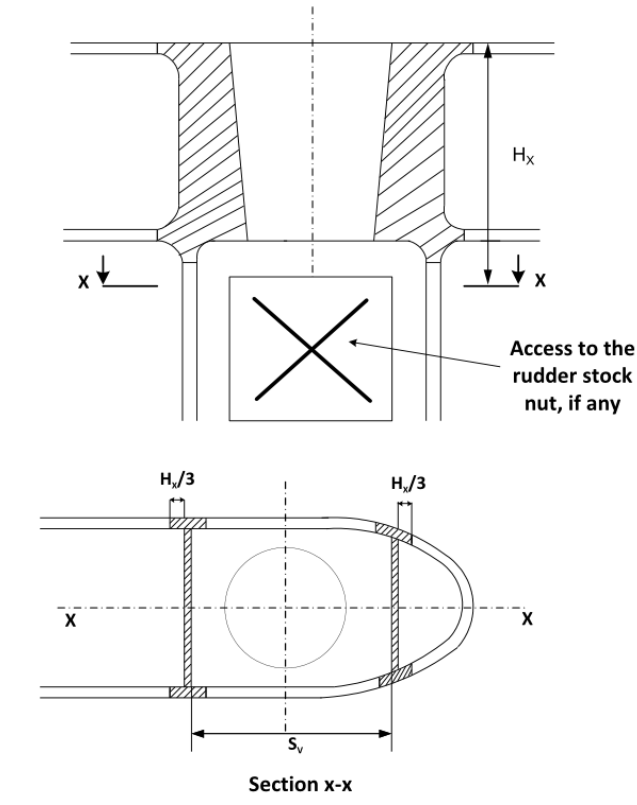
$$b = s_V + 2 \frac{H_X}{3}$$

Where:

$s_V$  = spacing between the two vertical webs ( $m$ ) (See Fig. CS3.5)

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. CS3.5).

**Fig. CS3.5** Cross-section of the connection between rudder blade structure and rudder stock housing



### **3.7.4** Thickness of the Horizontal Web Plates

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

$$t_H = 1.2 t$$

$$t_H = 0.045 \frac{d_S^2}{s_H}$$

Where:

$t$  : As defined in 3.6.1

$d_S$ : Diameter (mm) to be taken equal to:

$d_l$  for the solid part housing the rudder stock

$d_p$  for the solid part housing the pintle

$d_l$  : Rudder stock diameter (mm) defined in 3.5.2

$d_p$ : Pintle diameter (mm) defined in 3.10.1

$s_H$ : Spacing between the two horizontal web plates (mm).

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

### **3.7.5** Thickness of the Vertical Web Plates

The thickness of the vertical web plates welded to the solid part where the rudder stock is housed as well as the thickness of the rudder side plating under this solid part is to be not less than the values obtained (mm) from Table CS3.2.

The increased thickness is to extend below the solid piece at least to the next horizontal web.

Table CS3.2 Thickness of side plating and vertical web plates

Type of rudder	Thickness of vertical web plates (mm)		Thickness of rudder plating (mm)	
	Rudder blade without opening	Rudder blade with opening	Rudder blade without opening	Area with opening
Type A, B and single plate rudders	1.2t	1.6t	1.2t	1.4t
Type C rudders	1.4t	2.0t	1.3t	1.6t

t = thickness of the rudder plating, in mm, as defined in 3.6.1

### 3.78 Rudder Plates, Rudder Arms and Rudder Main Pieces of Single Plate Rudders

#### 3.78.1 Rudder Plates

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

$$t = 1.5SV\sqrt{K_{pl}} + 2.5 \quad (mm)$$

Where:

$S$ : Spacing (m) of rudder arms, not to exceed 1 (m)

$V$ : Ship speed (kt) as specified in 3.2

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

#### 3.78.2 Rudder Arms

1 The thickness of rudder arms is not to be less than that of rudder plates.

2 The section modulus of rudder arms is not to be less than the value obtained from the following formula. This section modulus, however, may be reduced gradually toward the edge of the rudder plate.

$$0.5SC_1^2V^2K_a \quad (cm^3)$$

Where:

$C_1$ : Horizontal distance (m) from the aft edge of the rudder plate to the centre of the rudder stock

$K_a$ : Material factor for the rudder arm as given in 3.1.2

$S$  and  $V$ : As specified in 3.78.1

#### 3.78.3 Rudder Main Pieces

The diameters of main pieces are not to be less than those of lower rudder stocks. In rudders having no bearing below the neck bearing, the main piece diameter may be reduced gradually within the lower 1/3 area of the rudder, and may be 75% of the specified diameter at the bottom part.

### 3.89 Couplings between Rudder Stocks and Main Pieces

#### 3.89.1 Horizontal Flange Couplings

1 Coupling bolts are to be reamer bolts, and at least 6 reamer bolts are to be provided in each coupling.

2 The diameter of coupling bolts  $d_b$  is not to be less than the dimension obtained from the following formula:

$$d_b = 0.62\sqrt{\frac{d^3 K_b}{ne_m K_S}} \quad (mm)$$

Where:

$d$ : Stock diameter (mm), the greater of the diameters  $d_u$  or  $d_l$  according to 3.5.1 and 3.5.2

$n$ : Total number of bolts

$e_m$ : Mean distance (mm) of the bolt axes from the centre of the bolt system

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

$K_b$ : Material factor for the bolts as given in 3.1.2

- 3 The thickness of the coupling flanges  $t_f$  is not to be less than that determined by the following formula, provided that the thickness is not less than  $0.9d_b$  (mm).

$$t_f = d_b \sqrt{\frac{K_f}{K_b}} \quad (\text{mm})$$

Where:

$K_f$ : Material factor for flange as given in 3.1.2

$K_b$ : As specified in -2

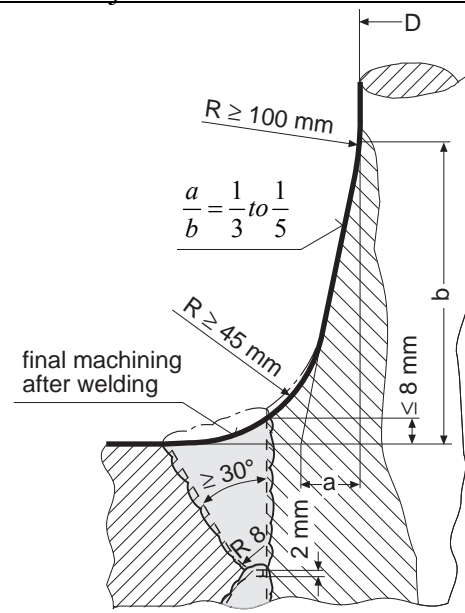
$d_b$ : Bolt diameter (mm), determined by a number of bolts not exceeding 8

- 4 The width of material outside between the perimeter of the bolt holes of the coupling flanges and the perimeter of the flange is not to be less than  $0.67d_b$  (mm).

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

- 6 Coupling bolts are to be fitted bolts and their nuts are to be locked effectively.

Fig. CS3.6 Welded joint between rudder stock and coupling flange



### 3.8.39.2 Vertical Flange Couplings

- 1 Coupling bolts are to be reamer bolts, and at least 8 reamer bolts are to be used in each coupling.

- 2 The diameter of the coupling bolts  $d_b$  is not to be less than the dimension obtained from the following formula.

$$d_b = \frac{0.81d}{\sqrt{n}} \sqrt{\frac{K_b}{K_s}} \quad (\text{mm})$$

Where:

$d$ : Stock diameter (mm), the greater of the diameters  $d_u$  or  $d_l$  according to 3.5.1 and 3.5.2

$n$ : Number of bolts

$K_b$ : Material factor for bolts as given in 3.1.2

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

3 The first moment of area  $M$  of the bolts about the centreline of the coupling flange is not to be less than the value obtained from the following formula:

$$M = 0.00043d^3 \text{ (cm}^3\text{)}$$

4 The thickness of the coupling flanges is not to be less than the bolt diameter.

5 The width of the flange material outside between the perimeter of the bolt holes and the perimeter of the flange is not to be less than  $0.67d_b$  (mm).

6 Coupling bolts are to be fitted bolts and their nuts are to be locked effectively.

### **3.8.29.3 Cone Couplings with Key**

#### **1 Tapering and coupling length**

Cone couplings that are mounted or dismounted without hydraulic arrangements (e.g. oil injection and hydraulic nut) are to ~~be tapered~~ have a taper  $c$  on diameter of 1:8 ~ 1:12 ~~of the diameter~~. (See Fig. CS3.47)

Where:

$$c = (d_0 - d_u) / \ell$$

~~The taper length  $\ell$  of rudder stocks fitted into the rudder plate and secured by the slugging nut is generally not to be less than 1.5 times the rudder stock diameter  $d_u$  at the top of the rudder. In this case, for couplings between stock and rudder, a key is to be provided. The scantling of the key is to be to the discretion of the Society.~~

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  $\ell$  is to be, in general, not less than  $1.5d_u$ .

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

$$a_s = \frac{17.55M_Y}{d_k \sigma_{Y1}} \text{ (cm}^2\text{)}$$

Where:

$M_Y$  : Design yield moment of rudder stock (N-m)

$$M_Y = 0.02664 \frac{d_u^3}{K_S}$$

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

$d_u$  : Stock diameter (mm) according to 3.5.1

$K_S$  : Material factor for stock as given in 3.1.2

$d_k$  : Mean diameter of the conical part of the rudder stock (mm) at the key

$\sigma_{Y1}$  : Minimum yield stress of the key material (N/mm<sup>2</sup>)

The effective surface area (cm<sup>2</sup>) of the key (without rounded edges) between key and rudder stock or cone coupling is not to be less than:

$$a_k = \frac{5M_Y}{d_k \sigma_{Y2}} \text{ (cm}^2\text{)}$$

Where:

$\sigma_{Y2}$  : Minimum yield stress of the key, stock or coupling material (N/mm<sup>2</sup>) whichever is



less.

~~23~~ The dimensions of the slugging nut as specified in -1 are to be as follows (See Fig. CS3.47):

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

~~Length of nut height:~~  $h_n \geq 0.6d_g$  (mm)

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

~~4~~ It is to be proved that 50% of the design yield moment is solely transmitted by friction in the cone couplings. This can be done by calculating the required push-up pressure and push-up length according to 3.9.4-2 and -3 for a torsional moment  $M_Y' = 0.5 M_Y$ .

~~35~~ Notwithstanding the provisions in -1 above, where a key is fitted to couplings between stocks and rudders, and it is considered that rudder torque is transmitted by friction at the couplings, the scantlings of the key as well as push-up force and push-up length are to be at the discretion of the Society.

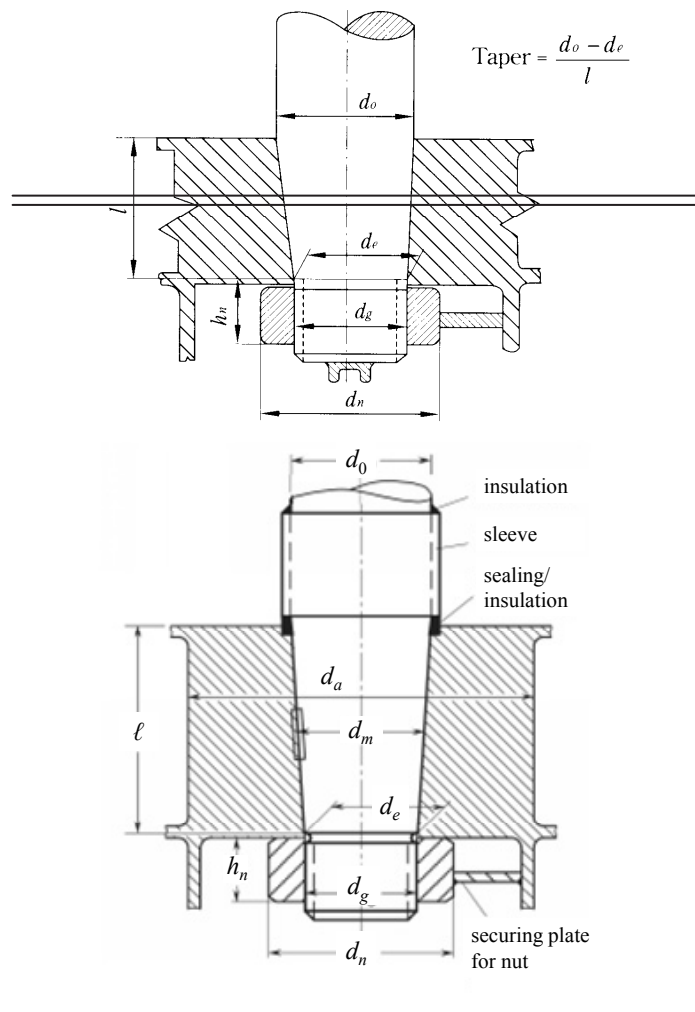
~~4~~ Cone couplings that are mounted or dismounted with hydraulic arrangements (e.g. oil injection and hydraulic nut) are to have a taper on the diameter of 1:12 – 1:20 (See Fig. CS3.4).

~~The push-up force and the push-up length are to be to the discretion of the Society.~~

~~56~~ The nuts fixing the rudder stocks are to be provided with efficient locking devices.

~~67~~ Couplings of rudder stocks are to be properly protected from corrosion.

Fig. CS3.47 Cone coupling with key



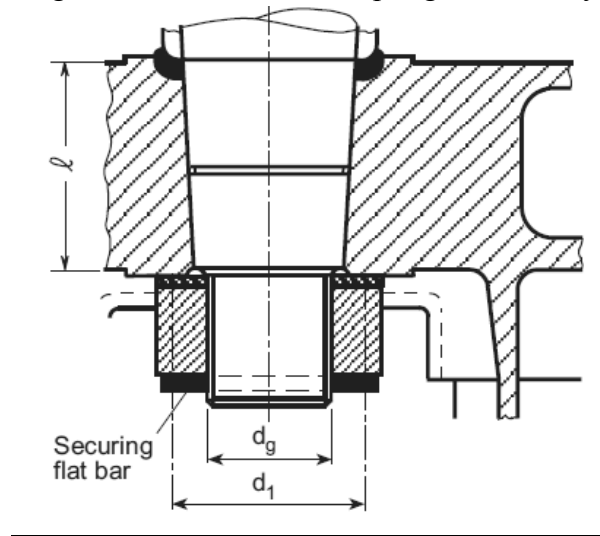
### 3.9.4 Cone couplings with special arrangements for mounting and dismounting the couplings

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

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

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

Fig. CS3.8 Cone coupling without key



#### 2 Push-up pressure

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

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

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

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)

$\ell$  : Cone length (mm)

$\mu_0$  : Frictional coefficient, equal to 0.15

$M_b$  : Bending moment in the cone coupling (e.g. in case of spade rudders) (N-m)

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

$$p_{perm} = \frac{0.8\sigma_Y(1-\alpha^2)}{\sqrt{3+\alpha^4}}$$

Where:

$\sigma_Y$  : Minimum yield stress (N/mm<sup>2</sup>) of the material of the gudgeon

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

$d_m$  : Mean cone diameter (mm) (See Fig. CS3.7)

$d_a$  : Outer diameter of the gudgeon (See Fig. CS3.7) (mm) to be not less than 1.5  $d_m$ .

### 3 Push-up length

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

$$\Delta \ell_1 \leq \Delta \ell \leq \Delta \ell_2$$

Where:

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

$$\Delta \ell_2 = \frac{1.6 \sigma_y d_m}{\sqrt{3 + \alpha^4} E c} + \frac{0.8 R_{tm}}{c}$$

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

$c$  : Taper on diameter according to 3.9.4-1

Notwithstanding the above, the push up length is not to be less than 2 mm.

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.

## 3.910 Pintles

### 3.910.1 Diameter of Pintles

The diameter of pintles  $d_p$  is not to be less than the dimension obtained from the following formula.

$$d_p = 0.35 \sqrt{BK_p} \quad (mm)$$

Where:

$B$ : Reaction force in bearing (N)

$K_p$ : Material factor for pintles as given in 3.1.2

### 3.910.2 Construction of Pintles

#### 1 Tapering

Pintles are to be constructed as taper bolts with a taper on the diameter not exceeding the following values, and capable of being fitted to the cast parts of the rudders. The nuts fixing the pintles are to be provided with efficient locking devices.

- (1) For pintles to be assembled and locked with slugging nuts: 1:8 ~ 1:12
- (2) For pintles mounted with hydraulic arrangements (e.g. oil injection and hydraulic nut): 1:12 ~ 1:20

#### 2 Push-up pressure for pintle bearings

The required push-up pressure for pintle bearings ( $N/mm^2$ ) is to be determined by the following formula:

$$p_{req} = 0.4 \frac{Bd_0}{d_m^2 \ell}$$

Where:

$B$  : As defined in **3.10.1**

$d_m, \ell$  : As defined in **3.9.4-2**

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

The push up length is to be calculated similarly as in **3.9.4-3**, using required push-up pressure and properties for the pintle bearing.

**3.3** The minimum dimensions of the threads and the nuts of pintles are to be determined by applying the requirements in ~~3.8.2~~ **3.9.3-3** correspondingly.

**3.4** The taper length of the pintle is not to be less than the maximum actual diameter of the pintle.

**4.5** Pintles are to be properly protected from corrosion.

### **3.10.1 Bearings of Rudder Stocks and Pintles**

#### **3.11.1 Sleeves and Bushes**

##### **1 Rudder stock bearing**

Sleeves and bushes are to be fitted in way of bearings. The minimum thickness of sleeves and bushes is to be equal to:

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

##### **2 Pintle bearing**

The thickness of any sleeve or bush is neither to be less than:

$$t = 0.01\sqrt{B} \text{ (mm)}$$

Where:

$B$  : As specified in **3.10.1**

nor than the minimum thickness defined in **-1**.

#### **3.10.11.2 Minimum Bearing Surface**

The bearing surface  $A_b$  (defined as the projected area:  $length \times outside \text{ diameter of sleeve}$ ) is not to be less than the value obtained from the following formula.

$$A_b = \frac{B}{q_a} \text{ (mm}^2\text{)}$$

Where:

$B$ : As specified in **3.10.1**

$q_a$ : Allowable surface pressure ( $N/mm^2$ )

The allowable surface pressure for the various bearing combinations is to be taken from **Table CS3.23**. When verified by tests, however, values different from those in this Table may be taken.

Table CS3.23 Allowable surface pressure  $q_a$

Bearing material	$q_a$ ( $N/mm^2$ )
Lignum vitae	2.5
White metal(oil-lubricated)	4.5
Synthetic material with hardness between 60 and 70, Shore D (Note 1) <sup>1)</sup>	5.5 <sup>2)</sup>
Steel (Note 2) <sup>3)</sup> , bronze and hot-pressed bronze-graphite materials	7.0

Notes:

- 1: Indentation hardness test at the temperature of 23°C and the humidity of 50%, is to be carried out according to a recognized standard. Synthetic bearings are to be of the type as deemed appropriate by the Society.
- 2: Surface pressures exceeding 5.5  $N/mm^2$  may be accepted in accordance with bearing manufacturer's specification and tests, but in no case more than 10  $N/mm^2$ .
- 3: Stainless and wear-resistant steel in an approved combination with a stock liner.

### ~~3.10.211.3~~ **Length of Bearings Bearing Dimensions**

The length/diameter ratio of the bearing surface is not to be less than 1.0. However, the ratio is not to be greater than 1.2 unless specially approved by the Society.

The bearing length  $L_p$  of the pintle is to be such that

$$d_{p0} \leq L_p \leq 1.2d_{p0}$$

Where:

$d_{p0}$ : As specified in 2.2.6

### ~~3.10.311.4~~ **Bearing Clearances**

With metal bearings, clearances are not to be less than  $d_{bs} / 1000 + 1.0$  (mm) on the diameter.  $d_{bs}$  is the internal diameter of the bush.

If non-metallic bearing material is used, the bearing clearance is to be specially determined considering the material's swelling and thermal expansion properties. This clearance is not to be taken as less than 1.5 mm on the bearing diameter unless a smaller clearance is supported by the manufacturer's recommendation and there is documented evidence of satisfactory service history with a reduced clearance.

## ~~3.142~~ **Rudder Accessories**

### ~~3.142.1~~ **Rudder Carriers**

Suitable rudder carriers are to be provided according to the form and the weight of the rudder, and care is to be taken to provide efficient lubrication at the support.

### ~~3.142.2~~ **Prevention of Jumping**

A suitable arrangement is to be provided to prevent the rudder from jumping due to wave shocks.

## Chapter 19 HATCHWAYS, MACHINERY SPACE OPENINGS AND OTHER DECK OPENINGS

### 19.1 General

Paragraph 19.1.3 has been deleted.

#### ~~19.1.3 Renewal Thickness of Steel Hatchway Covers and Hatchway Coamings for Ships in Operation~~

~~Structural drawings for hatch covers and hatch coamings complying with the requirements of 19.2 are to indicate the renewal thickness ( $t_{\text{renewal}}$ ) for each structural element given by the following formula in addition to the as-built thickness ( $t_{\text{as-built}}$ ). If the thickness for voluntary addition is included in the as-built thicknesses, the value may be at the discretion of the Society.~~

~~$$t_{\text{renewal}} = t_{\text{as-built}} + t_c + 0.5 \text{ (mm)}$$~~

~~$t_c$ : Corrosion additions specified in **Table C19.1**~~

~~Where corrosion addition  $t_c$  is 1.0 (mm), renewal thickness may be given by the formula~~

~~$$t_{\text{renewal}} = t_{\text{as-built}} + t_c \text{ (mm)}$$~~

### 19.2 Hatchways

Paragraph 19.2.3 has been amended as follows.

#### 19.2.3 Net Scantling Approach

(-1 to -3 are omitted.)

4 The corrosion addition  $t_c$  is to be taken as specified in **Table CS19.1** according to ship type, the type of structure and structural members of steel hatchway covers, steel pontoon covers and steel weathertight covers (hereinafter referred to as “steel hatch covers”). However, the corrosion additions for structural members that make up hatchway coamings are to be as deemed appropriate by the Society when their  $t_c$  values are not specified in **Table C19.1**.

5 Strength calculations using ~~beam theory~~, grillage analysis or FEM are to be performed with net scantlings.

Table CS19.1 Corrosion Additions

Type of ship	Type of structural member	Corrosion addition $t_c$ (mm)	
Container carriers and car carriers	Steel hatch covers	1.0	
	Hatchway coamings	1.5	
Ships other than those specified above and subject to the application of this section	Single plating type hatch cover	1.9	
	Double plating type hatch cover	Top, side and bottom plating	1.5
		Internal structures	1.0
	Hatchway coamings, hatch coaming stays and stiffeners	1.5	

Paragraph 19.2.4 has been amended as follows.

#### 19.2.4 Design Loads

The design loads for steel hatchway covers, steel pontoon covers, steel weathertight covers, portable beams and hatchway coamings applying the requirements in **19.2** are specified in following **(1)** to **(5)**:

((1) is omitted.)

- (2) Design horizontal wave load  $P_H$  ( $kN/m^2$ ) is not to be less than that obtained from the following formulae. However,  $P_H$  is not to be taken less than the minimum values given in **Table CS19.3**.  $P_H$  need not be included in the direct strength calculation of the hatch cover, except where structures supporting stoppers are assessed.

$$P_H = ac(bc_1 - y)$$

a: As given by the following:

$$20 + \frac{L'}{12} \quad \text{for unprotected front coamings and hatch cover skirt plates}$$

$$10 + \frac{L'}{12} \quad \text{for unprotected front coamings and hatch cover skirt plates, where the distance from the actual freeboard deck to the summer load line exceeds the minimum non-corrected tabular freeboard according to the ILCC by at least one superstructure standard height}$$

$$5 + \frac{L'}{15} \quad \text{for side and protected front coamings and hatch cover skirt plates}$$

$$7 + \frac{L'}{100} - 8 \frac{x}{L_1} \quad \text{for aft ends of coamings and aft hatch cover skirt plates abaft amidships}$$

$$5 + \frac{L'}{100} - 4 \frac{x}{L_1} \quad \text{for aft ends of coamings and aft hatch cover skirt plates forward of amidships}$$

$L'$ : Length of ship  $L_1$  ( $m$ ). However, where  $L_1$  exceeds  $300m$ ,  $L'$  is to be taken as  $300m$ .

$L_1$ : Length of ship specified in **2.1.2, Part A of the Rules** ( $m$ ). However,  $L_1$  need not to be greater than 97% of the total length on the summer load waterline.

$C_1$ : As given by the following formulae:

$$10.75 - \left( \frac{300 - L_1}{100} \right)^{1.5} \quad \text{for } L_1 \leq 300m$$

$$10.75 \quad \text{for } 300 < L_1 \leq 350m$$

$$10.75 - \left( \frac{L_1 - 350}{150} \right)^{1.5} \quad \text{for } 350 < L_1$$

$c_L$ : Coefficient to be taken as 1.0

b: As given by the following formulae:

$$1.0 + \left( \frac{0.45 - \frac{x}{L_1}}{C_{b1} + 0.2} \right)^2 \quad \text{for } \frac{x}{L_1} < 0.45$$

$$1.0 + 1.5 \left( \frac{\frac{x}{L_1} - 0.45}{C_{b1} + 0.2} \right)^2 \quad \text{for } \frac{x}{L_1} \geq 0.45$$

$x$ : Distance ( $m$ ) from the hatchway coamings or hatch cover skirt plates to after perpendicular, or distance from the mid-point of the side hatchway coaming or hatch cover skirt plates to after perpendicular. However, where the length of the side hatchway coaming or hatch cover skirt plates exceeds  $0.15L_1$ , the side hatchway coaming or hatch cover skirt plates are to be equally subdivided into spans not exceeding  $0.15L_1$  and the distance from the mid-point of the subdivisions to the after perpendicular is to be taken.

$C_{b1}$ : Block coefficient. However, where  $C_b$  is 0.6 or under,  $C_{b1}$  is to be taken as 0.6 and where  $C_b$  is 0.8 and over,  $C_{b1}$  is to be taken as 0.8. When determining scantlings of the aft ends of coamings and aft hatch cover skirt plates forward of amidships,  $C_{b1}$  does not need to be taken as less than 0.8.

$c$ : As given by the following formula. However, where  $\frac{b'}{B'}$  is less than 0.25,  $\frac{b'}{B'}$  is to be taken as 0.25.

$$0.3 + 0.7 \frac{b'}{B'}$$

$b'$ : Breadth ( $m$ ) of hatchway coamings at the position under consideration

$B'$ : Breadth ( $m$ ) of ship on the exposed weather deck at the position under consideration

$y$ : Vertical distance ( $m$ ) from the designed maximum load line to the mid-point of the span of stiffeners when determining the scantlings of stiffeners and to the mid-point of the plating when determining the thickness of plating

Table CS19.3 Minimum Value of  $P_H$  ( $kN/m^2$ )

	Unprotected front coamings and hatch cover skirt plates	others
$L \leq 250$	$25 + \frac{L_1}{10}$	$12.5 + \frac{L_1}{20}$
$L > 250$	50	25

(3) The load on hatch covers due to cargo loaded on said covers is to be obtained from the following (a) and (b). Load cases with partial loading are also to be considered.

(a) Distributed load due to cargo load  $P_{cargo}$  ( $kN/m^2$ ) resulting from heave and pitch (i.e., ship in upright condition) is to be determined according to the following formula:

$$P_{cargo} = P_C(1 + a_V)$$

$P_C$ : Static uniform cargo load ( $kN/m^2$ )

$a_V$ : Vertical ~~Acceleration~~ addition given by the following formula:

$$a_V = \frac{0.11mV'}{\sqrt{L_1}}$$

$m$ : As given by the following formulae:

$$m_0 - 5(m_0 - 1) \frac{x}{L_1} \quad \text{for } 0 \leq \frac{x}{L_1} \leq 0.2$$



$$1.0 \quad \text{for } 0.2 < \frac{x}{L_1} \leq 0.7$$

$$1 + \frac{m_0 + 1}{0.3} \left( \frac{x}{L_1} - 0.7 \right) \quad \text{for } 0.7 < \frac{x}{L_1} \leq 1.0$$

$m_0$ : As given by the following formula:

$$m_0 = 1.5 + \frac{0.11V'}{\sqrt{L_1}}$$

$V'$ : Speed of ship (*knots*) specified in **2.1.8, Part A of the Rules**. However, where  $V'$  is less than  $\sqrt{L_1}$ ,  $V'$  is to be taken as  $\sqrt{L_1}$ .

$x$  and  $L_1$ : As specified in (2) above

- (b) Point load  $F_{cargo}$  ( $kN$ ) due to a single force resulting from heave and pitch (i.e., ship in upright condition) (~~e.g. in the case of containers~~) is to be determined by the following formula. ~~When the load case of a partially loaded container is considered, the point load is at the discretion of the Society.~~ However, container loads are to comply with the provisions of (4) below.

$$F_{cargo} = F_S(1 + a_V)$$

$F_S$ : Static point load due to cargo ( $kN$ )

$a_V$ : As specified in (a) above

- (4) Where containers are stowed on hatch covers, cargo loads determined by following (a) ~~and (b)~~ to (c) are to be considered:

- (a) Cargo loads ( $kN$ ), acting on each corner of a container stack, due to heave, pitch and roll motion of the ship (i.e., ship in heel condition) are to be determined by the following formulae ~~are to be considered~~ (see Fig. CS19.1). When the load case of a partially loaded container is considered, the cargo load is at the discretion of the Society.

$$A_Z = 9.81 \frac{M}{2} (1 + a_V) \left( 0.45 - 0.42 \frac{h_m}{b} \right)$$

$$B_Z = 9.81 \frac{M}{2} (1 + a_V) \left( 0.45 + 0.42 \frac{h_m}{b} \right)$$

$$B_Y = 2.4M$$

$M$ : Maximum designed mass of container stack ( $t$ )

$$M = \sum W_i$$

$h_m$ : Design height of the centre of gravity of the stack above hatch cover ~~supports top plates~~ ( $m$ ) may be calculated as the weighted mean value of the stack, where the centre of gravity of each tier is assumed to be located at the centre of each container

$$h_m = \frac{\sum (z_i W_i)}{M}$$

$z_i$ : Distance from hatch cover top plate to the centre of  $i$ th container ( $m$ )

$W_i$ : weight of  $i$ th container in ( $t$ )

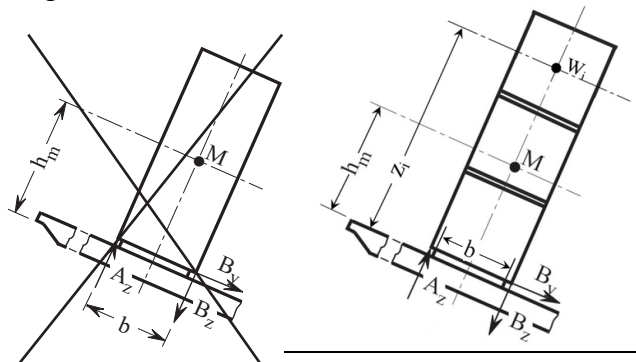
$b$ : Distance between midpoints of foot points ( $m$ )

$A_Z$  and  $B_Z$ : Support forces in vertical direction at the forward and aft stack corners ( $kN$ )

$B_Y$ : Support force in transverse direction at the forward and aft stack corners ( $kN$ )

$a_V$ : As specified in (3) above

Fig C19.1 Forces due to Container Loads



- (b) Details of the application of (a) above are to be in accordance with the following:
- ~~i) For the maximum design mass of container stack  $M$  and the design height of the centre of gravity of the stack above hatch cover supports  $h_m$ , it is recommended to apply the values which are used for the calculations of cargo securing (container lashing). If different assumptions are made for  $M$  and  $h_m$ , sufficient data which show that the hatch cover structure is not loaded by less than the recommended values is to be submitted.~~
  - ii) When the strength of a hatch cover structure is assessed FEM analysis using shell or plane strain elements,  $h_m$  may be taken as the design height of the centre of gravity of the stack above the hatch cover top plate by grillage analysis according to 19.2.5-5.  $h_m$  and  $z_i$  need to be measure from the hatch cover supports, not hatch cover top plates. Force  $B_y$  does not need to be considered in this case.
  - iii) The values of  ~~$M$~~   $A_z$  and  ~~$h_m$~~   $B_z$  applied for the assessment of hatch cover strength are to be shown in the drawings of the hatch covers.
  - iii) It is recommended that container loads, as calculated in (a) above, be considered as the limit for foot point loads of container stacks in cargo securing (container lashing) calculations.
  - ~~iv) In the case of container stacks secured to lashing bridges or carried in cell guides, the forces acting on the hatch covers may be specially considered by the Society.~~
  - ~~v) Container loads may be applied based on accelerations calculated by an individual acceleration analysis for the lashing system being used as deemed appropriate by the Society.~~
- (c) Stack load  $P_{stack}$  (kN), acting on each corner of a container stack, due to heave and pitch (i.e., ship in upright condition) is to be determined by the following formula.

$$P_{stack} = 9.81 \frac{M}{4} (1 + a_v)$$

$a_v$  : As specified in (3) above

$M$  : As specified in (a) above

- (5) In addition to the loads specified in (1) to (4) above, when the load in the ship's transverse direction by forces due to elastic deformation of the ship's hull is acting on the hatch covers, the sum of stresses is to comply with the permissible values specified in 19.2.5-1(1).

Paragraph 19.2.5 has been amended as follows.

### 19.2.5 Strength Criteria of Steel Hatch Covers and Hatch Beams

#### 1 Permissible stresses and deflections

(1) The equivalent stress  $\sigma_E$  ( $N/mm^2$ ) in steel hatchway covers and steel weathertight covers is to comply with the criteria in the following **(a)** and **(b)**:

(a) For ~~beam element calculations and~~ grillage analysis:

$$\sigma_E = \sqrt{\sigma^2 + 3\tau^2} \leq 0.8\sigma_F$$

$\sigma$ : Nominal stress ( $N/mm^2$ )

$\tau$ : Shear stress ( $N/mm^2$ )

$\sigma_F$ : Minimum upper yield stress ( $N/mm^2$ ) or proof stress ( $N/mm^2$ ) of the material.

However, when material with a  $\sigma_F$  of more than  $355 N/mm^2$  is used, the value for  $\sigma_F$  is to be as deemed appropriate by the Society.

(b) For FEM calculations, in cases where the calculations use shell or plane strain elements, the stresses are to be taken from centre of the individual element.

$\sigma_E = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau^2} \leq 0.8\sigma_F$  when assessed using the design load specified in **19.2.4(1)**

$\sigma_E = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau^2} \leq 0.9\sigma_F$  when assessed using any other design loads

$\sigma_x$ : Normal stress ( $N/mm^2$ ) in the  $x$ -direction

$\sigma_y$ : Normal stress ( $N/mm^2$ ) in the  $y$ -direction

$\tau$ : Shear stress ( $N/mm^2$ ) in the  $x$ - $y$  plane

$x, y$ : Coordinates of a two dimensional Cartesian system in the plane of the considered structural element

$\sigma_F$ : As specified in **(a)** above

(2) The equivalent stress  $\sigma_E$  ( $N/mm^2$ ) in steel pontoon covers and hatch beams is not to be greater than  $0.68\sigma_F$ , where  $\sigma_F$  is as specified in **(1)** above.

(3) For FEM calculations, equivalent stress  $\sigma_E$  ( $N/mm^2$ ) in girders with unsymmetrical flanges of steel hatchway covers and steel weathertight covers is to be determined according to the following **(a)** or **(b)**:

(a) FEM calculations using the stress obtained for fine mesh elements.

(b) FEM calculations using the stress at the edge of the element or the stress at the centre of the element, whichever is greater.

~~(3)~~ Deflection is to comply with following **(a)** and **(b)**:

(a) When the design vertical wave load specified in **19.2.4(1)** is acting on steel hatchway covers, steel pontoon covers, steel weathertight covers and portable beams, the vertical deflection of primary supporting members is not to be taken as more than that given by the following:

0.0056/ $l$  for steel hatchway covers and steel weathertight covers

0.0044/ $l$  for steel pontoon covers and hatch beams

$l$ : Span of primary supporting members ( $m$ )

(b) Where steel hatch covers are arranged for carrying containers and mixed stowage is allowed, i.e., a 40-foot container is stowed on top of two 19-foot containers, particular attention is to be paid to the deflections of hatch covers. In addition the possible contact of deflected hatch covers with in hold cargo has to be observed.

**2 Local net plate thickness of steel hatch covers**

(1) The local net thickness  $t_{net}$  (mm) of steel hatch cover top plating is not to be less than that obtained from the following formula, and it is not to be less than 1% of the spacing of the stiffeners or 6 mm, whichever is greater:

$$t_{net} = 15.8 F_p S \sqrt{\frac{P_{HC}}{0.95 \sigma_F}}$$

$F_p$ : Coefficient given by the following formula:

1.9  $\sigma/\sigma_a$  (for  $\sigma/\sigma_a \geq 0.8$ , for the attached plate flange of primary supporting members)

1.5 (for  $\sigma/\sigma_a < 0.8$ , for the attached plate flange of primary supporting members)

$\sigma$ : ~~Maximum Normal stress ( $N/mm^2$ ) of the attached plate flange of primary supporting members (see Fig. CS19.2). The normal  $\sigma$  may be determined at a distance  $S$  from the webs of adjacent primary supporting members perpendicular to secondary stiffeners and at a distance  $S/2$  from the web of an adjacent primary supporting member parallel to secondary stiffeners, whichever is greater (see Fig. C19.2). The distribution of normal stress  $\sigma$  between two parallel girders is to be in accordance with 19.2.5-6(3)(c).~~

$\sigma_a$ : Permissible stress ( $N/mm^2$ ) is to be as given by following formula:

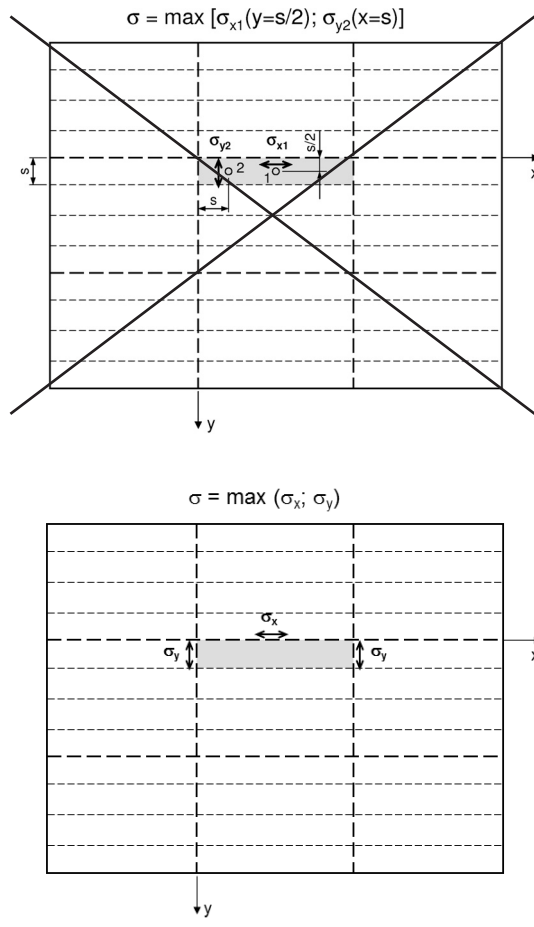
$$\sigma_a = 0.8 \sigma_F$$

$S$ : Stiffener spacing (m)

$P_{HC}$ : Design load ( $kN/m^2$ ) specified in 19.2.4(1) and 19.2.4(3)(a)

$\sigma_F$ : Minimum upper yield stress ( $N/mm^2$ ) or proof stress ( $N/mm^2$ ) of the material

Fig.CS19.2 Determination of the Normal Stress of Hatch Cover Plating



- (2) The net thickness of double skin hatch covers and box girders is to be obtained in accordance with -5 below taking into consideration of the permissible stresses specified in **19.2.5-1(1)**
- (3) ~~In addition to (2) above, w~~ When the lower plating of double skin hatch covers is taken into account as a strength member of the hatch cover, the net thickness  $t_{net}$  (mm) of the lower plating is not to be less than 5 mm, ~~that obtained from following formulae:~~

~~$$t_{net} = 6.5S$$~~

~~$$t_{net} = 5$$~~

~~S: As specified in (1) above~~

- (4) When lower plating is not considered to be a strength member of the hatch cover, the thickness of the lower plating is to be determined as deemed appropriate by the Society.
- (5) When cargo likely to cause shear buckling is intended to be carried on a hatch cover, the net thickness  $t_{net}$  (mm) is not to be less than that obtained from following formulae. In such cases, "cargo likely to cause shear buckling" refers particularly to especially large or bulky cargo lashed to the hatch cover, such as parts of cranes or wind power stations, turbines, etc. Cargo that is considered to be uniformly distributed over the hatch cover (e.g., timber, pipes or steel coils) does not need to be considered.

$$t_{net} = 6.5S$$

$$t_{net} = 5$$

S: As specified in (1) above

### 3 Net scantling of secondary stiffeners

- (1) The net section modulus  $Z_{net}$  ( $cm^3$ ) of the secondary stiffeners of hatch cover top plates, based on stiffener net member thickness, is not to be less than that obtained from the following formula. The net section modulus of the secondary stiffeners is to be determined based on an attached plate width that is assumed to be equal to the stiffener spacing.

$$Z_{net} = \frac{104SP_{HC}l^2}{\sigma_F} \quad \text{for the design loads specified in } \mathbf{19.2.4(1)} \text{ above}$$

$$Z_{net} = \frac{93SP_{HC}l^2}{\sigma_F} \quad \text{for the design loads specified in } \mathbf{19.2.4(3)(a)} \text{ above}$$

$l$ : Secondary stiffener span ( $m$ ) is to be taken as the spacing of primary supporting members or the distance between a primary supporting member and the edge support, as applicable.

$S$ : Stiffener spacing ( $m$ )

$P_{HC}$ : Design load ( $kN/m^2$ ) as specified in -2(1) above

$\sigma_F$ : Minimum upper yield stress ( $N/mm^2$ ) or proof stress ( $N/mm^2$ ) of the material

- (2) The net shear sectional area  $A_{net}$  ( $cm^2$ ) of the secondary stiffener webs of hatch cover top plates is not to be less than that obtained from the following formula:

~~$$A_{net} = \frac{10SP_{HC}l}{\sigma_F}$$~~

$$A_{net} = \frac{10.8SP_{HC}l}{\sigma_F} \quad \text{for the design loads specified in } \mathbf{19.2.4(1)} \text{ above}$$

$$A_{net} = \frac{9.6SP_{HC}l}{\sigma_F} \quad \text{for the design loads specified in } \mathbf{19.2.4(3)(a)} \text{ above}$$

$l$ ,  $S$  and  $P_{HC}$ : As specified in (1) above

- (3) For flat bar secondary stiffeners and buckling stiffeners, the following formula is to be applied:

$$\frac{h}{t_{W,net}} \leq 15\sqrt{k}$$

$h$ : Height ( $mm$ ) of the stiffener

$t_{W,net}$ : Net thickness ( $mm$ ) of the stiffener

$$k = 235/\sigma_F$$

$\sigma_F$ : As specified in (1) above

- (4) Stiffeners parallel to primary supporting members and arranged within the effective breadth according to **19.2.5-5(2)** are to be continuous at crossing primary supporting member and may be regarded for calculating the cross sectional properties of primary supporting members.
  - (5) The combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures is not to exceed the permissible stresses according to **19.2.5-1(1)**.
  - (6) For hatch cover stiffeners under compression, sufficient safety against lateral and torsional buckling according to **19.2.5-6(3)** is to be verified.
  - (7) For secondary stiffeners of the lower plating of double skin hatch covers, the requirements in (1) and (2) above do not need to be applied due to the absence of lateral loads.
  - (8) The net thicknesses ( $mm$ ) of a stiffener (except for U-type stiffeners) web is to not be taken as less than 4  $mm$ .
  - (9) Single-side welding is not permitted for secondary stiffeners, except for U-type stiffeners.
  - (10) The requirements in this -3 do not to be applied to stiffeners of the lower plating of double skin hatch covers in cases where the lower plating is not considered to be a strength member.
- (-4 is omitted.)

## 5 Strength calculation

- (1) Strength calculation for steel hatch covers may be carried out by ~~either using beam theory,~~ grillage analysis or FEM. Net scantlings are to be used for modeling. Strength calculations for double skin hatch covers or hatch covers with box girders are to be assessed using FEM, as specified in **19.2.5-5(3)**.
- (2) Effective cross-sectional properties for calculation by ~~beam theory or~~ grillage analysis are to be determined by the following (a) to (e):
  - (a) The effective breadth of the attached plating  $e_m$  of the primary supporting members specified in **Table CS19.5** according to the ratio of  $l$  and  $e$  is to be considered for the calculation of effective cross-sectional properties. For intermediate values of  $l/e$ ,  $e_m$  is to be obtained by linear interpolation.
  - (b) Separate calculations may be required for determining the effective breadth of one-sided or non-symmetrical flanges.
  - (c) The effective cross sectional areas of plates is not to be less than the cross sectional area of the face plate.
  - (d) The cross sectional area of secondary stiffeners parallel to the primary supporting member under consideration within the effective breadth may be included in the calculations (see **Fig. CS19.5**).
  - (e) For flange plates under compression with secondary stiffeners perpendicular to the web of the primary supporting member, the effective width is to be determined according to **19.2.5-6(3)**.
- (3) General requirements for FEM are as follows:
  - (a) The structural model is to be able to reproduce the behaviour of the structure with the highest possible fidelity. Stiffeners and primary supporting members subject to pressure loads are to be included in the modelling. However, buckling stiffeners may be disregarded for stress calculation.
  - (b) Net scantlings which exclude corrosion additions are to be used for modeling.

- (c) Element size is to be suitable to take effective breadth into account.
- (d) In no case is element width to be larger than stiffener spacing. The ratio of element length to width is not to exceed 4.
- (e) The element height of the webs of primary supporting members is not to exceed one-third of the web height.
- (f) Stiffeners may be modelled using shell elements, plane stress elements or beam elements.

Table CS19.5 Effective Breadth  $e_m$  of Plating of Primary Supporting Members

$l/e$	0	1	2	3	4	5	6	7	8 and over
$e_{m1}/e$	0	0.36	0.64	0.82	0.91	0.96	0.98	1.00	1.00
$e_{m2}/e$	0	0.19	0.37	0.52	0.65	0.75	0.84	0.89	0.90

(Notes)

- $e_{m1}$ : Effective breadth (mm) to be applied where primary supporting members are loaded by uniformly distributed loads or by not less than 6 equally spaced single loads
- $e_{m2}$ : Effective breadth (mm) to be applied where primary supporting members are loaded by 3 or less single loads
- $l$ : Length between zero-points of bending moment curve taken equal to:
  - For simply supported primary supporting members:  $l_0$
  - For primary supporting members with both ends constant:  $0.6l_0$
- $l_0$ : Unsupported length of the primary supporting members
- $e$ : Width of plating supported, measured from centre to centre of the adjacent unsupported fields

## 6 Buckling strength of steel hatch covers

The buckling strength of the structural members of steel hatch covers is to be in accordance with the following **(1)** to **(3)**:

- (1) The buckling strength of a single plate panel of the top and lower steel hatch cover plating is to comply with the following formulae:

$$\left( \frac{|\sigma_x| C_{sf}}{\kappa_x \sigma_F} \right)^{e1} + \left( \frac{|\sigma_y| C_{sf}}{\kappa_y \sigma_F} \right)^{e2} - B \left( \frac{\sigma_x \sigma_y C_{sf}^2}{\sigma_F^2} \right) + \left( \frac{|\tau| C_{sf} \sqrt{3}}{\kappa_\tau \sigma_F} \right)^{e3} \leq 1.0$$

$$\left( \frac{\sigma_x C_{sf}}{\kappa_x \sigma_F} \right)^{e1} \leq 1.0$$

$$\left( \frac{\sigma_y C_{sf}}{\kappa_y \sigma_F} \right)^{e2} \leq 1.0$$

$$\left( \frac{|\tau| C_{sf} \sqrt{3}}{\kappa_\tau \sigma_F} \right)^{e3} \leq 1.0$$

(omitted)

$C_{sf}$ : Safety factor taken as equal to:

$C_{sf} = 1.25$  for hatch covers when subjected to design vertical wave loads according to **19.2.4(1)**

$C_{sf} = 1.10$  for hatch covers when subjected to loads according to **19.2.4(2)**, **(3)** to **(5)**

(omitted)

((2) is omitted.)

- (3) The buckling strength of partial and total fields included in the structural members of steel hatch covers is to comply with the following **(a)** to **(e)**:

- (a) The buckling strength of longitudinal and transverse secondary stiffeners is to comply with following **(d)** and **(e)**: For U-type stiffeners, however, the requirements in **(e)** below may

be omitted.

((b) and (c) are omitted.)

(d) For lateral buckling, longitudinal and transverse stiffeners are to comply with following **i) to iii)**:

i) Secondary stiffeners subject to lateral loads are to comply with the following criteria:

$$\frac{\sigma_a + \sigma_b}{\sigma_F} C_{sf} \leq 1$$

$\sigma_a$ : Uniformly distributed compressive stress ( $N/mm^2$ ) in the direction of the stiffener axis, given by the following formula:

$$\sigma_a = \sigma_x \quad \text{for longitudinal stiffeners}$$

$$\sigma_a = \sigma_y \quad \text{for transverse stiffeners}$$

$\sigma_b$ : Bending stress ( $N/mm^2$ ) in the stiffeners, given by the following formula:

$$\sigma_b = \frac{M_0 + M_1}{Z_{st} 10^3} \quad \text{with } \sigma_x = \sigma_n \text{ and } \tau = \tau_{SF}$$

(omitted)

((e) is omitted.)

Paragraph 19.2.9 has been amended as follows.

### 19.2.9 Hatch Coaming Strength Criteria

(-1 is omitted.)

2 Scantlings of hatch coamings are to be in accordance with the followings.

((1) to (4) are omitted.)

(5) The net scantlings of hatch coaming stays are to be in accordance with following **(a) to (c)**:

(a) For hatch coaming stays considered to be simple beams (see **Examples 1 and 2 of Fig. CS19.8**), ~~the net section modulus  $Z_{net}$  ( $cm^3$ ) of such stays at their deck connections with a height of less than 1.6 m and the net scantling  $t_{w,net}$  ( $mm$ ) of their webs is~~ are not to be less

than that obtained from following formulae:

$$Z_{net} = \frac{526 H_C^2 S P_H}{\sigma_F}$$

$$t_{w,net} = \frac{2 H_C S P_H}{\sigma_F h}$$

$H_C$ : Hatch coaming stay height ( $m$ )

$h$ : Hatch coaming stay depth ( $m$ )

$S$ : Hatch coaming stay spacing ( $m$ )

$\sigma_F$  and  $P_H$ : As specified in **(1)** above

(b) ~~The scantlings of hatch coaming stays with a height of 1.6 m and over are to be determined by direct calculations. The effective breadth of the coaming plate is to be in accordance with 19.2.5-5(2) and stresses in hatch coaming stays are to comply with the criteria specified in 19.2.5-1.~~ For coaming stays other than those in **(a)** above (see **Example 3 of Fig. CS19.8**), the stresses are generally to be determined through grillage analysis or FEM, and the calculated stresses are to satisfy the permissible stress criteria of **19.2.5-1**.

(c) For calculating the net section modulus of coaming stays, the area of their face plates is to be taken into account only when it is welded with full penetration welds to the deck plating and an adequate underdeck structure is fitted to support the stresses transmitted by them.



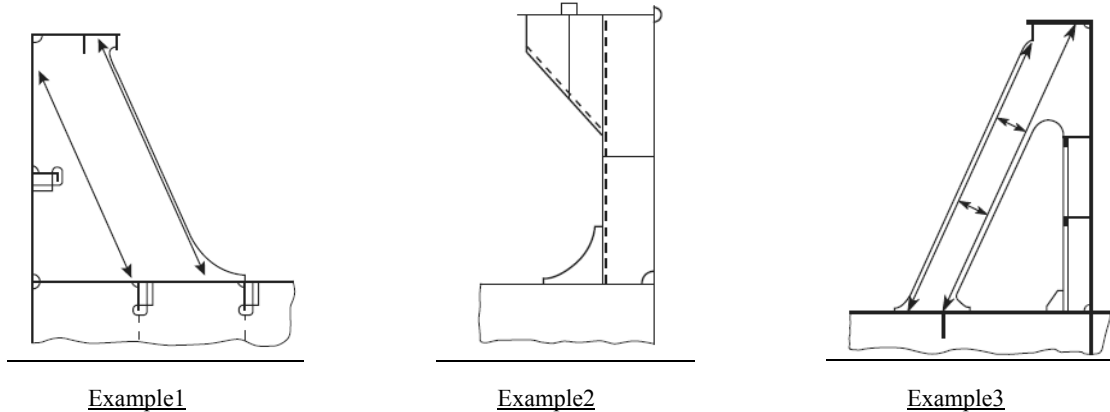
~~(d) The net scantling  $t_{w,net}$  (mm) of hatch coaming stay webs is not to be less than that obtained from the following formula:~~

~~$$t_{w,net} = \frac{2H_C S P_H}{\sigma_F h}$$~~

~~$h$ : Hatch coaming stay depth (m)~~

~~$H_C, S, P_H$  and  $\sigma_F$ : As specified in (a) above~~

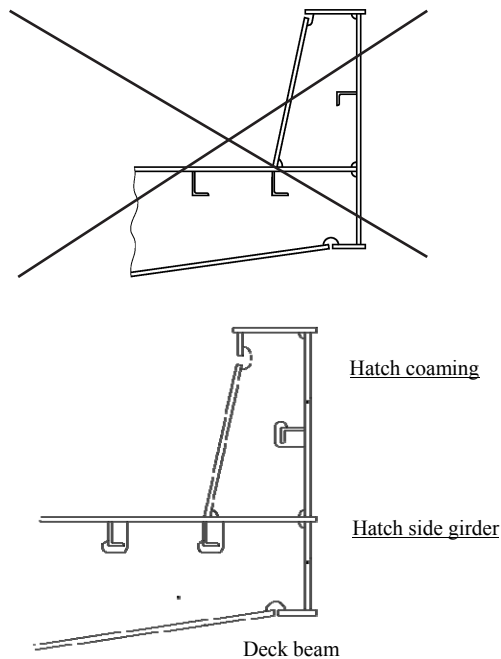
Fig. CS19.8 Examples of coaming stays



(-3 and -4 are omitted.)

**5** Coaming plates are to extend to the lower edge of the deck beams; moreover, they are to be flanged or fitted with face bars or half-round bars (see Fig. CS19.8), except where specially approved by the Society.

Fig. CS19.89 Example for the extension of coaming plates



(-6 is omitted.)

Paragraph 19.2.10 has been amended as follows.

### 19.2.10 Closing Arrangements

(-1 is omitted.)

2 The securing devices of hatch covers, on which cargo is to be lashed, are to be designed for a lifting force resulting from the loads according to 19.2.4(4) (see Fig. CS19.910). Unsymmetrical loading, which may occur in practice, is to be considered. Under such loading, the equivalent stress ( $N/mm^2$ ) in securing devices is not to be greater than that obtained from the following formula. Anti-lifting devices may be dispensed with at the discretion of the Society.

$$\sigma_E = \frac{150}{k_l}$$

$k_l$ : As obtained from the following formula:

$$k_l = \left( \frac{235}{\sigma_F} \right)^e$$

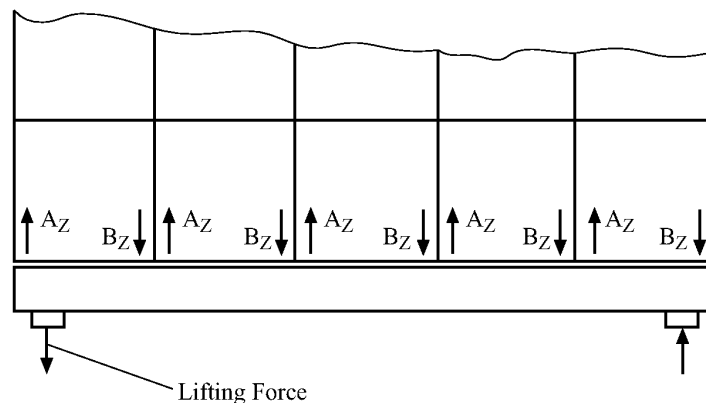
$\sigma_F$ : Minimum upper yield stress ( $N/mm^2$ ) or proof stress ( $N/mm^2$ ) of the material

$e$ : As given below:

0.75 for  $\sigma_F > 235$

1.00 for  $\sigma_F \leq 235$

Fig. CS19.910 Lifting forces at a hatch cover



Paragraph 19.2.11 has been amended as follows.

### 19.2.11 Hatch Cover Supports, Stoppers and Supporting Structures

Hatch cover supports, stoppers and supporting structures subject to the provisions of 19.2 are to comply with the following (1) to (3):

(1) For the design of the securing devices for the prevention of shifting, the horizontal mass forces  $F$  obtained from the following formula are to be considered. Acceleration in the longitudinal direction,  $a_X$ , and in the transverse direction,  $a_Y$ , does not need to be considered as acting simultaneously.

$$F = ma$$

$m$ : Sum of mass of cargo lashed on the hatch cover and mass of hatch cover

$a$ : Acceleration obtained from the following formula:

$a_X = 0.2g$  for longitudinal direction

$a_Y = 0.5g$  for transverse direction

(2) The design load for determining the scantlings of stoppers is not to be less than that obtained from **19.2.4(2)** and **(1)**, whichever is greater. Stress in the stoppers is to comply with the criteria specified in **19.2.5-1(1)**.

(3) The details of hatch cover supporting structures are to be in accordance with the following **(a)** to **(g)**:

(a) The nominal surface pressure ( $N/mm^2$ ) of hatch cover supports is not to be greater than that obtained from the following formula:

$$p_{n\max} = dp_n \quad \text{in general}$$

$$p_{n\max} = 3p_n \quad \text{for metallic supporting surface not subjected to relative displacements}$$

$d$ : As given by the following formula. Where  $d$  exceeds 3,  $d$  is to be taken as 3.

$$d = 3.75 - 0.015L_1$$

$$d_{\min} = 1.0 \quad \text{in general}$$

$$d_{\min} = 2.0 \quad \text{for partial loading conditions}$$

$L_1$ : Length of ship specified in **2.1.2, Part A of the Rules (m)**. However,  $L_1$  need not to be greater than 97% of the total length at the summer load waterline.

$p_n$ : As obtained from **Table CS19.10**

Table CS19.10 Permissible nominal surface pressure  $p_n$

Material	$p_n$ when loaded by	
	Vertical force	Horizontal force
Hull structure steel	25	40
Hardened steel	35	50
Plastic materials in steel	50	-

(b) Where large relative displacements of the supporting surfaces are to be expected, the use of material having low wear and frictional properties is recommended.

(c) Drawings of the supports are to be submitted. In these drawings, the permitted maximum pressure given by the material manufacturer ~~related to long time stress~~ is to be specified.

(d) ~~Sufficient abrasive strength may be shown by tests demonstrating an abrasion of support surfaces of not more than 0.3 mm per year in service at a total distance of shifting of 15,000 m per year when deemed necessary by the Society.~~ When the manufacturer of the vertical hatch cover support material can provide proof that the material is sufficient for the increased surface pressure, not only statically but under dynamic conditions, the permissible nominal surface pressure  $p_{n\max}$ , as specified in (a) above, may be relaxed at the discretion of the Society. However, realistic long term distributions of spectra for vertical loads and relative horizontal motion between hatch covers and hatch cover stoppers are as deemed appropriate by the Society.

(e) Irrespective of the arrangement of stoppers, the supports are to be able to transmit the following force  $p_h$  in the longitudinal and transverse direction.

$$p_h = \mu \frac{p_v}{\sqrt{d}}$$

$p_v$ : Vertical supporting force

$\mu$ : Friction coefficient generally to be taken as 0.5. For non-metallic or low-friction materials, the friction coefficient may be reduced as appropriate by the Society. However, in no case  $\mu$  is to be less than 0.35.

- (f) Stresses in supporting structures are to comply with the criteria specified in **19.2.5-1(1)**.
- (g) For substructures and adjacent constructions of supports subjected to horizontal forces  $p_h$ , special consideration is to be given to fatigue strength.

#### EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2016.
2. Notwithstanding the amendments to the Rules, the current requirements may apply to ships for which the date of contract for construction\* is before the effective date.  
\* “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.

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# **GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS**

**Part CS**

**Hull Construction and Equipment of  
Small Ships**

**GUIDANCE**

**2016 AMENDMENT NO.1**

Notice No.39      30th June 2016

Resolved by Technical Committee on 5th February 2016

Notice No.39 30th June 2016

**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 1-1**

**Appendix 1 APPLICATION OF PART C OF THE GUIDANCE**

Table CS has been amended as follows.

**Table CS Correspondence Table of Guidance between Part CS and Part C**

Part CS	Part C	Part CS	Part C	Part CS	Part C
1.1.3	<b>C1.1.3</b> [See Note 1]	13.3	<b>C13.3</b>	21.1.3	<b>C23.1.3</b> [See Note 20]
1.3.1	<b>C1.1.7</b> <b>C1.1.11</b> and <b>C1.1.12</b>	14.1.3	<b>C14.1.3</b>	21.2.1	<b>C23.2.1</b> [See Note 21]
		14.2.3	<b>C14.2.3</b>	21.2.2	<b>C23.2.2</b> [See Note 22]
		15.1.1	<b>C15.1.1</b>	21.2.3	<b>C23.2.3</b>
2.1.1	<b>C2.1.1</b>	15.2.1	<b>C15.2.1</b>	21.3	<b>C23.3</b>
2.2.2	<b>C2.2.2</b>	15.2.3	<b>C15.2.3</b>	21.4	<b>C23.4</b> [See Note 23]
2.2.3	<b>C2.2.3</b>	15.3	<b>C15.4.1-2</b>	21.5.1	<b>C23.5.1</b>
2.2.4	<b>C2.2.4</b>	16.3.3	<b>C16.3.3</b>	21.5.3	<b>C23.5.3</b> [See Note 24]
3	<b>C3</b>	16.4.4	<b>C16.4.4</b>	21.5.7	<b>C23.5.7</b> [See Note 25]
4	<b>C4</b>	16.5.3	<b>C16.6.1</b>	21.6.5	<b>C23.6.5</b> [See Note 26]
5	<b>C5</b>	16.6.1	<b>C16.7.1</b>	21.6.7	<b>C23.6.7</b> [See Note 27]
		16.6.2	<b>C16.7.2</b>	21.6.8	<b>C23.6.8</b>
6.1.1	<b>C6.1.1-1 to -3</b> [See Note 2]	17.1.1-1	<b>C10.2.1</b> [See Note 9]	21.7.1	<b>C23.7.1</b> [See Note 28]
6.1.3	<b>C6.1.3</b> [See Note 3]	17.2.1	<b>C17.1.1</b>	21.7.2	<b>C23.7.2</b>
6.6.2-1	<b>C6.4.3-2</b>	17.2.2	<b>C17.1.2</b>	21.8.1	<b>C23.8.1</b> [See Note 29]
6.7.1	<b>C6.5.1-1</b> and <b>-4</b>	17.2.4	<b>C17.1.4</b> [See Note 10]	22.2.1	<b>C24.2.1</b>
6.9	<b>C6.8</b>	17.2.5	<b>C17.1.5</b>	22.4.1	<b>C25.2.1</b> [See Note 30]
7.5.2	<b>C7.6.2</b> [See Note 4]	17.3.2	<b>C17.2.2</b>	22.4.2	<b>C25.2.2</b>
7.5.3	<b>C7.6.3</b> [See Note 5]	17.3.4	<b>C17.2.4</b>	22.4.3	<b>C25.2.3</b> [See Note 31]
8.3	<b>C7.5.3</b>	17.3.5	<b>C17.2.5</b>	23.1.2	<b>C27.1.2</b>
9.1.2	<b>C9.1.2</b> [See Note 6]	17.4.1	<b>C17.3.1</b>	23.1.5	<b>C27.1.5</b> and <b>C27.1.6</b> [See Note 32]
9.1.3	<b>C9.1.3</b>	17.4.5	<b>C17.3.5</b>		
10.1.2	<b>C10.1.2</b>	18	<b>C18</b>	23.1.6	<b>C27.1.7</b>
10.2.3	<b>C10.3.3</b> [See Note 7]	19.2.4	<b>C20.2.4</b> [See Note 11]	23.2	<b>C27.2</b>
10.3.2	<b>C10.4.2</b>	19.2.5	<b>C20.2.5</b> [See Note 12]	24.1.1	<b>C29.1.1</b> [See Note 33] [See Note 34]
10.7.1	<b>C10.9.1</b>	19.2.6	<b>C20.2.6</b> [See Note 13]		
11.1.2	<b>C11.1.2</b>	19.2.10	<b>C20.2.10</b> [See Note 14]	24.1.2	<b>C29.1.2</b> [See Note 35]
11.2.1	<b>C11.2.1</b>	19.2.12	<b>C20.2.12</b> [See Note 15]	24.3.2	<b>C29.4.2</b>
12.1.3	<b>C12.1.3</b>	19.2.13	<b>C20.2.13</b> [See Note 16]	24.9.4	<b>C29.7.4</b> [See Note 36]
12.1.4	<b>C12.1.4</b>	19.3.5	<b>C20.3.5</b> [See Note 17]	24.11.5	<b>C29.12.4</b>
12.2.1	<b>C12.2.1</b> [See Note 8]	19.4.2	<b>C20.4.2</b>	25.1.2	<b>C34.1.2</b> [See Note 37]
13.1.1	<b>C13.1.1</b>	20.2.2	<b>C21.2.2</b>	26	<b>C35</b>
13.1.4	<b>C13.1.4</b>	21.1.1	<b>C23.1.1</b> [See Note 18]		
13.2.3	<b>C13.2.3</b>	21.1.2	<b>C23.1.2</b> [See Note 19]		

**Notes :**

(1. to 16. are omitted.)

17. In Guidance **C20.3.5**, **20.3.5** and **20.1.2**, Part C of the Rules ~~is~~are to be read as **19.3.5** and **19.1.2**, Part CS of the Rules.

(18. to 26. are omitted.)

27. In Guidance **C23.6.7**, **23.6.7** ~~and~~, **23.6.1** and **20.1.2**, Part C of the Rules are to be read as **21.6.7** ~~and~~, **21.6.1** and **19.1.2**, Part CS of the Rules.

(28. to 37. are omitted.)

**EFFECTIVE DATE AND APPLICATION (Amendment 1-1)**

- The effective date of the amendments is 30 June 2016.

Amendment 1-2

**Appendix 1 APPLICATION OF PART C OF THE GUIDANCE**

Table CS has been amended as follows.

Table CS Correspondence Table of Guidance between Part CS and Part C

Part CS	Part C
	(Omitted)
21.5.1	<b>C23.5.1</b> [See Note <del>24</del> ]
21.5.3	<b>C23.5.3</b> [See Note <del>24</del> 5]
21.5.7	<b>C23.5.7</b> [See Note <del>25</del> 6]
21.6.5	<b>C23.6.5</b> [See Note <del>26</del> 7]
21.6.7	<b>C23.6.7</b> [See Note <del>27</del> 8]
21.6.8	<b>C23.6.8</b>
21.7.1	<b>C23.7.1</b> [See Note <del>28</del> 9]
21.7.2	<b>C23.7.2</b>
21.8.1	<b>C23.8.1</b> [See Note <del>29</del> 30]
22.2.1	<b>C24.2.1</b>
22.4.1	<b>C25.2.1</b> [See Note <del>30</del> 1]
22.4.2	<b>C25.2.2</b>
22.4.3	<b>C25.2.3</b> [See Note <del>31</del> 2]
23.1.2	<b>C27.1.2</b>
23.1.5	<b>C27.1.5</b> and <b>C27.1.6</b> [See Note <del>32</del> 3]
23.1.6	<b>C27.1.7</b>
23.2	<b>C27.2</b>
24.1.1	<b>C29.1.1</b> [See Note <del>33</del> 4] [See Note <del>34</del> 5]
24.1.2	<b>C29.1.2</b> [See Note <del>35</del> 6]
24.3.2	<b>C29.4.2</b>
24.9.4	<b>C29.7.4</b> [See Note <del>36</del> 7]
24.11.5	<b>C29.12.4</b>
25.1.2	<b>C34.1.2</b> [See Note <del>37</del> 8]
26	<b>C35</b>

**Notes :**

(1. to 23. are omitted.)

24. In Guidance **C23.5.1-2**, **23.5.1-1** and **Table C23.5**, **Part C** of the Rules is to be read as **21.5.1-1** and **Table CS21.5**, **Part CS** of the Rules.

~~24~~5. (Omitted)

~~25~~6. (Omitted)

~~26~~7. (Omitted)

~~27~~8. (Omitted)

~~28~~9. (Omitted)

~~29~~30. (Omitted)



- 301. (Omitted)
- 342. (Omitted)
- 323. (Omitted)
- 324. (Omitted)
- 345. (Omitted)
- 356. (Omitted)
- 367. (Omitted)
- 378. (Omitted)

#### EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 30 June 2016.
2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships the keels of which were laid or which were at *a similar stage of construction* before the effective date.  
(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.

## CS3 RUDDERS

Section CS3.8 has been renumbered to Section CS3.9 and Title of Paragraph CS3.9.1 has been amended as follows.

### **CS3.9 Couplings between Rudder Stocks and Main Pieces**

#### **CS3.9.1 Horizontal Flanges Couplings**

In principle, rudder stock and flange are to be of monoblock construction. However, for ships less than 60 *m* in length, the rudder stock may be of a welded type where the stock is inserted into the flange and welded with edge preparation.

## Appendix 1 APPLICATION OF PART C OF THE GUIDANCE

Table CS has been amended as follows.

Table CS Correspondence Table of Guidance between Part CS and Part C

Part CS	Part C	Part CS	Part C	Part CS	Part C
1.1.3	<b>C1.1.3</b> [See Note 1]	13.3	<b>C13.3</b>	21.1.3	<b>C23.1.3</b> [See Note 20]
1.3.1	<b>C1.1.7</b> <b>C1.1.11</b> and <b>C1.1.12</b>	14.1.3	<b>C14.1.3</b>	21.2.1	<b>C23.2.1</b> [See Note 21]
		14.2.3	<b>C14.2.3</b>	21.2.2	<b>C23.2.2</b> [See Note 22]
		15.1.1	<b>C15.1.1</b>	21.2.3	<b>C23.2.3</b>
2.1.1	<b>C2.1.1</b>	15.2.1	<b>C15.2.1</b>	21.3	<b>C23.3</b>
2.2.2	<b>C2.2.2</b>	15.2.3	<b>C15.2.3</b>	21.4	<b>C23.4</b> [See Note 23]
2.2.3	<b>C2.2.3</b>	15.3	<b>C15.4.1-2</b>	21.5.1	<b>C23.5.1</b>
2.2.4	<b>C2.2.4</b>	16.3.3	<b>C16.3.3</b>	21.5.3	<b>C23.5.3</b> [See Note 24]
3	<b>C3</b>	16.4.4	<b>C16.4.4</b>	21.5.7	<b>C23.5.7</b> [See Note 25]
4	<b>C4</b>	16.5.3	<b>C16.6.1</b>	21.6.5	<b>C23.6.5</b> [See Note 26]
5	<b>C5</b>	16.6.1	<b>C16.7.1</b>	21.6.7	<b>C23.6.7</b> [See Note 27]
		16.6.2	<b>C16.7.2</b>	21.6.8	<b>C23.6.8</b>
6.1.1	<b>C6.1.1-1</b> to -3 [See Note 2]	17.1.1-1	<b>C10.2.1</b> [See Note 9]	21.7.1	<b>C23.7.1</b> [See Note 28]
6.1.3	<b>C6.1.3</b> [See Note 3]	17.2.1	<b>C17.1.1</b>	21.7.2	<b>C23.7.2</b>
6.6.2-1	<b>C6.4.3-2</b>	17.2.2	<b>C17.1.2</b>	21.8.1	<b>C23.8.1</b> [See Note 29]
6.7.1	<b>C6.5.1-1</b> and -4	17.2.4	<b>C17.1.4</b> [See Note 10]	22.2.1	<b>C24.2.1</b>
6.9	<b>C6.8</b>	17.2.5	<b>C17.1.5</b>	22.4.1	<b>C25.2.1</b> [See Note 30]
7.5.2	<b>C7.6.2</b> [See Note 4]	17.3.2	<b>C17.2.2</b>	22.4.2	<b>C25.2.2</b>
7.5.3	<b>C7.6.3</b> [See Note 5]	17.3.4	<b>C17.2.4</b>	22.4.3	<b>C25.2.3</b> [See Note 31]
8.3	<b>C7.5.3</b>	17.3.5	<b>C17.2.5</b>	23.1.2	<b>C27.1.2</b>
9.1.2	<b>C9.1.2</b> [See Note 6]	17.4.1	<b>C17.3.1</b>	23.1.5	<b>C27.1.5</b> and <b>C27.1.6</b> [See Note 32]
9.1.3	<b>C9.1.3</b>	17.4.5	<b>C17.3.5</b>		
10.1.2	<b>C10.1.2</b>	18	<b>C18</b>	23.1.6	<b>C27.1.7</b>
10.2.3	<b>C10.3.3</b> [See Note 7]	19.2.4	<b>C20.2.4</b> [See Note 11]	23.2	<b>C27.2</b>
10.3.2	<b>C10.4.2</b>	19.2.5	<b>C20.2.5</b> [See Note 12]	24.1.1	<b>C29.1.1</b> [See Note 33] [See Note 34]
10.7.1	<b>C10.9.1</b>	19.2.6	<b>C20.2.6</b> [See Note 13]		
11.1.2	<b>C11.1.2</b>	19.2.10	<b>C20.2.10</b> [See Note 14]	24.1.2	<b>C29.1.2</b> [See Note 35]
11.2.1	<b>C11.2.1</b>	19.2.12	<b>C20.2.12</b> [See Note 15]	24.3.2	<b>C29.4.2</b>
12.1.3	<b>C12.1.3</b>	19.2.13	<b>C20.2.13</b> [See Note 16]	24.9.4	<b>C29.7.4</b> [See Note 36]
12.1.4	<b>C12.1.4</b>	19.3.5	<b>C20.3.5</b> [See Note 17]	24.11.5	<b>C29.12.4</b>
12.2.1	<b>C12.2.1</b> [See Note 8]	19.4.2	<b>C20.4.2</b>	25.1.2	<b>C34.1.2</b> [See Note 37]
13.1.1	<b>C13.1.1</b>	20.2.2	<b>C21.2.2</b>	26	<b>C35</b>
13.1.4	<b>C13.1.4</b>	21.1.1	<b>C23.1.1</b> [See Note 18]		
13.2.3	<b>C13.2.3</b>	21.1.2	<b>C23.1.2</b> [See Note 19]		

**Notes :**

(1. to 10. are omitted.)

11. ~~In Guidance **C20.2.4**, **20.2.4**, **Part C** of the Rules is to be read as **19.2.4**, **Part CS** of the Rules. In **C20.2.4** of the Guidance, **20.2.4** and **20.2.10**, **Part C** of the Rules are to be read respectively as **19.2.4** and **19.2.10**, **Part CS** of the Rules.~~

(12. to 37. are omitted.)

## EFFECTIVE DATE AND APPLICATION (Amendment 1-3)

1. The effective date of the amendments is 1 July 2016.
2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction\* is before the effective date.  
\* “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.